

**SECTION 40 05 15**  
**PIPING SUPPORT SYSTEMS**

**PART 1 - GENERAL**

**1.01 REFERENCES**

- A. The following is a list of standards which may be referenced in this section:
1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
  2. American Society of Mechanical Engineers (ASME): B31.1, Power Piping.
  3. ASTM International (ASTM):
    - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - b. A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
  4. International Code Council (ICC):
    - a. International Building Code (IBC).
    - b. International Mechanical Code (IMC).
  5. Manufacturers' Standardization Society (MSS):
    - a. SP 58, Pipe Hangers and Supports – Materials, Design and Manufacture.
    - b. SP 69, Pipe Hangers and Supports – Selection and Application.
    - c. SP 89, Pipe Hangers and Supports – Fabrication and Installation Practices.
    - d. SP 127, Bracing for Piping Systems, Seismic-Wind-Dynamic Design, Selection and Application

**1.02 DEFINITIONS**

- A. Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank or in other damp locations.

**1.03 SUBMITTALS**

- A. Action Submittals:
1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for piping 6 inches and larger. Identify support, hanger, guide and anchor type by catalog number and shop drawing detail number.
  2. For piping 4 inches and smaller provide catalog information for each type of support.

3. Submit revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.

B. Information Submittals: Maintenance information on piping support system.

#### 1.04 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown on the Drawings or not.
2. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required in accordance with this Specification, referenced standards, or the pipe and equipment and manufacturer's recommendations.
3. Piping 30 Inches and Larger: Support systems have been designed for piping shown.
4. Meet requirements of MSS SP58, MSS SP 69, MSS SP 89, and ASME B31.1, or as modified by this Section.
5. Supports for exposed PVC pipe shall be as set forth below:
  - a. Straight Runs: 5'-0" on-center (maximum)
  - b. Elbows and Bends: Each side of fitting
  - c. Tees: Each side of run and on branch

B. Pipe Support Systems:

1. Pipe support systems shall be designed for gravity and thrust loads imposed by weight of pipes or internal pressures, including weight of fluid in pipes and insulation.
2. Seismic loads shall be addressed in accordance with governing codes and as shown on Structural General Drawings
3. Wind loads shall be addressed in accordance with governing codes and as shown on Structural General Drawings
4. Maximum support spacing and minimum rod size shall be in accordance with MSS SP-69 Table 3 and Table 4 unless specified otherwise.

C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing of each particular support.

D. Vertical Sway Bracing: 10-foot maximum centers or as shown on the Drawings.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.
- B. Special support and hanger details may be required for cases where standard catalog supports are inapplicable.

### 2.02 HANGERS

- A. Clevis: MSS SP-58 and SP-69, Type 1.
  - 1. Anvil; Figure 260, sizes ½ inch through 30 inches.
  - 2. For Insulated Pipe: Anvil; Figure 260 with insulated saddle system (ISS) sizes ½ inch through 16 inches.
  - 3. B-Line; Figure B3100, sizes ½ inch through 30 inches.
  - 4. Or equal.

### 2.03 SADDLE SUPPORTS

- A. Saddle Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
  - 1. Nonadjustable Saddle: MSS SP 58 and MSS SP 69, Type 37 with U-bolt.
    - a. Anvil; Figure 259, sizes 4 inches through 36 inches with Figure 63D base.
    - b. B-Line; Figure B3090, sizes ¾ inches through 36 inches with B3088 base.
    - c. Or equal.
  - 2. Adjustable Saddle: MSS SP 58 MSS SP 69, Type 38 without clamp.
    - a. Anvil; Figure 264, sizes 2-½ inches through 36 inches with Figure 63T base.
    - b. B-Line; Figure B3093, sizes 1 inch through 36 inches with Figure B3088T base.
    - c. Or equal.
- B. Elbow and Flange Supports:
  - 1. Elbow with Adjustable Stanchion:
    - a. Sizes 2 inches through 18 inches.
      - 1) Anvil; Figure 62C base.
      - 2) Or equal.

2. Elbow with Nonadjustable Stanchion:
  - a. Sizes 2-½ inches through 42 inches.
    - 1) Anvil; Figure 63C base.
    - 2) Or equal.
3. Flange Support with Adjustable Base:
  - a. Sizes 4 inches through 24 inches.
    - 1) B-Line; B3094, with Figure B3088T base.
    - 2) Standon; Model S89.
    - 3) Or equal.

## 2.04 WALL BRACKETS AND SUPPORTS

- A. Welded Steel Wall Bracket: MSS SP 58 and MSS SP