

- c. Alternate cover material may be proposed provided it is of equal quality and performance. Alternate materials may be submitted at the time of bid. Alternates will be reviewed by the Engineer and Owner for acceptance. Changes in fabric shall not affect the warranty for the building.

PART 2 PRODUCTS

2.01 MATERIAL (FOUNDATION)

A. Foundation requirements:

1. Concrete Compression: 4,000 psi minimum.
2. Concrete W/C ratio: .44 maximum.
3. Slump: 3 to 5 inches.
4. Reinforcing Steel: ASTM A615, Grade 60.

2.02 MATERIAL (FRAMING)

A. Framework minimum requirements:

1. Structural tubing: ASTM A500 or ASTM A513.
2. Welding electrodes: AWS A5.1, E70XX.
3. High-strength steel bolts, nuts and washers: ASTM A325 or minimum Grade 5.
4. All structural fasteners: Hot-dip galvanized to ASTM A153 or stainless steel.
5. Cables, attachment couplers: Galvanized steel. Hot-dip galvanized to ASTM A153.
6. Anchor bolts: ASTM A36, A307, and F1554. Hot-dip galvanized to ASTM A153.
7. Shop coatings: Hot-dip galvanized per ASTM A123 with a minimum of 3.9 mils on interior and exterior or all members. Field repairs shall be in accordance with manufacturer's recommendations and shall not impact the

warranty. The repairs shall be at a minimum zinc coating at 2.2 oz/square feet on all surfaces damaged during installation.

8. Sheared, flattened, or deformed tubing is not allowed in truss design or manufacturing

2.03 MATERIAL (MEMBRANE)

A. Fabric minimum requirements:

1. Base Fabric: Polyester (ISO 2076).
2. Total Weight: 22 oz/yd (White Translucent) (ASTM D751).
3. Yarn: 1000 Denier (ISO 2060).
4. Grab Tensile (Warp/Weft): 450/480 lb./in². (ASTM D751).
5. Strip Tensile (Warp/Weft): 300/320 lb./in². (ASTM D751).
6. Tongue Tear (Warp/Weft): 100/100 lb./in². (ASTM D751).
7. Cold Resistance: -22°F (ASTM D2136).
8. Heat Resistance: 158°F (LB 3.15).
9. Light Transmission: 8.2% (ASTM E903).
10. Flame Spread Rating: ≤ 25 (ASTM E84).
11. Flame Resistance: 2 sec Flameout (NFPA 701).

- B. Structure covers shall be fabricated from PVC-coated polyester fabric manufactured by an approved and reputable supplier. Laminated materials are not acceptable for use as the outer membrane. Approved cover material manufacturers include Seamen, Mehler, Ferrari and Naizil. Other cover material manufacturers may be considered and must be able to demonstrate 10 years of experience with PVC-coated fabrics used on structures similar in use and function. The material must be UV-stabilized and flame-retardant, must carry a minimum 10-year manufacturer's warranty, and must have life expectancy of 15 to 20 years. If minimum allowable design values do not yield a product that can be warranted for 15 years, the Contractor must use materials with appropriate design values to secure the warranty requirements.

PART 3 EXECUTION

3.01 FABRICATION

- A. Fabrication shall be in strict accordance with the manufacturer's requirements.

3.02 INSTALLATION

- A. The pre-engineered fabric cover building shall be erected on the site as indicated on the Drawings.
- B. All methods of installation shall be in accordance with manufacturer's requirements. Field installation methods shall not be performed if there is risk of voiding the manufacturer's warranty.
- C. Furnish and install temporary bracing as required by the manufacturer to construct the fabric cover building system.
- D. Framing shall be installed to manufacturer's tolerances, set accurately to the required lines and levels, and secured in accordance with the manufacturer's recommendations.
- E. Tighten bolted connections in accordance with manufacturer's requirements.
- F. Field-welding shall be done only where allowed by the building manufacturer and shall use approved procedures.
- G. After erection, all abrasions, field welds, and unprimed surfaces shall be corrected using methods approved by the building manufacturer. Field corrections shall not affect the building warranty.

3.03 INSPECTION AND FIELD TESTING

- A. The building manufacturer shall provide periodic site visits to ensure conformance with their installation recommendations.
- B. Remove rejected steel work from the site within 10 working days after notification of rejection.
- C. The building manufacturer shall provide an inspection at the site 11 months after final approval-acceptance of the complete project. The date for such inspection will be stated in the Final Approval issued by the Engineer.
 - 1. The building manufacturer, together with representatives of the Contractor, Engineer, and the Owner, shall visually inspect each new building for damage, leaks, or abnormal conditions.
 - 2. The building manufacturer shall appropriately correct any deficiencies that are found by such visual inspection, as approved by the Engineer.

3. All costs involved in remobilizing, inspecting, or correcting deficiencies will be considered incidental to the project and shall be the responsibility of the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 13125—ATTACHMENT 1
PRE-ENGINEERED FABRIC COVER BUILDING WARRANTY STATEMENT

1.01 WARRANTY-STEEL STRUCTURE

- A. The Building Manufacturer, its successors, receivers, or assigns ("Manufacturer") warrants that the steel truss, including the steel purlins and related strapping and cables, are free from defects under use as expressed for this project for a period of 15 years from the Substantial Completion date. If the truss system is found to be defective in quality or workmanship as a result of manufacture or installation, the Manufacturer shall, at its discretion, replace or repair the defective material within 60 days from the Owner's notice. The cost of materials, installation, and labor to repair or replace the system or components shall be as follows:
1. If the steel truss system or steel components must be replaced within 15 years from the Substantial Completion date, the Manufacturer shall pay for the cost of labor, materials, and replacement parts. Replacement parts supplied by the Manufacturer may be new or rebuilt at the discretion of the Manufacturer, and such parts shall be guaranteed for 10 additional years.
 2. The Manufacturer warrants that all steel components have been hot-dip galvanized after fabrication to ensure maximum corrosion protection. If excessive corrosion appears within a period of 15 years, the Manufacturer shall repair or replace any corroded components, including installation, at no expense to the Owner. This warranty excludes all third-party-supplied minor components such as screws, washers, bolts, nuts, etc. after the first 5 years. However, the Manufacturer shall ensure that only zinc-coated components are used within the structure system.
- B. The Manufacturer states that the manufacturer's warranty is the only warranty, expressed or implied, that will apply to the merchantability or fitness for the purposes of doors, ventilation systems, lighting, heating, flooring, or foundation that may be part of or ancillary to the structure, and such warranty(s) shall be no less than 2 years.

1.02 WARRANTY MEMBRANE

- A. The membrane is warranted under use as expressed for this project for a period of 15 years from the Substantial Completion date against water and wind loads as required by Local Building Code. The membrane warranty includes the mechanical tensioning system. If the membrane deteriorates or fails from exposure conditions, the Manufacturer shall, at its discretion, replace or repair the

defective material within 30 days from the Owner's notice. The cost of material, installation, and labor to repair or replace the membrane shall be as follows:

1. If the membrane requires repair or replacement within the first 8 years from Substantial Completion, the Manufacturer shall pay the full cost of materials installation and labor.
2. If the membrane requires repair or replacement after the first 8 years and no longer than 15 years, the Manufacturer shall supply and install a new membrane at a cost to the Owner of 1/100th of Manufacturer's direct costs only per month based on the Owner's notice of defects to Manufacturer, for each month after the Substantial Completion date plus 8 years. Delivery and installation costs of the membrane shall be prorated as per the membrane.

1.03 WARRANTY TRANSFER

- A. The Membrane Warranty as well as the Steel Structure Warranty as stated above may be transferred upon sale of the building if all dismantling and erection is completed by the Manufacturer or a representative of same.

Dated at _____ this _____ day of _____, 20__

Name of Organization

BY: _____

Title of Person Signing
(if Corporation, Affix Corporate Seal)

State of _____
County of _____

The foregoing instrument was signed and acknowledged before me this ____ day of _____, 20__, by _____ who has produced
(Print or Type Name)

_____ as identification,
(Type of Identification and Number)

Notary Public Signature

Printed Name of Notary

Notary Commission Number/Expiration

SECTION 13300
PACKAGE LIFT STATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install one package lift station, complete and ready for operation in accordance with the plans and specifications. The package lift station shall consist of a fiberglass wet well, submersible pumps, control panel, and other related accessories. The Contractor shall be responsible for the equipment installation according to the recommendations of the supplier and in compliance with all OSHA, local, state, and federal codes and requirements.
- B. The Contractor shall furnish all labor, materials, equipment, and incidentals to install, place in operation, and field test the package lift station.

1.02 RELATED WORK

- A. Section 02230, Site Preparation.
- B. Section 02300, Earthwork.
- C. Division 16, Electrical.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The Contractor shall submit written certification from the pump supplier that the wet well size and layout are acceptable for the pump installation.
- B. Shop Drawings: The Contractor shall submit integrated shop drawings for the package lift station illustrating the mechanical and electrical equipment and components specified in this Section and including the following:
 - 1. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with Section 01330. Submittals and Acceptance and shall include at least the following:
 - a. Name of manufacturer, type, and model of pump.
 - b. Shop Drawings showing all important details of equipment to be furnished, including dimensional data and materials of construction.

- c. Descriptive literature, bulletins, and/or catalogs of the equipment.
 - d. Pump performance curves showing that the pump meets the specified requirements for head, capacity, and horsepower.
 - e. A complete total bill of materials of all equipment.
 - f. Complete motor data.
 - g. A copy of the warranty.
 - h. Eight copies of the manufacturer's Installation Instruction Manual.
2. Equipment Drawings: Submit a completely dimensioned plan, elevations, and cross sections of system equipment and sub-assemblies.
 3. Layout Drawing: Submit a completely dimensioned drawing of pump, pump base, anchor bolt size and patterns, complete guide rails system, installation notes, recommended grout configuration of wet well bottom, discharge elbow mounting instructions, and other pertinent setting details.
 4. Wiring Diagrams: Submit complete interconnecting wiring diagrams and schedules for electrical apparatus showing numbered wiring terminals in the pump control panel conforming to NEMA ICS-1-101. Identify field device terminals, wire number, wire sizes, control and power wire types, and interfaced elements.
 5. Control Panel Drawing: Submit a dimensioned drawing of the control panel indicating the primary electrical components and panel face with control devices, lights, indicators, and other panel-face-mounted apparatus located and identified. Provide an internal face view of the equipment arrangement with equipment identified.
 6. Additional Requirements: See Division 16, Electrical, for additional submittal requirements for the control panel furnished under this Section and specified below.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Specification section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A36—Standard Specification for Carbon Steel Plate.
2. ASTM A48—Standard Specification for Gray Iron Castings.
3. ASTM A126—Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
4. ASTM B584—Standard Specification for Copper Alloy Sand Castings for General Applications.
5. ASTM D695—Standard Test Method for Compressive Properties of Rigid Plastics.
6. ASTM D790—Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
7. ASTM D3753—Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wet Wells.
8. ASTM D3757—Standard Guide for Preparing Specifications for Solvent-based Floor Polishes.

B. American Iron and Steel Institute

1. AISI 316—Stainless Steel.
2. AISI 304—Stainless Steel.
3. AISI 4130—Heat Treated Alloy Steel.
4. AISI 4140—Heat Treated Hexagon Steel.

C. Controllers shall, as applicable, meet the requirements of the following Regulatory Agencies:

1. National Electrical Manufacturer's Association (NEMA) Standards.
2. National Electrical Code (NEC).
3. Occupational Health and Safety Administration (OSHA).
4. Underwriters Laboratory (UL and cUL).

1.06 QUALITY ASSURANCE

- A. Qualified suppliers shall have a minimum of 5 years of experience with lift station equipment with a minimum of 25 installations with similar equipment. The supplier shall provide a list of names and dates of installations for verification by the Engineer or the Owner's Representative.
- B. The pump supplier shall provide the services of a factory-trained representative to check the installation and to start up the package lift station. The factory representative shall have complete knowledge of proper installation, operation, and maintenance of equipment supplied. The representative shall inspect the final installation and supervise a start-up test of the equipment.

- C. Each lift station pump and control panel shall be factory-tested to ensure satisfactory operation.
- D. If difficulties occur in operating the equipment due to the manufacturer's fabrication or the Contractor's installation, additional services shall be provided at no change in contract price or time.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.
- B. Fiberglass Wet Well and Valve Box Warranty: The basin/structure manufacturer shall warranty the wet well against defects for at least 5 years after the date of Substantial Completion. Defects are defined as cracking, delimitation, or leaking. The warranty shall require the manufacturer to supply all necessary labor, materials, and equipment to repair defects to the satisfaction of the Owner. The Contractor and/or manufacturer shall not make any exemptions or exception to the conditions or warranty stated above.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. All parts shall be properly protected so that no damage or deterioration will occur during the delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- C. All equipment and parts must be properly protected against any damage during storage at the site.
- D. Factory-assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- E. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted.
- F. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

1.09 QUALIFICATIONS

- A. All the equipment specified under this Section shall be furnished by a single supplier and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed.
- B. All equipment furnished under this Section shall be new and unused and shall be the standard products of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified in this Section for a minimum of 5 years.

1.10 TESTING REQUIREMENTS

- A. Testing shall be in accordance with Part 3, Execution.

1.11 SPARE PARTS

- A. Furnish one set of all special tools required for normal operation and maintenance of the equipment.

1.12 SYSTEM DESCRIPTION

- A. The complete package lift station shall have pump bases, rail assemblies, and discharge piping assembled and be ready for field installation. The lift station supplier shall provide the fiberglass wet well, submersible grinder pumps, slide rail assemblies, control panel, float switches, aluminum hatches, and accessories to ensure proper operations and warranty.
- B. Pumps shall be of the submersible type. Each pump shall be mounted on a rail system. The rail system shall be self-engaging, resulting in a leakproof coupling. The rail system shall include the base elbow, discharge flange assembly, 1-inch 304SS guide rails, 316SS upper guide bracket, 316SS lifting bail and cable, and a six-hook 316SS cable holder. The rail system shall be mounted and pre-piped by the pump supplier.

1.13 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The Contractor shall provide O&M Manuals for the package lift station that are tailored to fit the training during start-up. The submittal shall reflect data that match the equipment provided and shall be in accordance with General Conditions and Supplementary Conditions.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General

1. The equipment covered by these Specifications is intended to be equipment of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed as shown on the Drawings.
2. All parts shall be designed and proportioned so as to have liberal strength and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs, and equipment.

B. The complete package lift station shall be in compliance with the Specifications and Drawings and shall be supplied by Barney's Pump Inc. or Engineer-approved equal.

C. Each unit of equipment shall be identified with stainless steel nameplates giving the name of the manufacturer. Name plate information shall include equipment model number, serial number, supplier's name, and location.

2.02 FIBERGLASS WET WELL

A. The pump supplier shall provide the fiberglass wet well. The rail system, internal piping, and discharge connections shall be pre-installed by the pump supplier.

B. The fiberglass wet well shall be designed and constructed to withstand or exceed the assumed loadings below and meet the requirements of ASTM D3753. In no case shall the wall thickness be less than 1/2 inch thick.

C. Pumps shall be anchored to a 1-inch-thick steel plate. The complete design must be submitted in the form of a shop drawing for the Engineer's review and approval. Fiberglass-reinforced polyester wet wells shall be manufactured from commercial grade unsaturated polyester resin with fiberglass reinforcements and shall be provided with an anti-floatation ring with a minimum diameter of 3 inches larger than the basin diameter. Unless approved otherwise by the Engineer, the wet well shall be a one-piece unit.

1. Reinforcing Material: The reinforcing materials shall be a commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric, or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcements and the resin.
2. Surfacing Materials: If reinforcing materials are used on the surface exposed to the contained substance, it shall be a commercial-grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin-rich surface.
3. Fillers and Additives: Fillers of any type shall not be used. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirements of this specification.
4. Exterior Surface: The exterior surface shall be relatively smooth with no sharp projections. Hand-work finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination, and fiber show.
5. Interior Surface: The interior surface shall be resin-rich with no exposed fibers. The surface shall be free of crazing, delamination, blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted if they are less than 3/4 inch in diameter and less than 1/16 inch deep.
6. Defects Not Permitted:
 - a. Exposed fibers: glass fibers not wet out with resin.
 - b. Resin runs: runs of resin and sand on the surface.
 - c. Dry areas: areas with glass not wet out with resin.
 - d. Delamination: separation in the laminate.
 - e. Blisters: light colored areas larger than 1/2 inch in diameter.
 - f. Crazing: cracks caused by sharp objects.
 - g. Pits or voids: air pockets.
 - h. Wrinkles: smooth irregularities in the surface.
 - i. Sharp projection: fiber or resin projections necessitating gloves for handling.
7. Installation of Brackets: Manufacturer or manufacturer-certified field personnel shall glass in all stainless steel fasteners and brackets, discharge piping brackets, etc. Manufacturer of wet well shall be responsible for integrity of all field glassing.

8. Marking and Identification: The wet well shall be marked with the following information:
- Manufacturer's name or trademark.
 - Manufacturing special number.
 - Total length and nominal diameter.
9. Load Rating: The complete wet well shall have a minimum dynamic-load rating of 16,000 ft-lb when tested in accordance with ASTM 3753, Section 8, ASTM D790, and ASTM D695. To establish this rating, the complete wet well shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lb and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lb.
10. Stiffness: The wet well cylinder shall have a minimum pipe-stiffness value as shown in Table 1 (at a minimum) when tested in accordance with ASTM D3753, Section 8.

Table 1 Stiffness Requirements (Minimum)	
Length, ft	F/AY psi
10 to 20	2.01
21 to 30	3.02
31 to 40	5.24

2.03 PUMP

- A. The pump volute, motor, and seal housing shall be constructed of cast iron, ASTM A48. All external fasteners shall be Type 300 stainless steel. The pump shaft shall be constructed of Type 416 stainless steel.
- B. The impeller shall be multi-vane, semi-open cast iron construction. The impeller shall include pump-out vanes on the back of the impeller and shall be statically and hydraulically balanced.
- C. The explosion-proof motor shall be mounted in a sealed-submersible type housing. The stator shall be securely held in place with a removable end ring and treaded fasteners for ease of removal without the use of heat or a press. The motor will have two heavy-duty ball bearings, one upper (radial) and one lower (thrust), to support the shaft. The motor shall be equipped with a winding thermostat that automatically shuts the motor off in case of motor overheating.
- D. The pump shall have two mechanical seals, mounted in tandem with an oil chamber between the seals. The pump shall be equipped with a seal-leak detection probe and warning system using a seal-failure sensor installed in the seal chamber.

E. Performances of Building Drain Pump Station:

- | | | |
|----|--------------------------|---------------------|
| 1. | Number of pumps: | Two |
| 2. | Primary design condition | 50 gpm @ 24 feet |
| 3. | Shutoff head | 35 feet |
| 4. | Discharge size | 1 1/2 -inch |
| 5. | Rated Pump Speed | 1,750 rpm |
| 6. | Motor horsepower | 1/2 HP |
| 7. | Electrical service | 230V, 60Hz, 1 phase |

F. The grinder pump shall be Hydromatic Model SPX50H, or Engineer-approved equal.

2.04 VALVES

A. Bronze Swing Check Valves, 3 Inches and Smaller:

1. Check valves 3 inches and smaller shall be all bronze with screwed ends and cap, tee-pattern body, and swing disc type. The disc shall be bronze, swing type. Valves shall be rated for 200-psi WOG and shall be Crane Valves North America Figure 1707 or Engineer-approved equal.

B. Bronze Gate Valves, 3 Inches and Smaller:

1. Bronze Gate Valves 3 inches and smaller shall be all-bronze construction with screwed end connections and screwed bonnet, single solid wedge gate with rising stem, and handwheel operator for exposed service operation. Valves shall be rated for 200-psi WOG and shall be manufactured by Crane Valves North America, or Engineer-approved equal.

2.05 FLOATS

- A. Floats shall be Anchor Scientific Roto-Float or Engineer-approved equal.
- B. No splicing of the float switch cable shall be allowed. An extra 6 feet of float switch cable shall be looped and neatly tied in the wet well with plastic ties.

2.06 HATCH COVER

- A. The hatch cover shall be 2/3 hinged to allow for maximum access to the wet well. The hatch cover shall be aluminum with stainless-steel fasteners, rated for 150 psf or greater. The hatch cover shall include a single or dual door of dimensions

specified by the pump manufacturers for proper pump clearance. The cover shall be manufactured by US Fabrication or Engineer-approved equal.

2.07 METALLIC QUICK-CONNECT COUPLINGS

- A. Quick-connect couplers shall be stainless steel with locking handles. Provide dust plug and security chain with each coupler. Bodies and locking handles shall be Type 316 stainless steel. The gasket shall be Teflon. Couplers shall be by CIVACON Kamlok, or equal.

2.08 PUMP CONTROL PANEL

- A. Refer to the Electrical Drawings and Division 16, Electrical, for additional requirements.
- B. Controls:
 - 1. The pump controls shall be designed to alternate the lead pump each time a pump is called to start. Control panel circuitry shall be 120-volt, single-phase, 60 Hz. A control power transformer (CPT) shall be provided, mounted in the control panel, and sized to serve all continuous loads including motor starter coils.
 - 2. A "Hand-Off-Auto" selector switch shall be provided for each pump. In the ON position, pumps may be started and stopped independent of the level controls. In the AUTO position, pumps shall be controlled by the level controls and a sequencing device. The sequencing device shall alternate pump duty between the pumps to maintain approximately equal run times.
 - 3. Control Description: The Pump Control Panel control system shall operate the pumps as described below based on the level setting shown on the Drawings:
 - a. On a rising level with pumps initially off, the LEAD PUMP ON level setting shall initiate the starting of the lead pump. If the level continues to rise, the LAG PUMP ON level setting shall initiate the starting of the lag pump. An HW ALARM/REDUNDANT ALL PUMPS ON level setting shall provide backup for the lead and lag on level settings and shall turn on all pumps.
 - b. On a falling level with pumps initially on, the ALL PUMPS OFF level setting shall stop all pumps. If the level continues to fall, the

LW ALARM/REDUNDANT ALL PUMPS OFF shall provide backup to the ALL PUMPS OFF level and turn off all pumps.

4. The following local indicating lights shall be provided on the front of the panel for each pump:

Function	Color
Pump or Pump Starter Fault	Amber
Pump On	Red
Pump Off	Green
Pump Motor Moisture	Amber

All local indicating lights shall be LED-type lights.

5. The following additional local indicating lights shall be provided on the front of the panel:

Function	Color
Control Power On	White
Pumps Off	Amber
Lag Pump	Amber
Lead Pump	Amber
HL Alarm	Red
LW Alarm	Red

6. Local indication of common alarm shall be by a red Zenon strobe alarm light. The alarm shall produce a 1,000 effective candlepower intensity minimum and shall be mounted on top of the panel enclosure. The alarm light shall remain active until reset by a pushbutton on the front of the control panel. The strobe light alarm shall have a manual on/off switch in the panel to allow the operator to inactivate this function if desired.
7. Circuit breakers shall be 600-volt magnetic motor circuit protectors with 22,000 AIC ratings. Each breaker shall be manually operated with a quick-make, quick-break, trip-free toggle mechanism.
8. The Pump Control Panel shall have an elapsed run-time meter for each pump that is not resettable. Each elapsed run-time meter shall measure in hours and have read up to 99,999 hours before rolling over to 0.
9. All wiring to the wet well shall be intrinsically safe.
10. Full-voltage non-reversing starters shall be provided as indicated on the Drawings. Refer to Division 16 for full-voltage non-reversing starter requirements.

11. Terminal strips shall be by Marathon or Engineer-approved equal.
12. Each control panel shall have a GFCI duplex power receptacle rated at 20 amps. The receptacle shall provide 120-volt AC service.
13. The Pump Control Panel shall have an audible alarm that sounds upon all alarm conditions. This alarm shall have a push-button reset as well as a manual on/off switch in the panel to allow the operator to inactivate this function if so desired.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in strict accordance with pump supplier's instructions and recommendation and in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations
- B. Supply all anchor bolts, temporary lift equipment, power, water, labor, and all other incidentals required for the proper installation of the package lift station.
- C. Fiberglass wet wells and valve vaults shall be installed plumb.

3.02 PAINTING

- A. Before exposure to weather and before shop painting, all surfaces shall be thoroughly cleaned, dry, and free from all mill/scale, rust, grease, dirt, and other foreign matter.
- B. All equipment, motors, and drives shall be shop-primed and painted with the manufacturer's standard enamel coating suitable for exposure to domestic wastewater.
- C. Gears, bearing surfaces, and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during periods of storage and installation up to the time of the final acceptance.
- D. All nameplates shall be properly protected during painting.

3.03 TESTING

- A. After equipment has been completely installed and working under the direction of the manufacturer, the Contractor shall conduct, in the presence of the Owner and Engineer, such tests as are necessary to indicate that the installation is performing to the standards indicated in the Specifications.
- B. If the package lift station performance does not meet the Specifications, corrective measures shall be taken or defective equipment shall be removed and replaced with equipment that satisfies the conditions specified.
- C. Submit six copies of certified test results upon satisfactory completion of testing.

END OF SECTION

DIVISION 15
MECHANICAL

SECTION 15053
COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.
9. Supports and anchorages.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Welding certificates.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society of Mechanical Engineers (ASME)

1. ASME B16.21—Nonmetallic Flat Gaskets for Pipe Flanges
2. ASME B1.20.1—Pipe Threads, General Purpose (Inch)

B. American Society for Testing of Materials (ASTM)

1. ASTM A53—Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM B32—Standard Specification for Solder Metal.
3. ASTM B813—Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
4. ASTM B828—Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
5. ASTM C1107—Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
6. ASTM D1785—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
7. ASTM D2564—Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
8. ASTM D2672—Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
9. ASTM D2846/D2846M—Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
10. ASTM D2855—Standard Practice for Making Solvent-Cemented Joint with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
11. ASTM D3212—Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
12. ASTM F402—Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
13. ASTM F493—Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
14. ASTM F656—Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

C. American Welding Society (AWS)

1. AWS A5.8—Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1—Structural Welding Code – Steel.
3. AWS D10.12—Guide for Welding Mild Steel Pipe.

1.06 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS (NOT USED)

1.13 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to

outdoor ambient temperatures. Examples include installations within unheated shelters.

PART 2 PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 15 piping sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 JOINING MATERIALS

- A. Refer to individual Division 15 piping sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or Bag1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F493.
 - 2. PVC Piping: ASTM D2564. Include primer according to ASTM F656.

2.03 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.04 SLEEVES

- A. PVC Pipe: ASTM D1785, Schedule 40.

2.05 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

2.06 GROUT

- A. Description: ASTM C1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PIPING SYSTEMS – COMMENT REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's *Copper Tube Handbook* using lead-free solder alloy complying with ASTM B32.
- E. Brazed Joints: Construct joints according to AWS's *Brazing Handbook*, "Pipe and Tube" chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F402, for safe-handling practice of cleaners, primers, and solvent cements.
 2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
 3. PVC Pressure Piping: Join schedule number ASTM D1785, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
 4. PVC Nonpressure Piping: Join according to ASTM D2855.
- H. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D3212.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.03 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.04 EQUIPMENT INSTALLATION – COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with

minimum interference to other installations. Extend grease fittings to accessible locations.

- D. Install equipment to allow right of way for piping installed at required slope.

3.05 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use the supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to the anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 03300, Cast-in-Place Concrete.

3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Section 05500, Metal Fabrications, for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.07 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

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

3.08 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely fitting equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 15055
PIPING SYSTEMS—GENERAL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Specification describes responsibilities and requirements for Piping Systems including the following:
 - 1. Labor, materials, tools, equipment, and services to be furnished in accordance with the provisions of the Contract Documents.
 - 2. Coordination of work with other trades.
 - 3. Furnishing and installing all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, although such work is not specifically indicated.
 - 4. Furnishing Record Drawings and documents for piping systems.

1.02 RELATED WORK

- A. Section 01300, Contract Administration.
- B. Section 01330, Submittals and Acceptance.
- C. Section 01650, Delivery, Storage, and Handling.
- D. Section 09900, Painting and Coating.
- E. Section 15155, Ductile Iron Pipe and Fittings.
- F. Section 15250, Small-Diameter Piping.
- G. Section 15291, Polyvinyl Chloride (PVC) Pressure Pipe and Fittings.

1.03 SUBMITTALS

The Contractor shall submit the following in accordance with Section 01330, Submittals and Acceptance:

- A. Copies of any manufacturer's written directions regarding material handling, delivery, storage, and installation.
- B. Record piping drawings shall meet the requirements of Section 01300, Contract Administration, or Section 01785, Record Documents. During the work, the Contractor shall maintain accurate, up-to-date Record Drawings of piping systems installed in the project, including pre-existing piping discovered, relocated, or at locations other than as originally shown on the Drawings. When the work is

completed and accepted by the Owner and the Engineer, the Contractor shall submit Record Drawings in accordance with Section 01785, Record Drawings. The Contractor shall identify complete location, elevations, and description of piping systems. Piping systems and fittings are to be identified from three points on structures and/or stationary appurtenances.

- C. Submit copies of forms documenting required field pressure testing work and results.
- D. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American National Standards Institute (ANSI)
 - 1. ANSI A21.11—Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.
 - 2. ANSI B1.1—Unified Inch Screw Threads.
 - 3. ANSI B2.1—Pipe Threads.
 - 4. ANSI B16.21—Nonmetallic Gaskets for Pipe Flanges.
 - 5. ANSI B18.2.1—Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Lag Screws.
 - 6. ANSI B18.2.2 —Square and Hex Nuts.
 - 7. ANSI B31.3—Process Piping.
- B. American Society of Mechanical Engineers (ASME)
 - 1. ASME B31.1—Power Piping (Pressure Piping).
 - 2. ASME Boiler and Pressure Vessel Code.

C. American Society for Testing and Materials (ASTM)

1. ASTM A183—Specification for Carbon Steel Track Bolts and Nuts.
2. ASTM A193—Standard Specification for Alloy-Steel; and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and other Special Purpose Applications.
3. ASTM A194—Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
4. ASTM A307—Specification for Carbon Steel Externally Threaded Standard Fasteners.
5. ASTM D1330—Standard Specification for Rubber Sheet Gaskets.
6. ASTM F467—Standard Specification for Nonferrous Nuts for General Use.

D. American Water Works Association (AWWA)

1. AWWA C207—Steel Pipe Flanges for Waterworks Service-Sizes 4 inch through 144 inch.

E. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS SP 58—Pipe Hangars and Supports – Material, Design, and Manufacture.

F. NSF International (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. The Contractor shall protect the pipe from kinks, cuts, end damage, and other defects when transporting all piping. Binding and tie-down methods shall not

damage or deflect the pipes in any way. Pipe damaged during shipment shall be rejected.

- C. Pipe shall be stored on level ground, preferably turf or sand, free of sharp objects that could damage the pipe. Stacking of any pipe shall be limited to a height that will not cause excessive deformation of the lower layers of pipe under anticipated temperature conditions. When necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such widths to not allow deformation of the pipe at the point of contact with the sleeper or between supports. Pipe shall not be removed from storage until bedding or sub-grade work is complete and ready to receive the pipe.
- D. The joined pipe shall be handled in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipe. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped. Slings for handling joined pipe shall not be positioned at socket-welded joints. Sections of the pipes with cuts and gouges shall be removed and the ends of the pipe rejoined. In accordance with the pipe manufacturer's written instructions, the Contractor shall repair all pipe with damaged linings and pipe exterior coatings that have been damaged before the pipe is installed.
- E. The Contractor shall cover all pipe stored on the site with canvas or other opaque material to protect it from sunlight. Provide air circulation under the covering.
- F. The Contractor shall inspect all pipe, fittings, and other accessories upon delivery and during the work. Any defective or damaged materials found during field inspection or during tests shall be removed from the site and replaced by, and at the expense of, the Contractor.
- G. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Fittings shall be drained and stored in a manner that will protect them from damage by freezing.
- H. Gaskets shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-delivered-to-site and first-to-be-installed rotation basis. Mechanical-joint glands, bolts, and washers shall be handled and stored in a manner that will ensure proper use with respect to types and sizes.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals and Training.

1.13 DEFINITIONS OF BURIED, EXPOSED, AND SUBMERGED PIPING

- A. Buried piping is piping buried in soil, beneath a structure and/or encased in concrete. Where an exterior pipe coating is specified to be factory- or field-applied, the Contractor shall provide the coating up to the penetration of a structure. Piping encased in concrete does not require an exterior coating other than what is factory furnished.
- B. Exposed piping is piping in any of the following conditions or locations:
 - 1. Above ground.
 - 2. Inside buildings, vaults, or other structures.
 - 3. In underground concrete trenches or galleries.
- C. Submerged piping is considered to be all piping within a liquid holding tank.

1.14 SYSTEM DESIGN REQUIREMENTS

- A. General
 - 1. The Specifications and Drawings are not all inclusive of explicit piping details; provide piping for intended use in compliance with laws and regulations, including ASME B31.1 Code (Power Piping).
 - 2. Pressure ratings and materials specified represent minimum acceptable standards for piping systems.
 - 3. Piping Systems: Suitable for the services specified and intended.
 - 4. Piping shall be color coded in accordance with the Department of Environmental Protection requirements.

B. Support Systems

1. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of responsibility for sizing and providing supports for this project.
2. Select and design within the specified spans and component requirements.
3. Comply with requirements of MSS SP 58, Pipe Hangers and Supports – Materials, Design, and Manufacture.
4. Criteria for structural design and selection of pipe support system components:
 - a. Dead loads imposed by the weight of the pipes filled with water, within specified spans and component requirements, plus any insulation.
 - b. Safety factor: Minimum of 5.
5. Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor the support, to withstand the shear and pullout loads imposed by loading and spacing on each particular support.
 - a. Piping smaller than 30 inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required and are to be provided and installed by the Contractor at no additional cost to the Owner.

C. Adapters

1. No attempt has been made to show all adapters, spool pieces, reducers, bushings, or other fittings required to accommodate the connection of pipes, fittings, and valves of various joint design and sizes throughout the project. The Contractor is completely responsible for providing, at his expense, all adapters, reducers, sleeves, spool pieces, and other fittings and appurtenances necessary for connection of pipe (for the same pipe material or a transition of pipe materials), valves, fittings, and appurtenances throughout the project, which shall be constructed of appropriate materials, coated and lined to match the materials, coatings, and linings specified for the connected components. All adapters, reducers, sleeves, spool pieces, and other fittings shall be coated and lined in accordance with the specifications for each individual pipe system.

D. Unions

1. No attempt has been made to show all unions required for the project. The Contractor shall provide unions at all connections of threaded pipe to installed equipment unless deleted by the Engineer, in writing, at certain locations. The unions shall meet or exceed the quality of materials, pressure rating, service, and painting requirements of connected piping.

PART 2 PRODUCTS

2.01 PIPING SYSTEM GENERAL REQUIREMENTS SCHEDULE

- A. Unless noted otherwise in the Drawings, piping system materials, fittings, and appurtenances are subject to requirements of the individual Specifications for the piping systems.

2.02 THREAD FORMING FOR STAINLESS STEEL BOLTS

- A. Form threads for stainless steel bolts by rolling, not by cutting or grinding.

2.03 BOLTS AND NUTS FOR FLANGES FOR DUCTILE IRON PIPE FLANGES

- A. Bolts, washers, and nuts for pipe installed indoors, outdoors above and below ground, and in vaults and structures shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.
- B. Bolts, washers, and nuts for submerged Class 150 flanges shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts. Fit shall be Classes 2A conforming to ANSI B1.1 when connecting to cast-iron valves having body bolt holes.

2.04 BOLTS AND NUTS FOR PVC, CPVC, AND PVDF PIPE FLANGES

- A. Bolts, washers, and nuts for buried and submerged flanges and flanges located outdoors above ground or in vaults and structures shall be Type 304 stainless steel conforming to ASTM A193, Grade B8, for bolts and ASTM A194, Grade 8, for nuts.
- B. The Contractor shall provide a washer under each nut and under each bolthead. Washers shall be of the same material as the nuts.

2.05 BOLTS AND NUTS FOR STEEL PIPE FLANGES

- A. Bolts, washers, and nuts for Class 150 flanges (including AWWA C207, Class D) located indoors, outdoors above ground, in vaults, and in structures shall be carbon steel, ASTM A307, Grade B. Bolts, washers, and nuts for buried service shall also be hot-dipped galvanized.

2.06 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

- A. Anti-seize thread lubricant shall be applied to the thread portion of all (above grade and below grade) stainless steel bolts (stainless steel tie rods, etc.) during assembly. Anti-seize lubricant shall be chloride free and shall be nongalling NSF approved. Anti-seize thread lubricant shall be Jet-Lube "Nikal," John Crane "Thred Gard Nickel," Never-Seez "Pure Nickel Special," or Permatex "Nickel Anti-Seize."

2.07 FLANGE GASKETS FOR STEEL, DUCTILE IRON, AND STAINLESS STEEL PIPE

- A. Flange gaskets shall be in accordance with AWWA C207, except as modified in this Section. Gaskets shall be ring type. All gasket material shall be suitable for the fluid being conveyed. Gaskets shall be SBR or an approved equal.

2.08 FLANGE GASKETS FOR PVC AND CPVC PIPE

- A. Gaskets for flanged joints shall be full faced, 1/8 inch thick, having a Brinell Hardness of 50 to 70 durometer A. Gasket material shall be EPR unless noted or specified otherwise. Gaskets shall be compatible with the fluids conveyed.

2.09 POTABLE WATER PIPING SYSTEMS

- A. All potable water piping systems including pipe, valves, fittings, weld-solvents, linings, gaskets, lubricants, grout disinfection agents, etc., and surfaces in contact with potable water shall meet all local and State of Florida regulations and requirements including NSF 61. The Contractor shall coordinate the color of the potable water system piping color with the Owner's color standard and shall provide color as approved by the Owner.

2.10 LOCATOR WIRE (OR DETECTABLE PIPELINE MARKING TAPE)

- A. All 1-1/2-inch and larger buried non-metallic piping shall be laid with underground detectable caution tape, 2-inch tape for a maximum of 12-inch depth and 6-inch tape for a maximum of 24-inch depth.

2.11 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be EPDM suitable for UV exposure and be provided with galvanized retaining rings and Type 300 series stainless steel gusset plates and control rods. Expansion joints shall have flat-face flanges integral with the body to match Class 125, ANSI B16.1.
- B. Expansion joints shall be manufactured by Mercer Series 452, or engineer approved equal.

PART 3 EXECUTION

3.01 PREPARATION

- A. Field Alignment:
 - 1. The piping shown on the Contract Drawings is generally indicative of the work, with symbols and notations provided for clarity. However, the Contract Drawings are not an exact representation of all conditions involved; therefore, install piping to suit actual field conditions and measurements as approved by the Engineer. No extra compensation will be made for work due to differences between indicated and actual dimensions.
 - 2. The Contractor shall install all adapters, fittings, flanged connections, closures, restrained joints, etc. not specified but necessary for a complete installation acceptable to the Engineer.
 - 3. The Contract Drawings do not indicate all adapters, fittings, spool pieces, bushings, unions, supports, hangers, and other items required to accommodate the installing and connecting of pipe, fittings, valves, and equipment of various joint designs and sizes. Provide such required items of appropriate designs, materials, coatings, and linings.
 - 4. An extensive network of underground piping, conduit, direct-buried conductors, and related structures of various sizes, materials, alignments, age, and function exist within the project site. Conclusive information concerning these facilities is not available. Consequently, the design of new piping indicated on the Contract Drawings is approximate. Adjust alignment, fitting, valve, and joint locations as required and as approved by the Engineer to accommodate and protect existing facilities and provide the intended functionality of new piping.

3.02 FIELD LAYOUT AND MODIFICATIONS

- A. Unless directed otherwise, the Contractor shall be responsible for setting construction layout stakes and/or offsets required to complete the designated work. The Contractor shall ensure that those stakes and/or offsets are protected and any re-staking required for any reason including work stoppage shall be included in the bid price and no additional compensation to the Contractor will be made.
- B. The Engineer has the right to make any modifications the Engineer deems necessary due to field conditions, conflicts with other utilities, or to protect other properties.

3.03 PIPE PRODUCTS INSPECTION

- A. The Contractor shall obtain from the pipe manufacturer a certificate of inspection to the effect that the pipe, fittings, gaskets, glands, bolts, and nuts supplied for this Contract have been inspected at the plant and that they meet the requirements of these specifications. The Contractor shall submit these certificates to the Engineer before installing the pipe materials. The Contractor shall visually inspect all pipe and fittings at delivery and before they are lowered into the trench to be installed. Pipe or fittings that do not conform to these Specifications or have been damaged in any manner will be rejected and the Contractor must remove them immediately. The entire product of any plant may be rejected when, in the opinion of the Engineer, the methods or quality assurance and uniformity of manufacturer fail to secure acceptable and uniform pipe products or where the materials used produce inferior pipe products.

3.04 REMOVAL OF EXISTING PIPE AND FITTINGS

- A. Pipe specifically identified on the Drawings to be removed or replaced from service shall be physically taken out of the ground. The limits of pipe to be removed shall be specifically called for in the plans or shall be approved in writing by the Engineer. Any other removal not specifically called for shall be approved in writing and shall be considered incidental to construction of other items in the contract and the Contractor will not receive compensation for such work.
- B. When removing pipe the Contractor shall excavate a trench wide enough to dislodge the pipe from the surrounding soil and long enough to be able to handle the pipe without causing any damage to nearby utilities, structures, or adjacent property.

- C. The removed pipe, fitting, and appurtenances will become the Contractor's property and the Contractor shall be responsible for proper disposal and any required permits for disposal.
- D. Regarding pipe remaining in the ground subsequent to removal of connected pipe or pipe fittings, the remaining buried pipes, openings, and fittings shall be plugged or capped as approved by the Engineer.
- E. Pipe that will be abandoned in place shall be plugged or capped as approved by the Engineer.

3.05 BURIED PIPING AND PIPE FITTINGS

- A. Trenching and backfilling for all pipe and fittings shall also be in accordance with Section 02300, Earthwork.
- B. Installation:
 - 1. Inspect all piping for defects and remove all lumps or excess coatings before installation. The inside of the mechanical joint and outside of plain-end pipe shall be cleaned before joining pipe. Caution shall be taken to prevent damage to the pipe during lowering into the trench. Remove all foreign matter that has entered the pipe during storage and installation. The Contractor shall cover the pipe ends during installation to prevent debris from entering the pipe. No debris, tools, clothing, or other material shall be placed in the pipe.
 - 2. After being placed in the trench, the pipe shall be brought to the proper line and grade by compacting the approved backfill material under it, except at the bell end. Joint deflection shall not exceed 75% of the manufacturer's limit.
 - 3. The Contractor shall install temporary water-tight plugs on the pipe ends during the time that the pipe is in the trench but no work is in progress. If there is water in the trench upon beginning work, this plug shall remain in place until the trench has been pumped dry, unless otherwise approved by the Engineer, the Engineer's Representative, or the Owner's Representative.
 - 4. Coat threaded portions of stainless steel bolts and nuts with lubricant before assembly.
 - 5. Restrained plugs or caps shall be inserted into all buried dead end pipes, tees, or crosses. Provide blind flanges for all flanged exposed piping.

Restrained plugs and caps installed for pressure testing shall be fully secured and blocked to withstand the test pressure.

6. Where plugging is required because of contract division or phasing for later connection, the ends of such lines shall be equipped with a suitable cast-iron or ductile-iron plug/cap or blind flange with or without a blowoff cock, as shown on the Drawings. Installation or removal of such plugging shall be considered incidental to the work and the Contractor shall not be compensated by the Owner for performing this work.

3.06 FLANGED JOINTS FOR EXPOSED PIPE AND FITTINGS

- A. When bolting flanged joints, the Contractor shall avoid restraint on the opposite end of the pipe or fitting, which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate to ensure uniform compression of the gasket, in accordance with pipe and fitting manufacturer's recommendations.
- B. Coat threaded portions of stainless steel bolts and nuts with lubricant before assembly.

3.07 PIPING CONNECTIONS TO PUMPS AND OTHER EQUIPMENT

- A. When connecting to pumps and equipment, the Contractor shall ensure that piping stresses are not transmitted to the pump and equipment. All connecting pipe shall be permanently supported and aligned so that accurate matching of bolt holes and uniform contact over the entire surface of pump flanges are obtained before any bolts are installed in the flanges or pipe is threaded into pump and equipment. In addition, pump connection piping shall be free to move parallel to its longitudinal center line while the bolts are being tightened.
 1. Pumps and equipment shall be leveled, aligned, and wedged into a position that will fit the connecting pipe, but shall not be grouted until the initial fitting and alignment of the pump and equipment may be shifted on its foundation if necessary to properly install the connecting pipe. Each pump and piece of equipment shall, however, be grouted before final bolting of the connecting piping.
 2. After final alignment and bolting, the pump and equipment connections shall be tested for applied piping stresses by loosening the flange bolts which, if the piping is properly installed, should result in no movement of the piping relative to the pump or opening of the pump connection joints. If any movement is observed, the piping shall be loosened and re-aligned

as required and then the flanges bolted back together. The flange bolts then shall be loosened and the process repeated until no movement is observed.

3. All carbon steel bolts and nuts shall be coated with the same exterior coating applied to the piping system.

3.08 ANCHORING AND RESTRAINING

- A. Thrust blocks shall be used in new lines and shall be limited to areas in which a new fitting has been installed in an existing line and field restraining joints are not feasible or when directed by the Engineer.

3.09 PIPE COLOR CODING

- A. The Contractor shall coordinate with the Engineer and the Owner to generate a list of acceptable pipe colors for exposed piping systems. Where color-coding is achieved by painting exterior surfaces of the piping systems, painting shall be provided in accordance with Section 09900, Painting and Coating. On applicable pipes, color shall be in accordance with FDEP color-coding requirements.

END OF SECTION

SECTION 15081
PLUMBING INSULATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes equipment insulation, covering, and thermal insulation for piping systems, including vapor retarders, jackets, and accessories.

1.02 RELATED WORK

- A. Section 09900, Painting and Coating.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product Data: Provide product description, thermal characteristics and list of materials and thickness for each service, and locations.
- B. Manufacturer's Installation Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing of Materials (ASTM)
 - 1. ASTM A167—Standard Specification for Stainless and Heat-Resisting Chromium- Nickel Steel Plate, Sheet, and Strip.
 - 2. ASTM B209—Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

3. ASTM C177—Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
4. ASTM C195—Standard Specification for Mineral Fiber Thermal Insulating Cement.
5. ASTM C449/C449M—Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
6. ASTM C518—Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
7. ASTM C533—Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
8. ASTM C534—Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
9. ASTM C547—Standard Specification for Mineral Fiber Preformed Pipe Insulation.
10. ASTM C552—Standard Specification for Cellular Glass Thermal Insulation.
11. ASTM C553—Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
12. ASTM C591—Standard Specification for Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation.
13. ASTM C592—Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
14. ASTM C610—Standard Specification for Expanded Perlite Block and Pipe Thermal Insulation.
15. ASTM C612—Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
16. ASTM C795—Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
17. ASTM C1126—Standard Specification for Preformed Closed Cell Phenolic Foam Pipe and Board Insulation.
18. ASTM C1136—Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
19. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
20. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
21. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
22. ASTM E162—Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

- 23. ASTM G21—Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. North American Insulation Manufacturers Association (NAIMA)
 - 1. National Insulation Standards.
- C. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - 1. HVAC Duct Construction Standards – Metal and Flexible.
- 1.06 QUALITY ASSURANCE (NOT USED)
- 1.07 WARRANTY
 - A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.
 - B. Provide 5-year manufacturer warranty for man-made fiber.
- 1.08 DELIVERY, STORAGE, AND HANDLING
 - A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
 - B. Accept materials onsite in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
 - C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage by storing in original wrapping.
- 1.09 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 3 years' experience.
 - B. Applicator: Company specializing in performing work of this section with minimum 3 years' experience.
- 1.10 TESTING REQUIREMENTS (NOT USED)
- 1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS (NOT USED)

1.13 DEFINITIONS (NOT USED)

1.14 PRE-INSTALLATION MEETING

- A. Convene at least 1 week before commencing Work of this Section.

1.15 ENVIRONMENTAL REQUIREMENTS

- A. Do not install insulation outside ambient conditions required by manufacturer of each product.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

1.16 FIELD MEASUREMENTS

- A. Verify field measurements before fabrication.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Insulation
 - 1. Owens Corning.
 - 2. Certainteed.
 - 3. Schuller.
 - 4. Armstrong.
 - 5. Or Engineer-approved equal.

- B. PVC Jackets
 - 1. Schuller.
 - 2. Speedline.
 - 3. Or Engineer-approved equal.

2.02 ELASTOMERIC CELLULAR FOAM

- A. Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form: ASTM C534; Type I, Tubular form
- B. Elastomeric Foam Adhesive:
 - 1. Air-dried, contact adhesive, compatible with insulation.

2.03 PVC PLASTIC

- A. Pipe Jacket: ASTM D1784, one piece molded type fitting covers and sheet material, off-white color.
 - 1. Thickness: 30 mil.
 - 2. Connections: Brush on welding adhesive, tacks or pressure-sensitive color-matching vinyl tape.
- B. Aluminum Jacket: ASTM B209.
 - 1. Thickness: 0.016-inch-thick sheet.
 - 2. Finish: smooth or embossed.
 - 3. Joining: Longitudinal slip joints and 2-inch laps.
 - 4. Fittings: 0.016-inch-thick die-shaped fitting covers with factory-attached protective liner.
 - 5. Metal Jacket Bands: 3/8-inch-wide; 0.015-inch-thick aluminum.
- C. Mineral Fiber (Outdoor Duct) Jacket: Asphalt-impregnated and coated sheet, 50 lb/square.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping and equipment have been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with NAIMA National Insulation Standards.
- B. Exposed piping: Locate insulation and cover seams in least visible locations.
- C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- D. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment with removable sections and jackets.
- E. Inserts and shields:
 - 1. Application: piping or equipment all piping

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert location: Between support shield and piping and under the finish jacket.
 4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory-fabricated.
 5. Insert material: Compression-resistant insulating material suitable for the planned temperature range and service.
- F. Continue insulation through penetrations of building assemblies or portions of assemblies having a fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.
- G. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- H. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at the 3 or 9 o'clock position on the side of horizontal piping with the overlap facing down to shed water or on the bottom side of horizontal equipment.
- I. Buried Piping: Insulate only where the manufacturer of a specific insulation recommends that their product may be installed in a trench, tunnel, or direct buried. Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1-mil-thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- J. Factory Insulated Equipment: Do not insulate.
- K. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- L. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- M. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement, factory-applied, or field-applied. Finish with glass cloth and adhesive.
- N. Finish insulation at supports, protrusions, and interruptions.

- O. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.
- P. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- Q. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 THICKNESS

- A. Provide insulation thicknesses per California Energy Commission (CEC) Title-24.

END OF SECTION

SECTION 15083
HVAC INSULATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the following:

1. Insulation materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied jackets.
10. Tapes.
11. Securements.
12. Corner angles.

1.02 RELATED WORK

A. Section 15081, Plumbing Insulation.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 1. Detail application of protective shields and saddles at hangers for each type of insulation and hanger.

2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
3. Detail removable insulation at piping specialties, equipment connections, and access panels.
4. Detail application of field-applied jackets.
5. Detail application at linkages of control devices.
6. Detail field application for each equipment type.

C. Field quality-control reports.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing of Materials (ASTM)

1. ASTM B209—Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM C449/C449M—Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulation and Finishing Cement.
3. ASTM C534—Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
4. ASTM C553—Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
5. ASTM C612—Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
6. ASTM C871—Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions.
7. ASTM C1136—Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
8. ASTM C1290—Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
9. ASTM D1644—Standard Test Methods for Nonvolatile Content of Varnishes.

10. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
11. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
12. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.

B. Department of Defense (DOD)

1. MIL-A-24179A—Adhesive, Flexible Unicellular-Plastic Thermal Insulation.
2. MIL-A-3316C—Adhesives, Fire-Resistant, Thermal Insulation.
3. MIL-C-19565C—Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier.

C. Environmental Protection Agency (EPA)

1. 40 CFR 59 Subpart D—National Volatile Organic Compound Emission Standards for Architectural Coatings.

1.06 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have the fire-test-response characteristics indicated, as determined by testing identical products in accordance with ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

1.07 WARRANTIES

A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS (NOT USED)

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles regarding where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in Article 2.06.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied all-service jacket (ASJ). For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Article 2.06.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449/C449M.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.03 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 Adhesive: Comply with MIL-A-24179A, Type II, Class 1.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
2. For indoor applications, use adhesive that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based, suitable for indoor and outdoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180°F.
 - 4. Solids Content: ASTM D1644, 59% by volume and 71% by weight.
 - 5. Color: White.

2.05 SEALANTS

- A. ASJ Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to the following:
 - a. Childers Products, Division of ITW; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250°F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with *aluminum*-foil backing; comply with ASTM C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; comply with ASTM C1136, Type I.

2.07 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division, Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2%.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or square of ASJ tape.

2.08 SECUREMENTS

A. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers:
Baseplate welded to a projecting spindle capable of holding insulation, of the thickness indicated, securely in the position indicated when the self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - (1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - (2) GEMCO; Perforated Base.
 - (3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by the hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers:
Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in the position indicated when the self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to the following:

- (1) GEMCO; Nylon Hangers.
 - (2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030-inch thick by 1-1.2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by the hanger manufacturer. Product with demonstrated capacity to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, or substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of the thickness indicated, securely in position indicated when the self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - (1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - (2) GEMCO; Press and Peel.
 - (3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, full annealed, 0.106-inch-diameter shank, length to suit the depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:

- (1) AGM Industries, Inc.; RC-150.
- (2) GEMCO; R-150.
- (3) Midwest Fasteners, Inc.; WA-150.
- (4) Nelson Stud Welding; Speed Clips.

- b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

- 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to the following:

- (1) GEMCO.
- (2) Midwest Fasteners, Inc.

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

2.09 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040-inch thick, minimum 1 by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 EXECUTION

3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces free of voids throughout the length of equipment, ducts and fittings, and piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either a 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 the insulation material manufacturer.
- I. Install insulation with the 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 the supported item to the point of attachment to the structure. Taper and seal ends at the attachment to the 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 the insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over the jacket, arranged to protect the 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 the same material as the insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of the strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the bottom of pipe. Clean and dry the surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by the insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75% 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 the same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.03 PENETRATIONS

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

3.04 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, 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 the 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 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.
 4. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

5. 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 gauges, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.05 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with the manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to the outer diameter of pipe flange.
 2. Make width of insulation section the 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 the manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with the 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 the 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 the manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.06 FINISHES

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

3.07 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Inspect ductwork, randomly selected by the Engineer, by removing the field-applied jacket and insulation in layers in reverse order of their installation. The inspection shall be limited to two locations for each duct system defined in the Article 3.08.
 2. Inspect pipe, fittings, strainers, and valves randomly selected by the Engineer by removing the field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location of straight pipe, two locations of fittings, for each pipe service defined in the Article 3.08.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.08 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply and outdoor air.
 2. Indoor, exposed supply and outdoor air.
 3. Indoor, concealed exhaust air.
 4. Indoor, fabricated plenum return under ac unit.

B. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Factory-insulated access panels and doors.

3.09 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air, Outdoor-Air, and Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket or board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Exposed, Supply-Air and Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket or board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

3.10 PIPING INSULATION SCHEDULE, GENERAL

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

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping: Flexible elastomeric, 1 inch thick.
- B. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric, 1 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping: Insulation shall be flexible elastomeric, 1 inch thick.
- B. Refrigerant Suction and Hot-Gas Flexible Tubing: Insulation shall be flexible elastomeric, 1 inch thick.

END OF SECTION

SECTION 15110
MANUAL, CHECK, AND PROCESS VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install complete and ready for operation all valves as shown in the Drawings and as specified in this Section. All valves shall be complete with all necessary manual actuators, valve boxes, extension stems, and floor stands, which are required for proper valve operation and completion of the work.
 - 1. All valves shall be of the sizes shown in the Drawings. All equipment of the same type shall be from one manufacturer, unless authorized in writing by the Engineer.
 - 2. The valves shall include but not be limited to the following:
 - a. Air valves
 - b. Ball valves
 - c. Check valves
 - d. Gate valves
 - e. Globe and angle valves
 - f. Solenoid valves
 - g. Special types of valves

1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance.
- B. Section 09900, Painting and Coating.
- C. Section 15055, Piping System—General.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product technical submittal data shall contain the following information and data:
 - 1. Acknowledgment that products submitted meet requirements of standards referenced.

2. Manufacturer's installation instructions.
3. Manufacturer's operation and maintenance manuals.
4. Data of valves, actuators, and accessories:
 - a. Pressure and temperature rating.
 - b. Materials of construction, with ASTM reference and grade.
 - c. Linings and coatings.
 - d. Dimensions and weight.
 - e. Flow coefficient.
 - f. Actuators and accessories details.
 - g. Manufacturer's product brochure, cut-sheets, and parts diagrams.
- B. Dimensions and orientation of valve actuators as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.
- C. The following test reports: Performance Tests; Leakage Tests; Hydrostatic Tests; and Proof-of-Design Tests as applicable or required.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American National Standard Institute
 1. ANSI A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 2. ANSI B1.20.1—Pipe Threads, General Purpose (Inch).
 3. ANSI B1.20.7—Hose Coupling Screw Threads (Inch).
 4. ANSI B16.1—Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 5. ANSI B16.5—Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 6. ANSI B16.10—Face to Face and End-to-End Dimensions of Valves.
 7. ANSI B16.18—Cast Copper Alloy Solder Joint Pressure Fittings.
 8. ANSI B16.34—Valves Flanged, Threaded and Welding End.

9. ANSI B16.42—Ductile-Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300.
10. ANSI B16.104—Control Valve Seat Leakage.
11. ANSI/NSF 61—Drinking Water System Components – Health Effects.

B. American Society for Testing of Materials (ASTM)

1. ASTM A36—Standard Specification for Carbon Structural Steel.
2. ASTM A47—Standard Specification for Ferritic Malleable Iron Castings.
3. ASTM A48—Standard Specification for Gray Iron Castings.
4. ASTM A105—Standard Specification for Carbon-Steel Forgings for Piping Applications.
5. ASTM A108—Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
6. ASTM A126—Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
7. ASTM A148—Standard Specification for Steel Castings, High Strength, for Structural Purposes.
8. ASTM A181—Standard Specification for Carbon-Steel Forgings, for General-Purpose Piping.
9. ASTM A182—Standard Specification for Forged or Rolled Alloy and Stainless-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
10. ASTM A193—Standard Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.
11. ASTM A194—Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High-Temperature Service, or Both.
12. ASTM A216—Standard Specification for Steel Castings, Carbon, Suitable for Fusion-Welding, for High-Temperature Service.
13. ASTM A240—Standard Specification for Chromium and Chromium-Nickel Stainless-Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
14. ASTM A269—Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Purpose.
15. ASTM A276—Standard Specification for Stainless-Steel Bars and Shapes.
16. ASTM A313—Standard Specification for Stainless-Steel Spring Wire.
17. ASTM A322—Standard Specification for Steel Bars, Alloy, Standard Grades.
18. ASTM A351—Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
19. ASTM A395—Standard Specification for Ferritic Ductile-Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
20. ASTM A436—Standard Specification for Austenitic Gray Iron Castings.

21. ASTM A439—Standard Specification for Austenitic Ductile-Iron Castings.
22. ASTM A449—Standard Specification for Hex Cap Screws, Bolts and Studs, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
23. ASTM A276—Standard Specification for Stainless-Steel Bars and Shapes.
24. ASTM A479—Standard Specification for Stainless-Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
25. ASTM A494—Standard Specification for Castings, Nickel and Nickel Alloy.
26. ASTM A516—Standard Specification for Pressure Vessel Plates, Carbon-Steel, for Moderate- and Lower-Temperature Services.
27. ASTM A536—Standard Specification for Ductile-Iron Castings.
28. ASTM A564—Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless-Steel Bars and Shapes.
29. ASTM A582—Standard Specification for Free-Machining Stainless-Steel Bars.
30. ASTM A666—Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
31. ASTM A743—Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
32. ASTM A744—Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
33. ASTM A890—Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application.
34. ASTM B16—Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
35. ASTM B21—Standard Specification for Naval Brass Rod, Bar, and Shapes.
36. ASTM B61—Standard Specification for Steam or Valve Bronze Fittings.
37. ASTM B62—Standard Specification for Composition Bronze or Ounce Metal Castings.
38. ASTM B98—Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
39. ASTM B99—Standard Specification for Copper-Silicon Alloy Wire for General Applications.
40. ASTM B127—Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
41. ASTM B148—Standard Specification for Aluminum-Bronze Sand Castings.
42. ASTM B150—Standard Specification for Aluminum Bronze Rod, Bar, and Shapes.

43. ASTM B164—Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
44. ASTM A169—Standard Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar.
45. ASTM B193—Standard Test Method for Resistivity of Electrical Conductor Materials.
46. ASTM B371—Standard Specification for Copper-Zinc-Silicon Alloy Rod.
47. ASTM B427—Standard Specification for Gear Bronze Alloy Castings.
48. ASTM B446—Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar.
49. ASTM B443—Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip.
50. ASTM B462—Specification for Forged or Rolled UNS N06030, N06022, N06035, N06200, N06059, N06686, N06020, N06024, N06026, N08367, N10276, N10665, N10675, N10629, N08031, N06045, N06025, & R20033 Alloy Pipe Flanges, Forged Fittings, & Valves & Parts for Corrosive High-Temperature Service.
51. ASTM B463—Standard Specification for UNS N08020, UNS N08026, and UNS N08024 Alloy Plate, Sheet, and Strip.
52. ASTM D471—Standard Test Method for Rubber Property—Effect of Liquids
53. ASTM B472—Standard Specification for Nickel Alloy Billets and Bars for Reforging.
54. ASTM B584—Standard Specification for Copper Alloy Sand Castings for General Applications.
55. ASTM B763—Standard Specification for Copper Alloy Sand Castings for Valve Applications.
56. ASTM D1248—Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
57. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
58. ASTM D1785—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
59. ASTM F441—Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
60. ASTM F467—Standard Specification for Non-Ferrous Nuts for General Use.
61. ASTM F468—Standard Specification for Non-Ferrous Bolts, Hex Cap Screws, and Studs for General Use.

C. American Society of Mechanical Engineers (ASME)

1. ASME 16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
2. ASME B16.11—Standards of Pipes and Fittings.
3. ASME B16.24—Cast Copper Alloy Pipe Flanges and Flanged Fittings Classes 150, 300, 400, 600, 900, 1500, and 2500.
4. ASME Section VIII, Pressure Relief Devices.

D. American Society of Safety Engineers (ASSE)

1. ASSE 1011—Performance Requirements for Hose Connection Vacuum Breakers.

E. American Water Works Association (AWWA)

1. AWWA C110—Ductile-Iron and Gray-Iron Fittings for Water.
2. AWWA C111—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C115—Standard for Flanged Ductile-Iron Pipe with Threaded Flanges.
4. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).
5. AWWA C500—Metal-Seated Gate Valves for Water Supply Service.
6. AWWA C508—Swing-Check Valves for Waterworks Service, 2-Inch (50 mm) through 24-Inch (600 mm).
7. AWWA C509—Resilient-Seated Gate Valves for Water-Supply Service.
8. AWWA C512—Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
9. AWWA C515—Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
10. AWWA C550—Protective Epoxy Interior Coatings for Valves and Hydrants.
11. AWWA C800—Underground Service Line Valves and Fittings.

F. Fluid Controls Institute (FCI)

1. FCI 70-2—Control Valve Seat Leakage.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. All valves, unless otherwise directed, shall be loaded and unloaded by lifting, and under no circumstances shall valves be dropped, skidded, or rolled. Valves shall not be stacked or placed under pipe, fittings, or other valves in such a manner that damage could result.
- C. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surface or interior linings and valve components. If any part of the coating, lining, or components is damaged, the repairs or replacement shall be made by the Contractor at his expense and in a manner satisfactory to the Engineer before attempting to install such valves.
- D. Only new valves will be allowed for installation and shall be stored in a manner to prevent damage and be kept free of dirt, mud, or other debris.

1.09 QUALIFICATIONS

- A. All of the valves shall be products of well-established firms which are fully experienced, reputable, have been selling this product for a minimum of 10 years, and are qualified in the manufacture of the particular product furnished. The valves shall be designed, constructed, and installed in accordance with the requirements and procedures of applicable AWWA standards and shall comply with these Specifications as applicable.

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals and Training.

1.13 VALVE TYPE CLASSIFICATIONS

A. Air Valves (Type 100 Series)

1. Type 100: Air-Release Valves for Water Services
2. Type 140: Air Valves for Leachate Services, Air Release.

B. Ball Valves (Type 200 series):

1. Type 200: Threaded Bronze Ball Valves, 2 Inches and Smaller.
2. Type 210: Double-Union PVC Ball Valves, 3 Inches and Smaller, for Water and Light Chemical Service.
3. Type 221: Full-Port Threaded Stainless-Steel Ball Valves, 2 Inches and Smaller, for Water Service

C. Check Valves (Type 400 series):

1. Type 420: Cast-Iron Swing Check Valves with Outside Lever and Weight, 4 Inches and larger.
2. Type 456: Duckbill-Shaped In-Line Check Valves, 1 Inch through 24 Inches, Class 125.

D. Gate Valves (Type 600 series):

1. Type 680: Cast-Iron Resilient Wedge Gate Valves, 3 Inches through 20 Inches for Exposed Service (AWWA C509):

E. Globe and Angle Valves (Type 700 series):

1. Type 720: Bronze Hose Bibbs, 1/2 Inch through 1 Inch.

F. Plug Valves (Type 900 series):

1. Type 900: Eccentric Plug Valves, 3 Inches and Smaller.
2. Type 902: Eccentric Plug Valves, 4 Inches through 12 Inches.

G. Solenoid Valves (Type 1000 series):

1. Type 1030: Three-Way Metallic Solenoid Valves, 1/2 Inch and Smaller:

H. Special Types of Valves:

1. Safety Relief Valves 1/2 to 2 inch.

PART 2 PRODUCTS

2.01 GENERAL

- A. All valves shall be complete with all necessary geared actuators, chainwheels and chains, handwheels, levers, valve bonnets, valve boxes, extension stems, operating nuts, and T-handle wrenches, which are required for proper valve operating and completing of the work included under this Section. Renewable parts including discs, packing, and seats shall be of types specified in this Section and acceptable by valve manufacturer for the intended service. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached stainless-steel plate in raised embossed letters. All isolation valves shall be suitable for the intended service with bubble-tight shutoff to flow in either direction.
- B. Bronze or brass components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

- D. Valves and valve operators shall be factory prepared and primed and field finish coated in accordance with Section 09900, Painting and Coating.

2.02 VALVE ACTUATORS

- A. The valve actuator shall be an integral part of a valve. The valve actuator shall be provided, installed, and adjusted by the valve manufacturer. Actuator mounting arrangements shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the Drawings or directed by the Engineer.
- B. All valves shall open counter clockwise as viewed from the top. Unless otherwise required by the Owner, the direction of rotation of the wheel or wrench nut to open each valve shall be to the left (counterclockwise). Each valve body or actuator shall have the word "Open" cast on it and an arrow indicating the direction to open.
- C. Unless noted otherwise, valves shall be equipped with the following manual actuators:

1. Exposed valves 6 inches and smaller: removable lever or handwheel actuators.
 2. Buried or Submerged Valves 6 inches and smaller: 2-inch-square operating nuts (with valve bonnets, valve boxes, and extension stems as required) and T-handle wrench.
- D. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.
- E. All buried valves shall have non-rising stems. All buried valves 3 feet below grade or deeper as measured at the valve centerline shall be furnished with an operator stem extension to extend the operating nut within 6 inches from the top of the valve box cover.

2.03 VALVE END CONNECTIONS

- A. Provide valve end connections conforming to connected piping and as shown in the Drawings. Generally, all buried valves shall be mechanical joint type end connectors. Exposed valves shall be screwed-end, socket-weld end, or flanged to conform to adjacent exposed connected piping system.
- B. Comply with the following standards:
1. Threaded: ANSI B1.20.1.
 2. Flanged: ANSI B16.1 Class 125 unless other noted or AWWA C207.
 3. Mechanical (gland) Type: AWWA C111.
 4. Soldered: ANSI B16.18.
- C. Nuts, Bolts, and Washers: Wetted or internal to be bronze or stainless-steel. Exposed to be zinc or cadmium-plated.
- D. Epoxy Interior Coating: Provide epoxy coating for all interiors of ferrous valve body surfaces in accordance with AWWA C550. Coatings shall be NSF-approved for valves in all potable water piping services. Coatings shall not be required for stainless-steel valve interiors.

2.04 VALVE BOXES

- A. All buried valves 2-inch size and larger shall be equipped with a standard cast-iron roadway valve box. Valve boxes shall be of the slip or sliding type with a round lid marked "Water" for potable water valves or "Sewer" for wastewater and

a square lid marked "Reclaimed Water" for reclaimed water valves. The box shall be designed to prevent transfer of the surface loads directly to the valve or piping. Valve boxes must have a minimum adjustable range of 12 inches and a minimum inner diameter of 6 inches. All valve boxes and lids shall be produced from grey cast-iron conforming to the latest revision of specification for grey iron castings, ASTM designation A48, Class 20A-25A. All castings shall be true and free of holes and shall be cleaned according to good foundry practice, chipped and ground as needed to remove fins and rough places on castings. Valve boxes have to be rated to sustain FDOT H-20 loadings and have a minimum depth of 8 inches. The valve box lid shall fit flush in the top of the box without forcing and shall not rock, tip, or rattle.

- B. Provide debris cap as required in the Drawings.
- C. Valve boxes shall be as manufactured by Tyler Pipe, Geneco, Star Pipe Products, or equal.

2.05 EXTENSION STEMS (NOT USED)

2.06 BOLTS, NUTS, AND GASKETS FOR FLANGED VALVES

- A. Bolts, nuts, and gaskets for flanged valves shall be as described in Section 15055, Piping Systems—General.

2.07 PAINTING AND COATING

- A. Coat metal valves located aboveground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, coat valves as specified in Section 09900, System No. 7. Apply the specified prime and finish coat at the place of manufacture. The finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.
- B. Coat buried metal valves at the place of manufacture as specified in Section 09900, System No. 21.
- C. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless-steel pieces, as specified in Section 09900, System No. 7. Apply lining at the place of manufacture.
- D. Measure the thickness of the valve interior linings as specified in Section 09900. Repair areas having insufficient film thickness as specified in Section 09900.

2.08 AIR VALVES (TYPE 100 SERIES)

A. Type 100—Air-Release Valves for Water Services:

1. Type 100 air-release valves for water services shall have NPT ends of rolling seal mechanism to release air. Valve body and back shall be NSF 61 approved reinforced nylon. Valves shall be ARI S-050 with vacuum check or approved equal.

B. Type 140—Air Valves for Leachate Services, Air Release.

1. Type 140 air valves for sewage service shall have elongated cylindrical chambers. All valves shall provide the following: 1/2-inch clearance around the float in the chamber, minimum size 1/2-inch isolation valve and quick-disconnect couplings at the valve venting for back-flushing, blowoff port and valve at the bottom of the chamber, and inlet valve at the valve inlet. A back-flushing assemble shall be provided for all valves. The back-flushing assemble shall consist of an inlet shutoff valve, a flush valve, a clear water inlet valve, rubber supply hose, and quick-disconnect couplings. Type 1440 valves shall be air-release valves. Valves shall be APCO 443, Val-Matic Model 49A, or equal.

2.09 BALL VALVES (TYPE 200 SERIES)

A. Type 200—Threaded Bronze Ball Valves, 2 Inches and Smaller:

1. Ball valves 2 inches and smaller for air or water service shall have bronze (ASTM B62 or ASTM B584, Alloy C83600 or C84400) body and plug ball retainer. Ball and stem shall be brass, bronze or Type 316 stainless-steel. Provide chrome-plated ball if ball is brass or bronze. Valves shall have screwed ends (ANSI B1.20.1), non-blowout stems, reinforced PTFE seats, and have plastic-coated lever operators. Valves shall have a pressure rating of at least 600 psi WOG at a temperature of 150°F. Valves shall be Stockham T-285 Series, Nibco T-585-70 Series, Apollo 70-100 Series

B. Type 210—Double-Union PVC Ball Valves, 3 Inches and Smaller, for Water and Light Chemical Service:

1. Unless noted otherwise, ball valves installed in PVC piping systems 3 inches and smaller shall be constructed from polyvinyl chloride (PVC) ASTM D1784, rated to 150 psi minimum from 30° to 120°F, double-union design with two-way blocking capability, socket end connection except where threaded or flanged-end valves are specifically shown in the Drawings, double EPDM O-ring seals and EPDM backing cushions, PTFE

seals, ABS or polypropylene handle, NSF-61 certified. Valves shall be Asahi/America Inc., Quarter-Bloc Ball Valve Series, Spears Mfg. Co 2000 Series, or approved equal.

C. Type 221—Full-Port Threaded Stainless-Steel Ball Valves, 2 Inches and Smaller, for Water Service:

1. Stainless-steel ball valves 2 inches and smaller for water service shall be rated at a minimum pressure of 1,000 psi WOG at a temperature of 100°F. Provide full-port ball and body design. Valve body, ball, and stem shall be Type 316 stainless-steel, ASTM A276 or A351. Seat and seals shall be reinforced PTFE. Valves shall have lever actuators, plastic-coated. Valves shall have screwed ends (ANSI B1.20.1) and non-blowout stems. Valves shall be Worcester Series 59, Apollo 86A-100 Series, or Engineer-approved equal.

2.10 CHECK VALVES (TYPE 400 SERIES)

A. Type 420—Cast-Iron Swing Check Valves with Outside Lever and Weight, 4 Inches and larger:

1. Check valves 4 inches and larger shall be swing-check type with outside lever and weight and shall permit free flow of sewage forward and provide a positive check against backflow. Check valves shall be designed for a minimum working pressure of 150 psi. The manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow shall be directly cast on the body. Swing check valves shall exceed the minimum requirements of AWWA C508 with a heavy-duty body of cast-iron conforming to ASTM A126 Class B with integral flanges, faced and drilled in accordance with ASME B16.1 Class 125. Bolts, nuts, washers, etc., shall be Type 316 stainless-steel. The valve body shall be the full waterway type, designed to provide a net flow no less than the nominal inlet pipe size when swung open no more than 25°. The valve shall have a replaceable stainless-steel body seat and a cast-iron disc faced with a renewable resilient seat ring of rubber and held in place by stainless-steel screws. The disk arm shall be ductile-iron or steel, suspended from and keyed to a stainless-steel shaft, which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable. The valve interior shall be painted with epoxy coating by the valve manufacturer in accordance with AWWA C550. The check valve

shall be GA Industries, Inc. Figure 220 Lever and Weight or approved equal.

- B. Type 456—Duckbill-Shaped In-Line Check Valves with Cast-Iron Body, 1 Inch through 24 Inches, Class 125:
1. Valves shall consist of an in-line rubber flange with an attached duckbill sleeve-type exit, mounted in a cast-iron flanged body. Provide a cleanout plug on the top of the valve body. The valve body shall have two connecting Class 125 ANSI B16.1 cast-iron flanges to match the connecting pipe. Material of construction of the sleeve and attached flange shall be EPDM. Provide synthetic fabric reinforcement. Body material shall be cast-iron (ASTM A126) with 15-mil fusion-bonded epoxy lining and coating in accordance with AWWA C550. The valve shall open at a differential pressure of 4 inches of water column and shall close under a no-flow condition. Minimum body pressure rating shall be 150 psi for 4- and 6-inch sizes, 125 psi for 8-inch size, 100 psi for 10-inch size, and 75 psi for 12- and 14-inch sizes. Maximum backpressure: 60 psi. Products: Red Valve Company "Tideflex" Model 39 or equal.

2.11 GATE VALVES (TYPE 600 SERIES)

- A. Type 680—Cast-Iron Resilient Wedge Gate Valves, 3 Inches through 20 Inches for Exposed Service (AWWA C509):
1. Valves 3 inches and larger for exposed service operation shall be of cast-iron or ductile-iron body construction and conform to AWWA C509 for resilient seated gate valves. The valve design shall incorporate non-rising stems and "O" ring stem seals. Valves shall open counterclockwise. Valves shall be designed for bubbletight shutoff to flow in either direction. Before shipment, the valve manufacturer shall test each valve to 200 psi pressure differential in both directions and provide a certificate to the Engineer stating that each valve provided bubbletight shutoff during testing. The valve interior shall be epoxy-coated on the entire ferrous surface of the waterway. The valve exterior shall be coated in accordance with Section 09900, Painting and Coating.
 2. Exposed valves 3 inches and larger shall be flanged. Buried valves 2 inches and larger shall have mechanical jointends, conforming to AWWA C111. Valves shall be furnished complete with bolts, nuts, and gaskets.
 3. Gate valves shall be manufactured by Mueller, American Flow Control, Kennedy, or approved equal.

2.12 GLOBE AND ANGLE VALVES (TYPE 700 SERIES)

A. Type 720—Bronze Hose Bibbs 1/2-Inch through 1 Inch:

1. Hose bibbs 1/2 inch, 3/4 inch, and 1 inch shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with rising or non-rising stem, composition disc, bronze or malleable iron handwheel, and bronze stem (ASTM B99, Alloy C65100; ASTM B371, Alloy C69400; or ASTM B584, Alloy C87600). Packing shall be PTFE or graphite. Valves shall have a pressure rating of at least 125 psi for cold-water service. Threads on valve outlets shall be American National Standard fire hose coupling screw thread (ANSI B1.20.7). Provide atmospheric vacuum breaker conforming to ASSE 1011 and IAPMO code. Valves shall be manufactured by Nibco or approved equal.

2.13 PLUG (TYPE 900 SERIES)

- A. Plug and Seating Design for Eccentric Plug Valves (Types 900 and 902): Eccentric plug valves shall comply with MSS SP-108 and the following. Provide a rectangular plug design, with an associated rectangular seat. Provide bidirectional seating design. The valve shall seat with the rated pressure both upstream and downstream of the closed plug. Provide geared actuators sized for bidirectional operation.
- B. For Types 900 and 902 eccentric plug valves, the metallic portion of the plug shall be one-piece design and shall be without external reinforcing ribs, which result in a space between the rib and the main body of the plug through which water can pass. Valves shall be repackable without any disassembly of valve or actuator. The valve shall be capable of being repacked while under the design pressure in the open position. Nowhere in the valve or actuators shall the valve shaft be exposed to iron on iron contact. Sleeve bearings shall be Type 316 stainless steel unless otherwise noted.
- C. Rubber compounds shall have less than 2% volume increase when tested in accordance with ASTM D471 after being immersed in distilled water at a temperature of 73.4°F ±2°F for 70 hours.
- D. Type 900—Eccentric Plug Valves 3 Inches and Smaller:
1. Eccentric plug valves, 1/2 inch through 3 inches, shall be non-lubricated type. Minimum pressure rating shall be 175 psi. Bodies shall be made of cast iron in accordance with ASTM A126, Class B. Ends shall be threaded or flanged (ANSI B16.1, Class 125). Plugs shall be cast iron

(ASTM A126, Class B) with Buna-N coating. Body capscrews and bolts and nuts shall be Type 316 stainless steel. Packing shall be nitrile butadiene-filled Teflon. Valves shall be DeZurik Figure 118, Clow, Val-Matic "Cam-Centric," or equal.

E. Type 902—Eccentric Plug Valves 4 Inches through 12 Inches:

1. Eccentric plug valves 4 inches through 12 inches shall be non-lubricated type. Minimum pressure rating shall be 175 psi. Bodies shall be cast iron in accordance with ASTM A126, Class B. Ends shall be flanged, Class 125 in accordance with ANSI B16.1. Plugs shall be cast iron (ASTM A126, Class B), or ductile iron (ASTM A536, Grade 65-45-12) with Buna-N facing. Valve body seats shall be Type 304 or 316 stainless steel or have a raised welded-in overlay at least 1/8-inch thick of not less than 90% nickel. Body capscrews and bolts and nuts shall be Type 316 stainless steel. Packing shall be butadiene-filled Teflon. Valves shall be DeZurik Figure 118, Clow F-5412, Val-Matic "Cam-Centric," or equal.

2.14 SOLENOID VALVES (TYPE 1000 SERIES)

Design and construct solenoid valves so that they can be used in horizontal and in vertical piping.

A. Type 1030—Three-Way Metallic Solenoid Valves, ½ Inch and Smaller:

1. Design and construct solenoid valves so that they can be used in both horizontal and vertical piping.
2. Solenoid valves of sizes 1/8 inch through ½ inch for water service shall have forged brass (Alloy C23000) or bronze (ASTM B62) bodies with Teflon or Viton seats. The valves shall be Port 1-3 connected when normally closed and Port 2-1 connected when energized. Internal plunger, core tube, plunger spring, and cage assembly shall be stainless steel (Types 302, 304, or 305). Solenoid enclosures shall be NEMA 4. Valve actuators shall be 120-volt a-c with Class H insulation. Seals shall be Teflon or Viton. Valves shall have an operating pressure of 200 psi. Valves shall be ASCO "Red-Hat II" Model 8320 or equal.

2.15 OTHER SPECIAL TYPES OF VALVES

A. Safety Relief Valves 1/2 inch through 2 inch:

1. Safety relief valves body and bonnet shall be ductile iron and steel, with Viton o-ring seal; stainless steel piston, closing spring, and seat insert;

EPDM seat disc; and threaded end connections. Valves shall have a working pressure rating of at least 900 psig for cold-water service. Maximum operating temperature shall be 240°F. Valve initial pressure setting shall be 140 psig. Valves shall be Apollo Series 500 or Engineer-approved equal.

PART 3 EXECUTION

3.01 JOINTS

- A. 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. 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. Joints shall be watertight.
- B. 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.
- C. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

3.02 INSTALLING EXPOSED VALVES

- A. Unless otherwise indicated in the Drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.
- B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.03 INSTALLING BURIED VALVES

- A. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement as required on the Drawings, and place and compact the backfill to the height of the valve stem.

- B. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.
- C. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.
- D. Install debris cap as close as possible under the cast-iron cover without interfering with the cover operation. Trim flexible skirt to provide a smooth contact with the interior of the extension pipe.

3.04 FIELD COATING BURIED VALVES

- A. Coat flanges of buried valves and the flanges of the adjacent piping and the bolts and nuts of flanges and mechanical joints.

3.05 VALVE LEAKAGE AND FIELD TESTING

- A. Test valves for leakage at the same time that the connecting pipelines are tested. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.
- B. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

END OF SECTION

SECTION 15112 BACKFLOW PREVENTERS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials and installation of backflow preventers.

1.02 SUBMITTALS

- A. The Contractor shall do the following:
1. Submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
 2. Submit manufacturer's certificate of compliance with AWWA C511 for backflow preventers. Submit manufacturer's certificate of compliance with NSF 61.
 3. Submit manufacturer's catalog data and descriptive literature. Submit dimensional drawings. Call out materials of construction by ASTM reference and grade. Show coatings. Provide manufacturer's certification that materials are lead free.

PART 2 MATERIALS

2.01 BACKFLOW PREVENTERS

- A. Backflow preventers shall be of the double-check valve type, complying with AWWA C510. The Contractor shall provide two independently operating check valves, two shutoff ball valves, and test cocks so that a test of each check valve can be made.
- B. Backflow preventers of sizes 2 inches and smaller shall have bronze (ASTM B61 or B62) check valves. Check valves shall be of the poppet type and have replaceable seats.
- C. The interior of the backflow preventers shall be epoxy coated in accordance with AWWA C550.
- D. Isolation valves shall be 2-inch threaded bronze ball valves. Ball valves shall have a bronze (ASTM B62 or ASTM B584, Alloy C83600 or C84400) body and plug

ball retainer. Ball and stem shall be bronze (as specified for the body) or Type 316 stainless steel. Provide a chrome-plated ball if the ball is bronze. Valves shall have screwed ends (ANSI B1.20.1), nonblowout stems, reinforced Teflon seats, and plastic-coated lever operators. Valves shall have a pressure rating of at least 600 psi WOG at a temperature of 150°F. Valves shall be Stockham S-206, Apollo 77-100 Series, or equal.

- E. Backflow preventers shall be Watts Series LF007 or approved equal.

PART 3 EXECUTION

3.01 FIELD TESTING

- A. Pressure test the backflow preventers and detector checks along with the connecting piping for a minimum of 2 hours at the test pressure specified. There shall be no visible leaks in the backflow preventer and detector checks assembly, valves, or joints of the interconnecting piping.

END OF SECTION

SECTION 15120
HYDRAULICALLY-OPERATED CONTROL VALVES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes requirements for materials and installation of hydraulically operated and pilot controlled valves acting as pressure-sustaining valve.

1.02 SUBMITTALS

- A. The Contractor shall do the following:
1. Submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
 2. Submit the following manufacturer's catalog data and/or drawings for each valve size and type provided:
 - a. Manufacturer's model number.
 - b. Materials of construction.
 - c. Dimensional drawings and weights.
 - d. Pressure ratings of valve and components.
 - e. Pilot setting adjustment ranges.
 - f. Full open flow coefficient, Cv.
 - g. Maximum recommended continuous operating pressure.
 - h. Maximum allowable intermittent operating pressure.
 - i. Maximum recommended continuous flow rate.
 3. Submit schematics and functional descriptions of the pilot control system (e.g., piping, pilot(s), isolation valve(s), fittings, etc.) proposed for each control valve.
 4. Submit data on valve lining and paint primer coating with coating manufacturer and coating system number or designation.
 5. Submit valve manufacturer's certification that all wetted materials for each valve are suitable for use with the fluid being conveyed.
 6. For each control valve, submit a computer-generated cavitation analysis based on the specific performance characteristics specified in Article 2.06.

7. Submit manufacturer's valve handling and storage instructions.
8. Submit manufacturer's valve installation and adjustment instructions.
9. Submit manufacturer's operation and maintenance manuals in accordance with Section 01830, Operations and Maintenance Manuals and Training.

1.03 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.04 HANDLING AND STORAGE

- A. The Contractor shall protect, handle, and store valves in a manner to prevent damage. Follow manufacturer's written handling and storage instructions.

1.05 MANUFACTURER'S SERVICES

- A. The Contractor shall provide equipment manufacturer's factory services at the jobsite for at least one labor day, travel time excluded. The Contractor shall notify the Owner and Engineer at least 5 calendar days before scheduled activities.

PART 2 PRODUCTS

2.01 GENERAL

- A. Each valve shall consist of a main valve and pilot control system as described herein. The control system shall be designed and supplied by the manufacturer of the main valve.

2.02 MANUFACTURERS

- A. All hydraulically operated control valves shall be provided by one manufacturer.
- B. Valves shall be provided by the following manufacturers:
 1. Cla-Val Company.
 2. Singer.
 3. Ames.
 4. Bermad.

2.03 MATERIAL OF CONSTRUCTION

- A. Materials of construction for valves shall be as follows:

Item	Material
Main valve body and bonnet	Ductile Iron, ASTM A 536, Grade 65-45-12
Stem and spring	300 series stainless steel
Spool, seat disc retainer, diaphragm plate	Ductile Iron, ASTM A 536
Diaphragm and seat disc	Nylon Reinforced Buna-N
Pilot piping and tubing	300 series stainless steel
Seat ring	Bronze
Bonnet nuts and bolts	300 series stainless steel

- B. All wetted materials shall be suitable for the fluid being conveyed.
- C. Non-metallic components (e.g., elastomers, etc.) shall be Buna-N, EPDM, Viton, Teflon, or other materials accepted by the Engineer.

2.04 MAIN VALVE

- A. The main valve shall be a hydraulically operated, single-diaphragm-actuated, globe-pattern valve. The main valve shall consist of three major components: the body with seat installed, the bonnet with bearings installed, and the diaphragm assembly.
- B. The main valve seat and the stem bearing in the valve bonnet shall be removable for ease of maintenance. The seat shall be a solid, one-piece design and shall have the seating surface for a positive, drip-tight shut off. The lower bearing of the valve stem shall be contained concentrically within the seat. The valve body and bonnet shall be machined to ensure proper alignment of the valve stem. Stem alignment shall be provided through the use of precision guide dowel pins between the valve cover and body. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.
- C. The main valve shall contain a resilient seat disc, with a rectangular cross-section contained by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks.

- D. The diaphragm assembly shall be fully guided at both ends by a bearing in the valve bonnet and an integral bearing in the valve seat. The stem shall be machined to receive and affix such accessories as may be deemed necessary. The diaphragm shall utilize an FDA-approved non-wicking material. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall be able to be replaced without the removal of the valve stem assembly. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position. The diaphragm shall not be used as a seating surface.
- E. The main valve shall be provided with a valve position indicator stem, which is directly connected to the valve plug/disc.
- F. All units shall have the name of the manufacturer and the nominal size of the valve cast into the body or bonnet or shown in recessed letters on a permanently attached 316 SS plate.

2.05 VALVE END CONNECTIONS

- A. Valves 2 inches and smaller shall have threaded ends. Valves larger than 2 inches shall have flanged ends.
- B. Threaded ends shall comply with ANSI B1.20.1.
- C. Flanges for ductile iron valves shall be ductile iron, same grade as the valve. Class 150 flanges shall comply with ANSI B16.42, Class 150. Flanges shall be flat face.
- D. Raised-face mating flanges on the connecting piping shall not be allowed.

2.06 CONTROL SYSTEMS

- A. Pressure Sustaining Control with Solenoid Shut-off Control (PSV 1)
 - 1. General
 - a. The main valve, through the pressure sustaining control system, shall maintain inlet line pressure to a pre-set but adjustable value. The valve opens when the inlet increases to the set point and will close when the inlet pressure drops below the set point.

- b. The control pilot shall be a direct acting, spring-loaded, diaphragm valve. The control pilot shall respond to the inlet pressure of the valve.
- c. The pressure sustaining control system shall include an opening speed Cv controller, a closing speed Cv controller, a filter, and isolation valves. The filter shall be all 316SS construction with a cleanable 316SS filter element that shall prevent debris from entering the control system and the main valve cover chamber. The isolation valves isolate the pilot system from line pressure to facilitate pilot maintenance and repair.

2. Solenoid Shutoff Control

- a. The pilot control shall be equipped with a three-way solenoid valve to intercept the operation of the pressure sustaining control and close the main valve. The solenoid valve shall be Type 1030 (see Section 15110, Manual, Check, and Process Valves). When the solenoid valve is energized, the main valve functionality shall be governed by the pressure sustaining control system. When the solenoid is de-energized, the main valve shall close.
3. For additional information regarding settings, service conditions, and valve requirements, refer to the following table.

PSV 1	
Main valve size:	2-inch
Pressures Sustaining Setting:	30 psi (initial setting) Equipment Adjustable Range: 20 to 50 psi
Cv at Full Open:	54 gpm/psi ^{0.5} (minimum)
Maximum upstream pressure:	55 psi
Minimum upstream pressure:	20 psi
Maximum downstream pressure:	10 psi
Minimum downstream pressure:	1 psi
Opening Speed Cv Controller – Opening Time (from full closed to full open):	1 second
Closing Speed Cv Controller - Closing Time (from full open to full closed):	Standard Needle Valve Speed Controller: 30 seconds (initial setting) Adjustable Range: 1 to 60 seconds
Minimum Flow	5 gpm
Maximum Flow	50 gpm

2.07 BOLTS AND NUTS FOR FLANGED VALVES

- A. Bolts and nuts for flanged valves shall be as specified for the piping to which the valves are connected.

- B. The Contractor shall provide washers for each nut. Washers shall be of the same material as the nuts.

2.08 GASKETS

- A. Gaskets for flanged end valves shall be as specified for the piping to which the valve is connected.

2.09 SPARE PARTS

- A. The Contractor shall provide the following spare parts for each valve:

Quantity	Description
1	Main Valve elastomer kit
1	Strainer element
1	Pilot Valve Overhaul kits (rubber parts and hardware)

- B. The Contractor shall pack spare parts in a wooden box and label with parts' description and vendor name, address, and telephone number.

PART 3 EXECUTION

3.01 LINING AND COATING

- A. The Contractor shall coat valves the same as the adjacent piping. If the adjacent piping is not coated, then coat in accordance with Section 09900, Painting and Coating, System No. 10. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in the field. Finish coat shall match the color of the adjacent piping.
- B. The Contractor shall line valves with an NSF 61 approved 2 part high build epoxy with 10 to 12 mils.
- C. The Contractor shall not coat seating areas, bronze or stainless steel pieces, or stainless steel pilot system.

3.02 INSTALLATION

- A. The main valve and the pilot control system shall be factory assembled and tested to determine conformance with the requirements of this Specification section.
- B. All settings shall be factory pre-set and verified/adjusted in the field.

- C. All valves shall be installed at the location shown in the Drawings, unless the Engineer accepts an alternate location submitted by the Contractor, true to alignment and rigidly supported.
- D. Valves shall be installed according to the valve manufacturer's instructions.

3.03 VALVE LEAKAGE FIELD TESTING

- A. The Contractor shall test valves for leakage at the same time that the connecting pipelines are tested. Valves shall show zero leakage. The Contractor shall repair or replace any leaking valves and retest.

END OF SECTION

SECTION 15125
PIPING APPURTENANCES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install complete and ready for operation all piping appurtenances as shown on the Drawings and as specified in this Section.
- B. All piping appurtenances shall be of the size shown on the Drawings. All equipment of the same type shall be from one manufacturer, unless authorized in writing by the Engineer.
- C. All piping appurtenances shall have the name of the manufacturer and the working pressure for which they are designed cast in raised letters upon the body.
- D. The piping appurtenances shall include, but not be limited to, the following:
 - 1. Emergency Shower/Eyewash and Face/Eyewash Station

1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance.
- B. Section 09900, Painting and Coating.
- C. Section 15055, Piping Systems—General.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product technical submittal data shall contain the following information and data:
 - 1. Acknowledgment that products submitted meet requirements of standards referenced.
 - 2. Manufacturer's installation instructions.
 - 3. Expansion joints, flexible joints, couplings, adaptors, tapping sleeves, and other appurtenances:

- a. Pressure and temperature rating.
- b. Materials of construction.
- c. Linings.
- d. Dimensions and weight.
- e. Accessories.
- f. Manufacturer's product brochures, cut-sheets, and parts diagrams.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Iron and Steel Institute (AISI)

1. AISI Type 304L—Stainless Steel.
2. AISI Type 316—Stainless Steel.

B. American Society for Testing and Materials (ASTM)

1. ASTM A536—Standard Specification for Ductile Iron Castings.
2. ASTM C285—Standard Test Methods for Sieve Analysis of Wet-Milled and Dry-Milled Porcelain Enamel.

C. American Water Works Association (AWWA)

1. AWWA/ANSI C105/A21.5—Polyethylene Encasement for Ductile-Iron Pipe Systems.
2. AWWA/ANSI C153/A21.53—Standard for Ductile-Iron Compact Fittings for Water Service.
3. AWWA C207—Standard for Steel Pipe Flanges for Waterworks Service.
4. AWWA C210—Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
5. AWWA/ANSI C213—Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
6. AWWA C500—Standard for Metal-Seated Gate Valves for Water Supply Service.
7. AWWA C502—Standard for Dry-Barrel Fire Hydrants.
8. AWWA C700—Standard for Cold-Water Meters—Displacement Type, Bronze Main Case.
9. AWWA C800—Transit-Time Flowmeters in Full Closed Conduits.

D. American National Standards Institute (ANSI)

1. ANSI B16.5—Pipe Flanges and Flanged Fittings.

E. National Sanitation Foundation (NSF)

1. NSF 61—Drinking Water System Components - Health Effects.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, HANDLING, AND STORAGE

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. All piping appurtenances, unless otherwise directed, shall be loaded and unloaded by lifting, and under no circumstances shall any piping appurtenances be dropped, skidded, or rolled.
- C. Slings, hooks, or tongs used for lifting shall be padded to prevent damage to exterior surface or interior linings of piping appurtenances. If any part of the coating, lining, or components is damaged, the Contractor shall make repairs or replacement at his expense and in a manner satisfactory to the Engineer before attempting to install such piping appurtenances.
- D. Only new piping appurtenances will be allowed for installation and shall be stored to prevent damage and be kept free of dirt, mud, or other debris.

1.09 QUALIFICATIONS

- A. All of the piping appurtenances shall be products of well-established firms that are fully experienced, reputable, have been selling this product for a minimum of 10 years, and qualified in the manufacture of the particular product furnished. The piping appurtenances shall be designed, constructed, and installed in accordance with the requirements and procedures of applicable AWWA standards and shall comply with these Specifications as applicable.

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals.

PART 2 PRODUCTS

2.01 EMERGENCY SHOWER/EYEWASH AND FACE/EYEWASH STATION

- A. The emergency shower shall be a drench shower with a large stainless-steel arm and pull rod with large, easy-to-find triangle handle. Eyewash shall be activated with a foot treadle for hands-free operation or with a large push flag. The face wash will have an antisurge design and spray ring to wash the entire face. All valves shall stay open until manually closed. The facility must meet current ANSI standards and OSHA requirements. The unit shall be a Haws Corporation Model 8300 or approved equal.

2.02 TOOLS

- A. If required for normal operation and maintenance, special tools shall be supplied with the equipment. Two T-handle wrenches to operate standard 2-inch nuts on buried valves and buried valve actuators shall be provided as part of the work.

PART 3 EXECUTION

3.01 INSTALLATION

- A. The Contractor shall install all piping appurtenances as shown on the Drawings.
- B. All piping appurtenances shall be installed in the location shown, unless approved otherwise, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Owner and the Engineer.
- C. Install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures which have a direct bearing on their location and shall be responsible for the proper location of these piping appurtenances during the construction of the structures.

3.02 SHOP PAINTING

- A. Exterior surfaces of ferrous valves and piping appurtenances shall be painted in accordance with Section 09900, Painting and Coating, unless noted or specified otherwise.

3.03 INSPECTION AND TESTING

- A. Completed valves and piping appurtenances shall be subjected to hydrostatic pressure test as described in Section 15055, Piping Systems—General, and the detail pipe sections of these Specifications. All leaks in valves and piping appurtenances shall be repaired and lines retested as approved by the Engineer. Before testing, the valves and pipelines shall be supported and thrust restrained for forces in excess of the test pressure to prevent movement during tests.

END OF SECTION

SECTION 15145
DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes requirements for the following domestic water piping specialties:
1. Vacuum breakers.
 2. Backflow preventers.
 3. Water pressure-reducing valves.
 4. Temperature-actuated water mixing valves.
 5. Hose bibbs.
 6. Water-hammer arresters.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE

A. Comply as follows:

1. 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.
2. NSF Compliance:
 - a. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

1.07 WARRANTIES

- ### A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- ### A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS

Testing requirements shall be as follows:

- ### A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- ### A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals.

PART 2 PRODUCTS

2.01 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include but are not limited to the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Conbraco Industries, Inc.
 - c. MIFAB, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Woodford Manufacturing Company.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.

4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.02 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to the following:
 - a. FEBCO; SPX Valves & Controls.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size: As indicated on Drawings.
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
10. The interior of the backflow preventer shall be epoxy coated in accordance with AWWA C550 and be NSF approved. Backflow preventer shall be

equipped with a thermally activated valve set for freeze protection installed on the downstream side of the backflow preventer. Thermally activated valve shall be Crispin Model TAVS or approved equal.

11. Manufacturer-recommended flow range of each unit shall be provided in the shop drawing submittal. The reduced-pressure backflow preventer shall be installed where its discharge will not be objectionable or will not cause a safety hazard and where it can be positively drained away from the unit when installed within a structure. When the preventer is installed in a structure, the Contractor shall provide a 12-inch air gap accessory and a drain pipe in the floor slab, connected to the RPBP air gap accessory, to drain the RPBP discharge to the closest floor drain.

B. Hose-Connection Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water (30-kPa) back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm (0.19-L/s) flow.

2.03 TEMPERATURE-ACTUATED WATER-MIXING VALVES

A. Water-Temperature-Limiting Devices:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.

- d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a Watts Industries Co.
 - h. Symmons Industries, Inc.
 - i. Taco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig.
 - 4. Type: Thermostatically controlled water-mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded union inlets and outlet.
 - 7. Accessories: Check stops on hot- and cold-water supplies and adjustable temperature-control handle.
 - 8. Valve Finish: Rough bronze.

2.04 HOSE BIBBS

A. Hose Bibbs (HB-1):

- 1. Standard: ASME A112.18.1 for sediment faucets.
- 2. Body Material: Bronze.
- 3. Seat: Bronze, replaceable.
- 4. Supply Connections: NPS ½ or NPS ¾ threaded or solder-joint inlet.
- 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
- 6. Pressure Rating: 125 psig.
- 7. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
- 8. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.05 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 EXECUTION

3.01 INSTALLATION

To ensure proper installation the Contractor shall do the following:

- A. Install water regulators with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- B. Install water hammer arresters in water piping according to PDI-WH 201.
- C. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1% and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according with Division 16 Sections.
- C. Connect wiring according with Division 16 Sections.

3.03 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Supply-type trap-seal primer valves.

3.04 FIELD QUALITY CONTROL

- A. The Contractor shall perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
 - 2. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

- A. Set field-adjustable pressure set points of water-pressure-reducing valves.

END OF SECTION

SECTION 15146
HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Description: The Contractor shall provide all materials and incidentals, including piping, molded and ductile iron fittings, flanged adapters, flanged joints, mechanical joint adapters, hardware, and appurtenances for the HDPE piping systems shown on the Drawings and the Drawing Process Flow Identification.

1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 02240, Dewatering.
- D. Section 02300, Earthwork.
- E. Section 15055, Piping Systems—General.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance and Section 15055, Piping Systems—General.

- A. In general, shop drawings and related manufacturer's product certification shall be made in accordance with the General and Special Conditions of the Contract for approval before the manufacturer constructs or fabricates the material. The following items, which require shop drawings, are brought to the Contractor's attention. The list may not include all items for which shop drawing submittals are required to meet the requirements of the project.
 - 1. Detail drawings of all classes of pipe, joints, and fittings.
 - 2. Detail Drawings of all joints, including manufacturer's certified factory and/or laboratory test reports to confirm thrust-restraint capacities and restraining mechanism application.
 - 3. Existing piping connection details.
 - 4. Adapters for connection to mechanical joint valves and ductile iron pipe fittings.

- B. Certification and test reports for the materials, manufacturing, and testing of the types of pipe supplied shall be furnished by the HDPE pipe manufacturer for the manufacturer's own products in accordance with the latest standards of the industry as described in this Section.
- C. Provide a statement in writing from the HDPE pipe manufacturer that the manufacturer is listed with the Plastic Pipe Institute as a qualified extruder for the polyethylene resin to be used in the manufacture of the pipe for this project.
- D. All persons making heat fusion joints shall receive training in the manufacturer's recommended procedures. The Contractor shall maintain records of trained personnel and certify that training was received not more than 12 months before construction began. Additionally, the Contractor shall have worked on one or more projects involving combined installation of at least 10,000 feet of HDPE butt-fusion-welded pipe and shall provide the Engineer with a written list of HDPE pipeline installation experience, including project location, date, Owner, and personnel assigned and installing on this project.
- E. The pipe manufacturer shall certify in writing that the Contractor is qualified to join, lay, and pull the pipe or representative of the pipe manufacturer shall be onsite to oversee all pipe joining. All costs for the manufacturer's representative shall be paid for by the Contractor.
- F. The Contractor shall provide qualifications of the proposed firm to be used to clean, inspect, and videotape HDPE piping for record purposes. The Contractor shall submit a video record on DVD when the system is complete. The DVD shall be clearly labeled with the video inspection date, pipe starting and ending point, name, address, and phone number of firm performing the videotaping. Each section of pipe that is video inspected shall have a complete dialogue dubbed onto the video recording that at a minimum describes the length of pipe videotaped, the location of pipe videotaped, all welds, any deflections, and other features of interest.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American National Standards Institute (ANSI)
 - 1. ANSI A21-51—Ductile Iron Pipe.
- B. American Society for Testing and Materials (ASTM) Standards
 - 1. ASTM A307—Standard Specification for Standard Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 2. ASTM D3261—Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - 3. ASTM D3350—Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 - 4. ASTM D4976—Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
 - 5. ASTM F714—Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- C. American Water Works Association (AWWA)
 - 1. AWWA C901—Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch (13 mm) through 3-Inch (76 mm), for Water Service.
 - 2. AWWA C906—Polyethylene (PE) Pressure Pipe and Fittings, 4-Inch (100 mm) through 63-Inch (1,600 mm), for Water Distribution and Transmission.
- D. International Organization for Standardization (ISO)
 - 1. ISO 9001—Quality Management Systems – Requirements.

1.06 QUALITY ASSURANCE

- A. The pipe and fitting manufacturer(s) shall have an established quality-control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rated, and contamination. The cell classification properties of the material shall be certified by the supplier and verified by the manufacturer's quality control.

1.07 WARRANTIES (NOT USED)

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, and Section 15055, Piping Systems—General for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals and Training.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

A. General

1. All HDPE shall be DriscoPlex PE 3408 HDPE; or approved equal.
2. All HDPE pipe 4 inches in diameter or greater shall have a Ductile Iron Pipe outside diameter, and HDPE pipe 3 inches in diameter and smaller shall be IPS unless otherwise specified or shown in the Drawings.
3. All HDPE piping system components shall be the products of one manufacturer.
4. Pipe and fittings shall be manufactured by an ISO 9001-certified manufacturer.

B. HDPE Pipe

1. HDPE pipe 4 inches in diameter and larger shall conform to material standard ASTM D3350 345434 E cell classification rated as PE 3408 by the Plastics Pipe Institute. Minimum pressure rating shall be in accordance with Piping Schedule Drawing or as specified in this Section. Minimum pressure rating shall be 100 psi SDR 17 (Standard Dimension Ratio) for

pipe sizes greater than 4 inches in diameter. For pipe sizes 3 inches and smaller in diameter, the minimum pressure rating shall be 200 psi SDR 9.

2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light.
3. The maximum allowable hoop stress shall be 800 psi at 73.4°F.
4. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the requirements of the resin manufacturer to manufacture pipe from the resin used.

C. Perforated HDPE Pipe for Leachate Collection and Leak Detection Systems

1. Perforated HDPE pipe shall conform to the requirements specified for HDPE pipe.
2. Perforations shall be drilled into the pipe at the pipe extrusion plant or fabrication shop. Any burrs remaining after drilling shall be removed. Perforations shall be drilled and deburred before the pipe is delivered to the job site. Job site perforation or perforation by the Contractor shall not be permitted.
3. Number of perforations: Unless indicated otherwise on the Drawings, pipe perforations shall be 3/8-inch diameter ($\pm 1/16$ inch) on 3-inch ($\pm 1/4$ inch) centers down the length of the pipe. For the 8-inch leachate collection pipe there shall be three holes spaced at 120° ($\pm 5^\circ$) around the perimeter of the pipe and the rows shall be parallel to the pipe axis. The 24-inch leachate collection and detection pipe shall have three holes spaced at 60° ($\pm 5^\circ$) within the bottom 120° of the pipe perimeter and the rows shall be parallel to the pipe axis.

D. Fittings

1. The pipe manufacturer shall mold or fabricate the polyethylene fittings. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe.
 - a. Molded Fittings: Molded fittings shall be manufactured in accordance with ASTM D3261 and shall be so marked. Each production lot of molded fittings shall be subjected to the test required under ASTM D3261. The manufacturer shall submit

samples from each molded fitting production lot to x-ray inspection for voids and shall certify that voids were not found.

(1) Polyethylene Flange Adapters: Flange adapter shall be made with sufficient throughbore length to be clamped in a butt fusion joining machine without the use of a subend holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to restrain the gasket against blow-out. Flange adaptors shall be fitted with ductile-iron backup rings pressure rated equal to or greater than the mating pipe. The Contractor shall provide flat ring-type gaskets with gasket thickness and hardness as recommended by the pipe manufacturer for use with HDPE flanged joints. Provide carbon steel hardware (bolts, nuts, washers, etc.) conforming to ASTM A307, Grade B for use with the flange adapters assemblies in accordance with the pipe manufacturer's recommendations. Gaskets shall be made from material suitable for exposure to the liquid within the pipe.

b. Fabricated Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full-service pressure rating of the mating pipe. Pressure de-rated fittings are not acceptable. Directional fittings 16 inches IPS and larger, such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets.

2. D.I./HDPE Mechanical Joint Adaptors.

a. The manufacturer of the HDPE pipe shall supply all D.I./HDPE mechanical joint adaptors and accessories required to connect plain-end HDPE piping to mechanical joint fittings, valves, and appurtenances.

b. The D.I./HDPE mechanical joint adaptor shall consist of:

- (1) A molded or fabricated HDPE mechanical joint transition fitting.
- (2) A gasket for a D.I. mechanical joint.
- (3) A ductile iron mechanical joint backup drive ring.
- (4) Cor-Ten mechanical joint tee bolts.

- (5) A stainless-steel sleeve stiffener molded or fabricated within the MJ end of the HDPE mechanical joint adaptor fitting.
- c. The D.I./HDPE mechanical joint adaptor shall be connected to the HDPE pipe by a heat-fused joint on one end and connected to a ductile iron pipe valve, fitting, or appurtenance with the internally stiffened mechanical joint end.
- d. The tee bolts and backup drive ring shall act as a joint restraint for connections to mechanical joints.
- e. The HDPE mechanical joint adaptor fitting shall be molded or fabricated by the manufacturer of the HDPE pipe. All molded fittings shall be fully pressure rated to match the SDR pipe pressure rating. Fabricated fittings shall be rated for internal pressure service equivalent to the full pressure rating of the mated IPS pipe.
- f. If rework compounds are required, only those generated in the manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.
- g. Solvent epoxy cementing and mechanical joining with bolt on wrap-around clamps shall not be used.
- 3. Ductile-iron fittings connected to SDR 17 HDPE pipe (4 inches and larger) shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.

E. HDPE Pipe Jointing Method

- 1. HDPE pipe shall be jointed by butt fusion in accordance with the pipe manufacturer's directions and only for pipe within one SDR ratio of each other.
- 2. For SDR ratios that are two or more apart (i.e., SDR 21 to an SDR 11), the joint shall be made using a restrained joints. Same-diameter pipe may be joined by using HDPE flange adapters and backup rings bolted to each other.
- 3. All HDPE pipe joined by butt fusion shall be made from the same class and type of raw material made by the same raw material supplier.

4. *Butt fusion* means the butt joining of the pipe by heat fusion aligned faces of the pipe ends (butts) in a suitable apparatus and joining under controlled pressure and alignment.
5. The external bead resulting from the butt-fusion process shall be visible and examined for complete butt-fusion 360° around the pipe exterior.
6. Short spools of pipe between valves and fittings shall be ductile iron pipe, with all joints restrained for sizes 4 inches and larger. For 2-inch, the spool shall be Schedule 40 Type 304 stainless steel piping or Schedule 80 PVC piping with IP threads stainless steel or PVC fittings and all joints restrained.
7. Where approved by the Engineer, the HDPE pipe and fittings may be fused with Electrofusion Couplings, as manufactured by Central Plastics Company, or approved equal. Technical information must be provided to demonstrate that the fused coupling will not compromise the structural integrity of the HDPE pipe.

2.02 LOCATOR WIRE

- A. All HDPE piping shall be installed with detectable pipeline marking tape for location purposes as specified in Section 15055, Piping Systems—General.

PART 3 EXECUTION

3.01 GENERAL

- A. All polyethylene pipe shall be cut, fabricated, joined, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with HDPE pipe.

3.02 LAYING PIPE

- A. Joints
 1. All HDPE to HDPE pipe joints shall be joined by heat fusion that produces homogeneous, sealed, leak-tight joints.
 2. Restrained mechanical joint adaptors shall be provided at tie-ins with valves, ductile iron fittings, and other pipe materials.

B. Butt Fusion Testing

1. The Contractor shall test the first fusion of each day.
2. Hot plate temperatures are maintained between 410°F and 420°F.
3. Pipe ends are squarely faced and cuttings are removed before fusion welding occurs.
4. Fusion weld time is approximately 55 seconds.
5. Cooling time of the fusion-welded pipe is approximately 5 minutes before release from the weld machine.
6. Fusion weld rollback (melted HDPE) is approximately 3/8-inch after the pipe ends are jointed.
7. In testing, the fusion shall be allowed to cool completely and then fusion test straps shall be cut out. The test shall be a minimum of 12 inches or 30 times the wall thickness in length with the fusion in the center and a minimum of 1 inch or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. The Contractor shall not begin until a fusion test has passed the bent strap test.
8. Internal fusion beads are removed at the time of welding.

C. Pipe Deflection

1. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane or where long radius curves are permitted, the amount of deflection shall not exceed 75% of that recommended by the manufacturer.

D. Pipe Cutting

1. Cutting HDPE butt fusion connections to HDPE pipe, valves, fittings, or closure pieces shall be done in a neat, workmanlike manner without damaging the pipe. Ends shall be cut square and perpendicular to the pipe axis.

3.03 PERFORATED HDPE PIPING INSTALLATION

- A. All sections of perforated HDPE pipe shall be thoroughly cleaned and deburred after perforating and before welding or delivery to the job site to ensure all drill cuttings are removed from the pipe.
- B. Pipe and fittings shall be joined using butt heat-fusion techniques in accordance with the pipe manufacturer's recommendations unless otherwise noted on the Drawings. Heat-fusion weld beads projecting into the interior of the piping on all solid wall and perforated gravity drain HDPE pipe shall be removed so that the internal weld is flush with the interior of the pipe. The joint must be completely cooled before bead removal. The internal bead shall be removed before making the next butt fusion.
- C. Pipe shall be installed in gravel fill as specified in Section 02300, Earthwork. Backfill operations are conducted in accordance with the technical specifications and backfilling requirements of this manual.
- D. Perforated pipe shall be installed in accordance with Drawing details and as specified for HDPE pipe.
- E. Before final acceptance, completely flush and clean all parts of the system. Flushing water shall be disposed of properly. Flushing water shall not be discharged to the leachate storage tanks. The leachate collection and leak detection pumps shall not be used to handle water resulting from flushing operations. Remove all accumulated construction debris, rocks, sand, gravel, and other foreign material.

3.04 TESTING AND LEAKAGE

- A. Hydrostatic Tests—General
 - 1. All field tests shall be made in the presence of the Owner or Engineer. Except as otherwise directed, all pipelines shall be tested. All piping to operate under liquid pressure shall be tested in sections of approved length, typically from valve to valve and in no case longer than 1,000 feet.
 - 2. Hydrostatic testing shall consist of a combined pressure test and leakage test. The field test pressure shall be as indicated on the Drawing Flow Stream Identification Table on the Drawings, measured at the lowest point of the section being tested. The pressure shall be applied by a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connection, and all necessary apparatus shall be furnished by the Contractor and shall be subject to the satisfaction of the Engineer.

3. The maximum duration for any test, including initial pressurization, initial expansion, and time at test pressure, must not exceed 8 hours. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section and allow it to “relax” for at least 8 hours before bringing the test section up to test pressure again.
4. Monitored Make-Up Water Test: The test procedure consists of initial expansion and test phases.
 - a. During the initial expansion phase, the test section is filled with water. Once the line is filled, make-up water is added at hourly intervals as required to maintain the test pressure for 3 hours.
 - b. At the end of the initial expansion period, the addition of make-up water will cease. During the test phase the pipe will not have any water added to it for the following 2 hours. The 2 hours will be the actual leakage test. At the end of the 2-hour period, measured make-up water will be added to the pipe to return it to the original test pressure.
 - c. If the amount of make-up water added is greater than calculated using the numbers listed below, the section being tested will be considered to have a leak. The leak shall be found and fixed at the Contractor’s expense and that section of the line retested before continuing with subsequent leakage tests. Testing and repairs shall be repeated at the Contractor’s expense until the amount of make-up water is less than the amount calculated using the numbers listed below.

ALLOWABLE FOR EXPANSION UNDER TEST PRESSURE*
POLYETHYLENE PIPE

Nominal Pipe Size (in.)	Allowances for Expansion (US Gal/100 Feet of Pipe)		
	1-Hour Test	2-Hour Test	3-Hour Test
2	0.08	0.12	0.15
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.3	2.1
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
24	4.5	8.9	13.3
30	6.2	12.6	19.1
36	9.0	18.0	27.0
42	12.0	24.0	36.0
48	15.0	27.0	43.0

These allowances only apply to the test phase and not to the initial expansion phase.

B. Video Inspection

1. All HDPE gravity piping (solid wall and perforated) shall be jet cleaned and then video inspected before final inspection. The Contractor shall provide all equipment and labor for such cleaning and inspection. Any Subcontractor must be approved by the Owner before work can begin.
2. Video inspection shall be performed after cleaning and pressure testing (when pressure testing is required) the pipe. If cleaning and video inspection of each pipe run from its respective cleanout is not possible, the Contractor shall correct installation deficiencies to allow cleaning and video inspection of the entire length.
3. Digital video recordings shall be taken of all inspections. The Contractor shall prepare a DVD video record of the inspection for submission as detailed in Paragraph 1.03F. The DVD shall be accompanied by an inspection log in addition to a summary report.

END OF SECTION

SECTION 15150
SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes requirements for the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM D2321—Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 2. ASTM D2665—Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - 3. ASTM D3311—Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns.

B. American Water Works Association (ASME)

1. AWWA C110—Standard for Ductile-Iron and Gray-Iron Fittings.
2. AWWA C111—Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C153—Standard for Ductile-Iron Compact Fittings for Water Service.

C. National Sanitation Foundation (NSF)

1. NSF 14—Drinking Piping Systems Components and Related Materials.

1.06 QUALITY ASSURANCE

- A. Piping materials shall bear a label, stamp, or other markings of the specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS

- A. Components and installation shall be able to withstand the following minimum working pressure, unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.11 MAINTENANCE (NOT USED)

1.12 RECORD DRAWINGS (NOT USED)

1.13 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals.

1.14 DEFINITIONS

- A. *PVC*: Polyvinyl chloride plastic.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to the manufacturers specified.

2.02 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D2665, socket type, made to ASTM D3311, drain, waste, and vent patterns.

2.04 SPECIAL PIPE FITTINGS

- A. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20° deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts:

- 1. Available Manufacturers:

- a. SIGMA Corp.

PART 3 EXECUTION

3.01 EXCAVATION

- A. Refer to Section 02300, Earthwork.

3.02 PIPING APPLICATIONS

- A. Aboveground soil and waste piping shall be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- B. Aboveground vent piping shall be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Underground soil, waste, and vent piping shall be the following:
 - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.03 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Section 02530, Pipework, Gravity Sewers.
- B. Basic piping installation requirements are specified in Section 15053, Common Work Results for HVAC.
- C. The Contractor shall install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install a wall-penetration fitting at each service pipe penetration through foundation wall. Make the installation watertight.

- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double-Y branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90°. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing the size of drainage piping in the direction of flow is prohibited.
- F. Lay buried building drainage piping beginning at the low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to the manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2% downward in the direction of flow for piping NPS 3 and smaller; 1% downward in the direction of flow for piping NPS 4 and larger.
 - 2. Vent Piping: 1% down toward the vertical fixture vent or toward the vent stack.
- H. Install PVC soil and waste drainage and vent piping according to ASTM D2665.
- I. Install underground PVC soil and waste drainage piping according to ASTM D2321.
- J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Section 15053, Common Work Results for HVAC.
- B. PVC Nonpressure Piping Joints: Join piping according to ASTM D2665.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Section 15055, Piping Systems—General. Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42 clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. MSS Type 1, adjustable, steel clevis hangers.
- B. Install supports according to Section 15055, Piping Systems—General.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches with 3/8-inch rod.
 - 2. NPS 3 (DN 80): 48 inches with 1/2-inch rod.
 - 3. NPS 4 and 5 (DN 100 and 125): 48 inches with 5/8-inch rod.
 - 4. NPS 6 (DN 150): 48 inches with 3/4-inch rod.
- F. Install supports for vertical PVC piping every 48 inches.
- G. Support piping and tubing not listed above according to MSS SP-69 and the manufacturer's written instructions.

3.06 CONNECTIONS

- A. The Drawings indicate the general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide a shutoff valve, if indicated, and a union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

3.07 FIELD QUALITY CONTROL

- A. During installation the Contractor shall notify authorities having jurisdiction at least 24 hours before inspection must be made. The Contractor shall perform the tests specified below in the presence of authorities having jurisdiction:
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspection, the Contractor shall make the required corrections and arrange for reinspection.
- C. Reports: The Contractor shall prepare inspection reports and have them signed by authorities having jurisdiction.
- D. The Contractor shall test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection to the completion of inspection, the water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave the building. Introduce air into the piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in the trap of the water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout the inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping or portions of piping until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.08 CLEANING

To ensure proper cleaning the Contractor shall do the following:

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during the remainder of construction to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at the end of day and when work stops.

3.09 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint. Paint and flashing shall match the color of the adjacent roofing.

END OF SECTION

SECTION 15155
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall provide all materials and incidentals, including piping, fittings, flanged joints, mechanical joints, retainer glands, polyethylene bagging for buried ductile iron piping, fittings, valves, and appurtenances for the ductile iron piping systems required for the work shown on the Drawings, in the Drawing—Piping Schedule, and described in Section 15055, Piping Systems—General.

1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 02300, Earthwork.
- D. Section 09900, Painting and Coating.
- E. Section 15055, Piping Systems—General.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. All ductile iron pipe and fittings to be installed under this Contract shall be inspected and tested at the foundry where the material for this project is manufactured. The Contractor shall submit sworn certificates of such tests and their results.
- B. The Contractor shall submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American National Standard Institute (ANSI)

1. ANSI A21.11—Rubber Gasket Joints Cast & Ductile Iron Pressure Pipe.
2. ANSI A21.53—Ductile-Iron Compact Fittings, 3-Inch through 24-Inch (76 mm through 610 mm) and 54-Inch through 64-Inch (1,400 mm through 1,600 mm), for Water Service.
3. ANSI B1.1—Unified Inch Screw Threads (UN & UNR Thread Form).
4. ANSI B16.1—Cast Iron Pipe Flanges and Pipe Fittings.
5. ANSI B16.21—Nonmetallic Flat Gaskets for Pipe Flanges

B. American Society for Testing and Materials (ASTM)

1. ASTM A193—Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
2. ASTM A194—Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both.
3. ASTM A307—Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
4. ASTM A536—Standard Specification for Ductile Iron Castings.
5. ASTM A563—Standard Specification for Carbons and Alloy Steel Nuts.
6. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
7. ASTM C150—Standard Specification for Portland Cement.
8. ASTM C283—Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
9. ASTM D714—Standard Test Method for Evaluating Degree of Blistering of Paints.
10. ASTM D792—Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
11. ASTM D1238—Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
12. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
13. ASTM G95—Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).

C. American Water Works Association (AWWA)

1. AWWA C104—Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110—Ductile-Iron and Gray-Iron Fittings, 3-Inch through 48-Inch (75 mm through 1200 mm) for Water and Other Liquids.

3. AWWA C111—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115—Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C150—Thickness Design of Ductile-Iron Pipe.
6. AWWA C151—Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
7. AWWA C153—Ductile-Iron Compact Fittings, 3-Inch through 16-Inch (76 mm through 610 mm), for Water and Other Liquids.
8. AWWA C207—Steel Pipe Flanges for Waterworks Service Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).
9. AWWA C600—Installation of Ductile-Iron Water Mains and their Appurtenances.

D. International Organization for Standardization (ISO)

1. ISO-9001—Quality Systems – Model for Quality Assurance in Production, Installation, and Servicing.

E. NSF International (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

1.06 QUALITY ASSURANCE

A. Source Quality Control:

1. The ductile iron pipe manufacturer shall submit certification that the pipe and fitting products meet all tests required by AWWA C151.
2. All materials shall be new and have a manufacturer's certificate verifying compliance to all tests and inspections as required in this Section. The weight, class, and casting period shall be shown on each piece of pipe. The manufacturer's "mark," the year produced, and the word "Ductile" or the letters "DI" shall be cast or stamped on all pipe.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals Training.

PART 2 PRODUCTS

2.01 GENERAL

- A. All ductile iron piping shall be designed and manufactured in accordance with AWWA C150 and AWWA C151 for the following minimum operating conditions:
 - 1. The minimum internal design pressure shall be 150 psi with a 100-psi surge allowance, with a safety factor of 2, for a total internal design pressure of 500 psi.
 - 2. The external loads design criteria shall be for the minimum cover indicated on the Drawings at 120 lb per cubic feet soil weight and live load based on one AASHTO H-20 truck load. The thickness design of ductile iron pipe shall be in accordance with AWWA C150.
 - 3. The horizontal deflection of cement-mortar-lined ductile iron pipe resulting from external load conditions shall not exceed 3% of the pipe diameter based on the trench design shown on the Drawings.
 - 4. Pressure Class: All ductile iron piping shall meet the following minimum working pressure classes:
 - a. 4 inch through 12 inch: 350 psi

2.02 JOINTS

- A. Ductile iron fittings shall be furnished with push-on joint, mechanical joints, and flanged joint ends as shown on the Drawings and specified in this Section:
1. Push-On Joints: Push-on joints shall conform to ANSI A21.11/AWWA C111. Gaskets shall be Viton.
 2. Mechanical Joints: All buried ductile iron fittings shall be furnished with mechanical joint ends unless noted otherwise. Mechanical joints shall conform to ANSI A21.11/AWWA C111. Glands shall be constructed of ductile iron.
 3. Flanged Joints: Pipe for threaded flange fabrication shall be Special Thickness Class 53 in accordance with AWWA C110, AWWA C111, and AWWA C115. Bolt circle and bolt holes shall match those of ANSI B16.1 Class 125 flanges. The flanges shall be rated for a maximum working pressure of 250 psi. Threaded flanges shall be individually fitted and machine tightened on the pipe ends. Flange facing shall be smooth or with shallow serrations in accordance with AWWA C115.

2.03 FITTINGS

- A. General: Ductile iron pipe fittings shall be the compact type meeting the requirements of ANSI/AWWA C110 and C153 where applicable. Fittings shall be cement lined and seal coated. Fittings shall be manufactured in accordance with ANSI/AWWA C110. Where taps are shown on fittings, tapping bosses shall be provided. At a minimum, fittings shall have the same pressure rating as the connecting pipe.
1. Flanged Joint: ANSI/AWWA C110/21.10 and ANSI B16.1, faced and drilled 125-pound ANSI standard.
 2. Mechanical Joint: ANSI/AWWA C110/A21.10
 - a. Provide mechanical joint fittings for all buried fittings as shown in the Drawings, unless noted otherwise.
 - b. Provide specified gaskets.

2.04 LINING AND COATING

- A. Ductile iron pipe shall be cement lined as specified below. The Contractor shall perform all field measurements confirming the accuracy of the piping sizes and

lengths shown on the Drawings. The Contractor shall notify the Engineer immediately before deviating from or altering the lining of ductile iron piping shown on the approved layout schedule.

- B. Cement-Lined Ductile Iron Pipe and Fittings: Interior surfaces of all cement-lined ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with a standard thickness cement-mortar lining applied in conformity with AWWA C104, Portland cement mortar. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the Contractor shall repair or replace damaged or unsatisfactory portions with lining conforming to these Specifications at no additional cost to the Owner. Pipe linings for potable water lines shall be NSF 61 approved.

All ductile iron pipe and fittings cement-mortar linings shall be surface sealed with an asphaltic seal coating, 1 mil, in accordance with AWWA C104.

2.05 MANUFACTURERS

- A. Acceptable ductile iron pipe manufacturers include US Pipe, American Ductile Pipe, Griffin Pipe, or approved equal.

2.06 BOLTS

- A. General: The Contractor shall provide carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts. Threads shall be as specified in ANSI B1.1 coarse thread series, Class 2A external and Class 2B internal. Nuts, bolts, and gaskets for flanged fittings and blind flanges shall be designed to withstand the design and test pressure ratings for the pipe.

2.07 GASKETS

- A. Gaskets for mechanical joints shall be compatible with raw water pipe service. See Section 15055, Piping System—General for gasket requirements.
- B. Gaskets for flanged joints shall be 1/8-inch-thick, cloth-inserted rubber conforming to applicable parts of ANSI B16.21 and AWWA C207. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in sewage and reclaimed water lines. Gaskets shall be full-face type for 125-pound flanges.

2.08 RETAINER GLANDS

- A. Retainer glands shall be provided for all buried ductile-iron mechanical joints, fitting, and ductile-iron pipe connections to buried valves. Retainer glands shall

be designed for joint retaining through the use of a follower gland and set screw-anchoring devices that impart multiple wedging action against the pipe. The mechanical joint-restraint device shall be UL listed and shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

1. Gland: Manufactured of ductile iron conforming to ASTM A536. Gland dimensions shall match ANSI A21.11 and A21.53.
2. Restraining Devices: Manufactured of ductile iron heat treated to a minimum hardness of 370 BHN. Restraining devices shall incorporate a set screw/twist-off nut bolt to ensure the proper actuating of the restraining device. The twist-off nut shall be designed to come off at the torque limit desired to anchor the restraining device in place on the pipe.
3. Joint Deflection: Retainer gland joint deflection shall be limited to manufacturer's recommended maximum deflection angle. Joint deflection shall be applied before the set screws are torqued.
4. Acceptable Manufacturers:
 - a. EBAA Iron, Inc. – Megalug 1100 Series.
 - b. Or approved equal.

PART 3 EXECUTION

3.01 HANDLING PIPE AND FITTINGS

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, fitting, lining, and coating. Pipe and fittings shall not be dropped. All pipe and fittings shall be examined before installation, and no piece that the Engineer finds defective shall be installed. The Contractor shall repair any damage to the pipe and fittings coating and/or lining as directed by the Engineer. If the Engineer determines that the coating and/or lining cannot be repaired, the Contractor shall replace the damaged pipe and fittings at no additional compensation.
- B. All pipe and fittings shall be subjected to a careful inspection immediately before installation.
- C. If any defective pipe is discovered after it has been installed, the Contractor shall remove and replace it with a pipe in satisfactory condition at no additional expense to the Owner.

- D. Ceramic epoxy and glass-lined pipe and fittings shall be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.

3.02 PIPE INSTALLATION

- A. The Contractor shall provide and use proper implements, tools, and facilities for the safe and convenient performance of the work. All pipe, fittings, valves, and appurtenances shall be lowered carefully into the trench and at above-grade locations to prevent damage to the pipe, protective coating, lining, and polyethylene bagging. Under no circumstances shall pipeline materials be dropped off or dumped. A trench shall be dewatered before the pipe is installed.
- B. The Contractor shall carefully examine all pipe fittings, valves, and other appurtenances for damage and other defects immediately before installation and before bagging buried ductile-iron pipe. The Contractor shall mark and hold defective materials for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.
- C. The Contractor shall remove all lumps, blisters, and excess coating from the socket and plain ends of push-on joint pipe for buried service. The outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any foreign material before the pipe is laid in trench.
- D. The Contractor shall prevent foreign material from entering the pipe while the pipe is being placed in the trench. During installation, no debris, tools, clothing, or other materials shall be placed in the pipe.
- E. As each length of buried pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
- F. When pipe is not being laid, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. When practical, the plug shall remain in place until the trench is pumped completely dry. Care shall be taken to prevent pipe flotation should the trench fill with water.
- G. Trench width at the top of pipe, bedding conditions, and backfill placement and compaction shall be such that design loadings on the pipe will not be exceeded.
- H. Joint Assembly: Pipe joints shall be assembled in accordance with the manufacturer's instructions and the requirements of ANSI/AWWA C600.

1. Flanged Joint: Before connecting flanged pipe the Contractor shall thoroughly clean all faces of the flanges of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to ensure proper sealing of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.
 2. Push-On, Restrained Joint, or Mechanical Joint: The Contractor shall joint piping in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstance.
- I. Pipe Deflection: When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane or where long radius curves are permitted, the amount of deflection shall not exceed that shown in ANSI/AWWA C600 and that recommended by the retainer gland manufacturer for mechanical joint pipe and fittings.
 - J. Pipe Cutting: For inserting valves, fittings, or closure pieces pipe shall be cut in a neat, workmanlike manner without damaging the pipe or lining. Ductile cast iron may be cut using an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw, milling wheel saw, or oxyacetylene torch. Cut ends and rough edges shall be ground smooth, and for push-on joint connections the cut end shall be beveled.

3.03 ABOVE-GROUND PIPE INSTALLATION

- A. The Contractor shall install pipe in horizontal or vertical planes, parallel or perpendicular to building surfaces unless otherwise shown. Support pipe and fittings to prevent strain on joints, valves, and equipment. Install flanged joints so that contact faces bear uniformly on the gasket. Tighten bolts in accordance with the pipe manufacturer's recommendations.

3.04 SURFACE PREPARATION AND PAINTING

- A. All exposed pipe and fittings shall be painted as specified in Section 09900, Painting and Coating.

- B. All buried steel bolts, nuts, washers, rods, harnesses, clamps, sleeves, and appurtenances shall be painted with System No. 21 as specified in Section 09900, Painting and Coating.

END OF SECTION

SECTION 15183
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on the manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, at a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a

part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing of Materials (ASTM)
 - 1. ASTM B32—Standard Specification for Solder Metal.
 - 2. ASTM B280—Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 3. ASTM B828—Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
- B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
 - 1. ASHRAE 15—Safety Standard for Refrigeration Systems.
 - 2. ASHRAE 34—Designation and Safety Classification of Refrigerants.
- C. American Society of Mechanical Engineers (ASME)
 - 1. ASME B16.22—Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B31.5—Refrigeration Piping and Heat Transfer Components.
- D. American Welding Society (AWS)
 - 1. AWS A5.8—Specification for Filler Metals for Brazing and Braze Welding.

1.06 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, “Safety Code for Refrigeration Systems.”
- B. Comply with ASME B31.5, “Refrigeration Piping and Heat Transfer Components.”

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS (NOT USED)

1.13 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-22.
 - 1. Suction Lines for Air-Conditioning Applications: 185 psig.
 - 2. Suction Lines for Heat-Pump Applications: 325 psig.
 - 3. Hot-Gas and Liquid Lines: 325 psig.
- B. Line Test Pressure for Refrigerant R-410A.
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 450 psig.
 - 3. Hot-Gas and Liquid Lines: 450 psig.

PART 2 PRODUCTS

2.01 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250°F.

2.02 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to the following:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.
- B. ASHRAE 34, R-22: Monochlorodifluoromethane.
- C. ASHRAE 34, R-410A: Azcotropic mixture of difluorourethane (R-32) and pentafluoroethane (R-125).

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated or in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping adjacent to machines to allow service and maintenance.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- J. Install refrigerant piping in protective conduit where installed below ground.
- K. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- L. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.

3. Install traps and double risers to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- M. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near the expansion-valve bulb.
 - N. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
 - O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
 - P. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
 - Q. Seal pipe penetrations through exterior walls for materials and methods according to Section 07900, Joint Fillers, Sealants, and Caulking.

3.03 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B828 or CDA's *Copper Tube Handbook*.
- B. Brazed Joints: Construct joints according to AWS's *Brazing Handbook*, Chapter "Pipe and Tube."
 1. Use Type BCuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.04 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section 15815, Metal Ducts.
- B. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.

2. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

3.05 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Article 1.13.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gauge throughout duration of test. Test duration shall not be less than 1 hour.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials and retest until satisfactory results are achieved.

3.06 SYSTEM CHARGING

- A. Charge system using the following procedures:
 1. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, the system is ready for charging.
 2. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 3. Charge system with a new filter-dryer core in charging line.

3.07 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning to the system design temperature.

END OF SECTION

SECTION 15250
SMALL-DIAMETER PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall provide small-diameter pipe and fittings (nominal diameters less than 4 inches unless noted otherwise on the Drawings) as shown on the Contract Drawings and described in Section 15055, Piping Systems—General.

1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 02240, Dewatering.
- D. Section 02300, Earthwork.
- E. Section 09900, Painting and Coating.
- F. Section 15055, Piping Systems—General.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance and Section 15055, Piping Systems—General.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American National Standard Institute (ANSI)
 - 1. ANSI B1.20.1—Pipe Threads, General Purpose (Inch).
 - 2. ANSI B16.5—Pipe Flanges and Flanged Fittings.
 - 3. ANSI B16.11—Forge Fittings, Socket-Welding and Threaded.
 - 4. ANSI B18.2.1—Square and Hex Bolts and Screws Inch Series.
 - 5. ANSI B36.10—Welded and Seamless Wrought Steel Pipe.
 - 6. ANSI B36.19M—Welded and Seamless Wrought Steel Pipe.

B. American Society for Testing and Materials (ASTM)

1. ASTM A53—Standard Specification for Pipe, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A90—Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A105—Standard Specification for Carbon Steel Forgings for Piping Applications.
4. ASTM A182—Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
5. ASTM A193—Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and other Special Purpose Applications.
6. ASTM A194—Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
7. ASTM A312—Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
8. ASTM A320—Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
9. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
10. ASTM D1785—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
11. ASTM D2464—Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
12. ASTM D2466—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
13. ASTM D2467—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
14. ASTM D2564—Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
15. ASTM F439—Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
16. ASTM F441—Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
17. ASTM F493—Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
18. ASTM F656—Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

C. Plastic Pipe Institute (PPI)

1. PPI TR31—Underground Installation of Polyolefin Piping.

D. National Sanitation Foundation (NSF)

1.06 QUALITY ASSURANCE

A. Piping materials and manufacturing shall adhere to the standards referenced in Section 15055, Piping Systems—General.

B. The Contractor shall strictly adhere to the manufacturer's written storage, handling, installation, and joining.

1.07 WARRANTIES

A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, and Section 15055, Piping Systems—General for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS

A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals and Training.

PART 2 PRODUCTS

2.01 GENERAL

A. All pipe joints and fittings shall have the same schedule, pressure ratings, thermal resistance, chemical resistance, and other pertinent properties as the pipe being joined or connected. Plastic fittings shall be manufactured of the same resin as used in the manufacture of the pipe being joined.

- B. Each pipe length shall be clearly marked with the manufacturer's name or trademark, applicable ASTM standards, size, pressure rating, and/or schedule.
- C. Provide line size reducing tees for connecting lateral or instrumentation to pipe systems. Seal threaded fittings with Teflon™ tape or Teflon™ paste. Engage threaded fittings in accordance with ASTM A53.
- D. All flange bolts, nuts, and washers shall be AISI Type 304 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts unless noted otherwise. Bolts shall be fabricated in accordance with ANSI B18.2.1 and shall be provided with washers. Treat all bolts with anti-galling compound before assembly.

2.02 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. Pipe: ASTM D1785, manufactured from Class 12454-B rigid PVC compounds with a hydrostatic design stress of 13.8 MPa (2000 psi) designated as PVC 1120. Provide Schedule 80 PVC piping and socket welded fittings and Schedule 80 PVC threaded fittings, unless noted otherwise on the Drawings or in the Specifications.
- B. Joints: Solvent-welded unless flanged or threaded joints are indicated on the Drawings or required for connection to equipment. Solvent cement shall be as specified in ASTM D2564 for PVC pipe and ASTM F493 for CPVC pipe.
- C. Fittings:
 - 1. Solvent-welded: ASTM D2466 or D2467, manufactured from Class 12454-B rigid PVC compound; solvent cement conforming to ASTM D2564. Solvent cement shall be as specified in ASTM D2564 for PVC pipe and ASTM F493 for CPVC pipe.
 - 2. Threaded: ASTM D2464 manufactured from Class 12454-B rigid PVC compound; thread tape of Teflon. Only Schedule 80 PVC threaded pipe fittings shall be used.
- D. Flanges: PVC Schedule 80 ANSI Class 150 flanges manufactured from rigid PVC compounds conforming to ASTM D1784.
 - 1. Gaskets: Flat-face elastomer as specified and compatible for pipe system service.
 - 2. Bolts: AISI Type 304 stainless steel conforming to ASTM A320, Grade B.

- E. Unions: ASTM D2467 manufactured from Class 12454-B rigid PVC compound with elastomer o-rings as specified and compatible for service. Schedule 40 or 80 to match adjacent piping.

2.03 CHLORINATED POLYVINYL CHLORIDE PIPE (CPVC) AND FITTINGS:

- A. Pipe: ASTM F441 Schedule 80 manufactured from Class 23447-B Rigid CPVC Compounds with a hydrostatic design stress of 13.8 MPA (2,000 psi) designated as CPVC 1120.
- B. Joints: All CPVC piping joints shall be Socket-Type unless otherwise indicated on the Drawings. Piping shall be solvent welded or flanged only.
- C. Socket Type Fittings: ASTM F439 manufactured from Class 23447-B Rigid CPVC Compound.

2.04 GALVANIZED STEEL PIPE

- A. Pipe: Steel piping shall conform to the requirements of ASTM A53, Type S, Grade B, and ANSI B36.10, Schedule 40 as indicated on the Contract Drawings.
- B. Fittings: Forged steel conforming to ASTM A105 and ANSI B16.11, Class 2000.
- C. Joints: Threaded conforming to ANSI B1.20.1.
- D. Galvanizing: Conform to ASTM A90.

2.05 STAINLESS STEEL PIPE

- A. Stainless Steel Pipe—Threaded Joints: Conforming to ASTM A312, Grade TP 304 and 316, and ANSI B36.19M, Schedule 40S.
 - 1. Fittings: Conforming to ASTM A182, Grade F 304 and 316, and ANSI B16.11 Class 2000, or Class 3000 where indicated on the Drawings or in the Specifications.
 - 2. Threaded Joints: Conforming to ANSI B1.20.1.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. The Contractor shall lay and maintain all pipes straight and true to line in conformance with the lines, grades, and elevations indicated on the Drawings.

Line and grade tolerances, where applicable, shall be in accordance with limits given for specific material.

- B. Trenching, bedding, and backfill shall be in accordance with Section 02300, Earthwork, and shall be installed in accordance with Section 15055, Piping Systems—General.
- C. During laying operations, the Contractor shall not permit debris, tools, clothing, or similar items to be placed inside pipes. Pipe interior shall be free of mud and kept clean at all times. The Contractor shall secure the open ends of all piping at the end of construction each work day or any portion of a work day to prevent the intrusion of debris, precipitation, or soil from erosion. The proposed method of securing pipe open ends shall be approved by the Engineer. If the Contractor fails to secure piping or if the secured end is dislodged, the Engineer shall require the Contractor to flush all affected piping to remove accumulated debris and verify that the piping is free of debris using a method acceptable to the Engineer, at no additional cost to the Owner.
- D. Pipe ends shall be kept clear and clean and the Contractor shall ensure that inside surfaces are maintained smooth and free from any projections that may interfere with joint assembly or flow through the completed line.
- E. The Contractor shall be careful when lowering pipe into trenches or on subgrade to prevent damage or twisting of the pipe. After laying and before completing backfill or cover operations, pipe shall be protected from any vehicular traffic.
- F. Existing piping flanged joints that are disassembled by the Contractor shall be fitted with new gaskets, as specified, upon reassembly.

3.02 PRESSURE AND LEAKAGE TESTS

- A. Pressure Testing
 - 1. The Contractor shall pressure test and leak test all new PVC, stainless steel, CPVC, and galvanized steel piping shown on the Drawings, the Flow Stream Identification Drawing, and Section 15055, Piping Systems—General.

END OF SECTION

SECTION 15291
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the work necessary to furnish, install, and complete the AWWA C900 DR 18 PVC pipe and ductile iron fittings specified.

1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance.
- B. Section 02240, Dewatering.
- C. Section 02300, Earthwork.
- D. Section 15155, Ductile Iron Pipe and Fittings.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. All PVC pipe and fittings to be installed under this Contract shall be inspected and tested at the location where the material for this project is manufactured. The Contractor shall submit certificates of such tests and their results.
- B. The Contractor shall submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society of Testing Materials (ASTM)
 - 1. ASTM A242—Standard Specification for High-Strength Low-Alloy Structural Steel.
 - 2. ASTM A536—Standard Specification for Ductile Iron Castings.

3. ASTM D2241—Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
4. ASTM F477—Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association (AWWA)

1. AWWA C900—Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch to 12 inch (100 mm to 300 mm), for Water Transmission and Distribution.
2. AWWA C905—Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 inch through 36 inch.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals and Training.

PART 2 PRODUCTS

2.01 LARGE PVC PRESSURE PIPE

A. Large PVC Pressure Piping:

1. Unless otherwise noted, PVC pressure pipe for nominal diameters 4 inches and larger shall conform to the requirements of AWWA C900 DR 18 up to 12 inches. Pipe shall be designed for maximum working pressure of not less than 150 psi. Pipe shall be made to ductile iron pipe ODs instead of IPS. The PVC pipe shall be blue and NSF approved for potable water use and purple for reclaimed water use.

B. Bell and Spigot:

1. Pipe joints shall be made with integral bell and spigot pipe ends. The bell shall consist of an integral thickened wall section designed to be at least as strong as the pipe wall. The bell shall be supplied with a factory glued rubber ring gasket that conforms to the manufacturer's standard dimensions and tolerances. The gasket shall meet the requirements of ASTM F477 "Elastomeric Seals (Gaskets) for Joining Plastic Pipe." PVC joints shall be "Ring-Tite" as manufactured by J-M Manufacturing Company, Inc. or an equal approved by the Engineer. Nontoxic gasket lubricant shall be as specified by the pipe manufacturer.

C. Restrained Joints:

1. The following pipe joints and fittings restraint methods can be used to prevent pipe joints and fittings from separating under pressure. No additional financial compensation will be provided to the Contractor for providing the following methods of restraint:
 - a. C-900 PVC pipe bell and spigot joints (4-inch- through 12-inch-diameter pipe) shall be restrained with the EBAA Iron MEGALUG® Series 1600 Restrainer or an equal approved by the Engineer. The Series 1600 restrainers shall provide a minimum of 150-psi restraint to DR 18 (Class 150) pipe with a 3 to 1 safety factor. The restraining device and tee head bolts shall be manufactured of high-strength ductile iron meeting ASTM A536, Grade 65-42-10. Clamping bolts and nuts shall be manufactured of corrosion-resistant, high-strength, low-alloy CORTEN steel meeting the requirements of ASTM A242.

- b. Mechanical joint fittings used with PVC pipe (3-inch- through 36-inch-diameter DR 18 pipe) shall be restrained with the EBAA Iron MEGALUG® Series 2000 PV Restrainer or an equal approved by the Engineer. The Series 2000 PV restrainers shall provide a minimum of 150-psi restraint with a 2 to 1 safety factor. The restraining device and Tee head bolts shall be manufactured of high-strength ductile iron meeting ASTM A536, Grade 65-42-10. Clamping bolts and nuts shall be manufactured of corrosion-resistant, high-strength, low-alloy CORTEN steel meeting the requirements of ASTM A242.
- c. All parts of the joint restraint systems shall be coated with Mega-Bond coating system by EBAA Iron, Inc. or Engineer-approved equal.

2.02 LARGE PVC PRESSURE PIPE FITTINGS

- A. Fittings for use with large PVC pipe shall be ductile-iron fittings conforming to the requirements of mechanical joint fittings as specified in Section 15155, Ductile Iron Pipe and Fittings.
- B. Exterior Coating
 - 1. Exterior coating for fittings shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.
- C. Lining
 - 1. Lining for fittings shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.
 - 2. Any damaged lined areas shall be repaired in accordance with the manufacturer's recommendations so that the repaired area is equal to the undamaged lined areas.

2.03 SMALL PVC PRESSURE PIPE

- A. See Section 15250, Small-Diameter Piping, for Schedule 40 and Schedule 80 PVC pipe.

PART 3 EXECUTION

3.01 EXAMINATION

- A. The Contractor shall examine pipe and appurtenances shall be examined at the point of delivery. Material found to be defective due to manufacture or damage in shipment shall be rejected. Tests as specified in the applicable material standard may be performed to ensure conformance with the standard.

3.02 PIPE INSTALLATION

- A. Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipe, fittings, and valves shall be lowered carefully into the trench using suitable tools or equipment to prevent damage to pipeline materials. Under no circumstances shall pipeline materials be dropped or dumped into the trench. The trench shall be dewatered before installing the pipe in accordance with the Specifications.
- B. The sealing surface of the pipe, the inside of the bell, and the inside of the gasket shall be cleaned immediately before assembly.
- C. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.
- D. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
- E. At all times when pipe laying is in progress, except when joining another piece of pipe, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer to prevent the entrance of objectionable materials. Care shall be taken to prevent pipe flotation.
- F. Trench width at the top of the pipe, bedding conditions, and backfill placement and compaction shall be in accordance with the Contract Documents.
- G. Joint Assembly
 - 1. Pipe joints shall be assembled in accordance with the manufacturer's instructions.

H. Pipe Deflection

1. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, the amount of deflecting shall not exceed 75% of that recommended by the manufacturer.

I. Pipe Cutting

1. Cutting pipe for the insertion of valves, fittings, or closure pieces shall be done in a neat, workmanlike manner without creating damage to the pipe. Ends shall be cut square and perpendicular to the pipe axis.
2. Burrs shall be removed from spigots, and ends shall be smoothly beveled. Field cut ends shall be marked for proper depth of joint assembly.

J. Thrust Restraint

1. All pipe, tees, valves, bends, and etc., unless otherwise specified, shall be restrained using mechanical means as specified. Pipe restraint using the specified mechanical restraining system with the restrained joint schedule or tie-rods is also acceptable. Reaction blocking shall not be used on this project.
2. All ductile iron fittings, valves, mechanical restraint harnesses, and other forms of mechanical restraint shall be installed and wrapped in polyethylene tube material as specified in Section 15155, Ductile Iron Pipe and Fittings.

3.03 LOCATION AND IDENTIFICATION

- A. All non-metallic potable water mains shall be installed with a continuous, insulated 14-gauge copper wire installed directly on top of pipe for location purposes. Detectable tape may be used in lieu of copper wire and shall be placed 1 foot above the top of the pipe.

END OF SECTION

SECTION 15410 PLUMBING FIXTURES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes the requirements for the following conventional plumbing fixtures and related components:
 - 1. Accessible Water Closet (WC-1).
 - 2. Accessible Lavatory (L-1).
 - 3. Kitchen Sinks.
 - 4. Shower Faucets.
 - 5. Service Sink.
 - 6. Emergency Shower/Eyewash.
 - 7. Lavatory Faucets.
 - 8. Toilet Seats.
 - 9. Protective Shielding Guards.
 - 10. Fixture Supports.

1.02 RELATED WORK

- A. Section 15125, Piping Appurtenances, for emergency plumbing fixtures.
- B. Section 15145, Domestic Water Piping Specialties, for backflow preventers, floor drains, and specialty fixtures.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.

- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM F409—Standard Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings.
 - 2. ASTM F444—Standard Consumer Safety Specification for Scald-Preventing Devices and Systems in Bathing Areas.
 - 3. ASTM F445—Consumer Safety Specification for Thermal-Shock-Preventing Devices and Systems in Showering Areas.
 - 4. ASTM F446—Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area.
- B. American National Standards Institute, Inc. (ANSI)
 - 1. ANSI/ICPA SS-1—Solid Surface Properties and Applications.
 - 2. ANSI Z124.2—Plastic Bathtub and Shower Units.
 - 3. ANSI Z124.5—Plastic Toilet (Water Closets) Seats.
- C. America Society for Mechanical Engineers (ASME)
 - 1. ASME A112.6.1—Supports for Off-the-Floor Plumbing Fixtures.
 - 2. ASME A112.6.3—Floor Drains and Trench Drains.
 - 3. ASME A112.18.1—Plumbing Supply Fittings.
 - 4. ASME A112.18.2—Plumbing Waste Fittings.
 - 5. ASME A112.18.3—Performance Requirements for Backflow Protection Devices and Systems in Plumbing Fixture Fittings.
 - 6. ASME A112.18.6—Flexible Water Connectors.
 - 7. ASME A112.19.1—.Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures.
 - 8. ASME A112.19.2—Ceramic Plumbing Fixtures.
 - 9. ASME A112.19.3—Stainless Steel Plumbing Fixtures.

10. ASME A112.19.5—Trim for Water-Closet Bowls, Tanks, and Urinals.
11. ASME B1.20.1—Pipe Threads, General Purpose, Inch.
12. ASME B1.20.7—Hose Coupling Screw Threads, Inch.

D. American Society of Sanitary Engineering (ASSE)

1. ASSE 1001—Performance Requirements for Atmospheric Type Vacuum Breakers.
2. ASSE 1011—Performance Requirements for Hose Connection Vacuum Breakers.
3. ASSE 1014—Performance Requirements for Backflow Prevention Devices for Hand-Held Showers.
4. ASSE 1016—Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations.
5. ASSE 1021—Performance Requirements for Drain Air Gaps For Residential Dishwasher Applications.
6. ASSE 1025—Performance Requirements for Diverters for Plumbing Faucets with Hose Spray, Anti-Siphon Type, Residential Applications.
7. ASSE 1037—Performance Requirements for Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures.

E. International Code Council (ICC)

1. ICC A117.1—Accessible and Usable Buildings and Facilities.

F. National Sanitation Foundation (NSF)

1. NSF 61—Drinking Water System Components--Health Effects.

G. National Electric Code (NFPA)

1. NFPA 70—National Electrical Code Handbook.

1.06 QUALITY ASSURANCE

Comply as follows:

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer:

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
- C. Regulatory Requirements: Comply with the requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act," for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with the requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 3. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 4. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 5. Vitreous-China Fixtures: ASME A112.19.2M.
 - 6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 7. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Potable-Water Materials: NSF 61.
 - 9. Pipe Threads: ASME B1.20.1.

10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Faucets: ASME A112.18.1.
4. Hand-Held Showers: ASSE 1014.
5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F445.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Manual-Control Antiscald Faucets: ASTM F444.
8. Pipe Threads: ASME B1.20.1.
9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F444 and ASSE 1016.
10. Thermostatic-Control Antiscald Faucets: ASTM F444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Dishwasher Air-Gap Fittings: ASSE 1021.
2. Flexible Water Connectors: ASME A112.18.6.
3. Floor Drains: ASME A112.6.3.
4. Grab Bars: ASTM F446.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Off-Floor Fixture Supports: ASME A112.6.1M.
7. Pipe Threads: ASME B1.20.1.
8. Plastic Shower Receptors: ANSI Z124.2.

9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents:
 1. Faucet Washers and O-Rings: Two of each type and size installed.
 2. Faucet Cartridges and O-Rings: One of each type and size installed.
 3. Flushometer Valve, Repair Kits: Two of each type installed.
 4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
 5. Toilet Seats: Two of each type installed.

1.12 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01830, Operations and Maintenance Manuals.

1.13 DEFINITIONS

- A. *ABS*: Acrylonitrile-butadiene-styrene plastic.
- B. *Accessible Fixture*: A plumbing fixture that can be approached, entered, and used by people with disabilities.

- C. *Cast Polymer*: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. *Cultured Marble*: Cast-filled-polymer-plastic material with surface coating.
- E. *Fitting*: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. *FRP*: Fiberglass-reinforced plastic.
- G. *PMMA*: Polymethyl methacrylate (acrylic) plastic.
- H. *PVC*: Polyvinyl chloride plastic.
- I. *Solid Surface*: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

PART 2 PRODUCTS

2.01 ACCESSIBLE WATER CLOSET

- A. The Contractor shall provide the product indicated on the Drawings or an Engineer-approved comparable product by one of the following:
 - 1. American Standard Companies, Inc.
 - 2. Crane Plumbing, L.L.C./Fiat Products.
 - 3. Kohler Co.
- B. Description: Accessible, floor-mounting, bottom-outlet, vitreous-china fixture designed for tank flushometer valve operation:
 - 1. Style: Tank w/ intergral flushometer valve system:
 - a. Bowl Type: Elongated with siphon-jet design.
 - b. Design Consumption: 1.6 gal/flush.
 - c. Color: White.
 - 2. Flushometer: Intergral to tank
 - 3. Toilet Seat: Refer to Article 2.09.

2.02 ACCESSIBLE LAVATORIES

- A. The Contractor shall provide the product indicated on the Drawings or an Engineer-approved comparable product by one of the following:

1. American Standard Companies, Inc.
2. Crane Plumbing, L.L.C./Fiat Products.
3. Kohler Co.

- B. Description: Accessible, wall-mounting, vitreous-china fixture:

1. Type: With back.
2. Size: 15 by 10 inches rectangular.
3. Faucet Hole Punching: two holes, 4-inch centers.
4. Faucet Hole Location: Top.
5. Pedestal: Not required.
6. Color: White.
7. Faucet: Refer to Article 2.07.
8. Supplies: NPS 3/8 chrome-plated copper with stops.
9. Drain: Brass chrome-plated grid strainer with offset waste.
10. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; 0.032-inch-thick tubular brass waste to wall; and wall escutcheon.
11. Protective Shielding Guard(s): Refer to Article 2.10.
12. Fixture Support: Refer to Article 2.11.

2.03 KITCHEN SINKS

- A. The Contractor shall provide the product indicated on the Drawings or an Engineer-approved comparable product by one of the following:

1. Elkay.
2. Kohler Co.
3. Moen, Inc.

- B. Description: A two-bowl, residential, counter-mounting, stainless-steel kitchen sink:

1. Overall Dimensions: 33 inches x 21 inches.
2. Metal Thickness: 18 gauge.

3. Left Bowl:

- a. Dimensions: 13 1/2 inches x 16 inches x 7 7/8 inches deep.
- b. Drain: 3-1/2-inch crumb cup.

(1) Location: Centered in bowl.

4. Right Bowl:

- a. Dimensions: 13 1/2 inches x 16 inches x 7 7/8 inches deep.
- b. Drain: 3-1/2-inch crumb cup.

(1) Location: Centered in bowl.

- 5. Sink Faucet: Refer to Article 2.08.
- 6. Supplies: NPS 3/8-inch chrome-plated copper with stops.
- 7. Drain Piping: Schedule 40 PVC, NPS 1-1/2 P-trap; tubular waste to wall; and wall escutcheon(s).
- 8. Disposer: Not required.
- 9. Dishwasher Air-Gap Fitting: Not required.
- 10. Hot-Water Dispenser: Not required.

2.04 SHOWER FAUCETS

- A. The Contractor shall provide the product indicated on the Drawings or an Engineer-approved comparable product by one of the following:

- 1. American Standard Companies, Inc.
- 2. Bradley.
- 3. Kohler Co.
- 4. Moen, Inc.
- 5. Zurn Plumbing Products Group; AquaSpec Commercial Faucet Operation.
- 6. Zurn Plumbing Products Group; Wilkins Operation.

- B. Description: Single-handle thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.

- 1. Body Material: Solid brass.
- 2. Finish: Polished chrome plate.
- 3. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
- 4. Diverter Valve: Not required.
- 5. Backflow Protection Device for Hand-Held Shower: Required.
- 6. Operation: Rotating bent arm, manual.

7. Antiscald Device: Integral with mixing valve.
8. Check Stops: Check-valve type, integral with or attached to body, on hot- and cold-water supply connections.
9. Supply Connections: NPS 1/2 (DN 15).
10. Shower Head Type: Ball joint and wall arm.
11. Shower Head Material: Combined, metallic, and nonmetallic with chrome-plated finish.
12. Spray Pattern: Fixed.

2.05 SERVICE SINK

- A. The Contractor shall provide the product indicated on the Drawings or an Engineer-approved comparable product by one of the following:
 1. Crane Plumbing, L.L.C./Fiat Products.
 2. Florestone Products Co., Inc.
 3. Precast Terrazzo Enterprises, Inc.
- B. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard:
 1. Shape: Four sided.
 2. Size: 18 by 24 inches (compartment dimensions).
 3. Height: 12 inches with dropped front.
 4. Rim Guard: Stainless steel on top surfaces.
 5. Material: 16 gauge Stainless Steel.
 6. Faucet: Refer to sink faucet section.
 7. Drain: Grid with NPS 3 outlet.

2.06 EMERGENCY SHOWER/EYEWASH

- A. Refer to Section 15125, Piping Appurtenances.

2.07 EMERGENCY SHOWER/EYEWASH

- A. Refer to Section 15125, Piping Appurtenances.

2.08 LAVATORY FAUCETS

- A. The Contractor shall provide the product indicated on the Drawings or an Engineer-approved comparable product by one of the following:
 1. American Standard Companies, Inc.
 2. Bradley Corporation.

3. Elkay Manufacturing Co.
4. Moen, Inc.
5. T&S Brass.

- B. Description: Two-handle mixing valve. Include hot- and cold-water indicators, coordinate faucet inlets with supplies and fixture holes, and coordinate outlet with spout and fixture receptor:

1. Body Material: Commercial, cast brass.
2. Finish: Polished chrome plate.
3. Maximum Flow Rate: 0.5 gpm.
4. Centers: 4 inches.
5. Mounting: Deck, exposed.
6. Valve Handle: Single lever rotating wrist blade, 4 inches.
7. Inlet(s): NPS 1/2 male shank.
8. Spout: Rigid, gooseneck type with 3-1/2-inch centerline.
9. Spout Outlet: Aerator.
10. Drain: Brass chrome-plated grid.
11. Temperature: Integral adjustable limiter

2.09 SINK FAUCETS

- A. The Contractor shall provide the product indicated on the Drawings or an Engineer-approved comparable product by one of the following:

1. American Standard Companies, Inc.
2. Bradley Corporation.
3. Elkay Manufacturing Co.
4. Moen, Inc.
5. T&S Brass.

- B. Description: Kitchen faucet without spray. Include hot- and cold-water indicators, coordinate faucet inlets with supplies and fixture holes, and coordinate outlet with spout and fixture receptor.

1. Body Material: Commercial, solid brass.
2. Finish: Polished chrome plate.
3. Maximum Flow Rate: 2.0 gpm.
4. Mixing Valve: Two-lever handle.
5. Centers: Adjustable.
6. Mounting: Deck.
7. Handle(s): Wrist blade, 4 inches.
8. Inlet(s): NPS 1/2 male shank.
9. Spout Type: Swing gooseneck.

10. Spout Outlet: Aerator.
11. Drain: Grid.
12. Temperature: External thermostatic mixing valve.

C. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators, coordinate faucet inlets with supplies and fixture holes, and coordinate outlet with spout and fixture receptor:

1. Body Material: Commercial, solid brass.
2. Finish: Polished chrome plate.
3. Maximum Flow Rate: 2.5 gpm.
4. Mixing Valve: Two-lever handle.
5. Backflow Protection Device for Hose Outlet: Required.
6. Centers: 8 inches.
7. Mounting: Back/wall.
8. Handle(s): Wrist blade, 4 inches.
9. Inlet(s): NPS 1/2.
10. Spout Type: Rigid, solid brass with wall brace.
11. Spout Outlet: Hose thread with detachable hose
12. Vacuum Breaker: Required.
13. Drain: Brass chrome-plated grid.

2.10 TOILET SEATS

A. Basis-of-Design Product: Subject to compliance with requirements, the Contractor shall provide the product indicated on the Drawings or an Engineer-approved comparable product by one of the following:

1. American Standard Companies, Inc.
2. Bemis Manufacturing Company.
3. Kohler Co.

B. Description: Toilet seat for water-closet-type fixture:

1. Material: Molded, solid plastic with antimicrobial agent.
2. Configuration: Open front without cover.
3. Size: Elongated.
4. Class: Standard commercial.
5. Color: White.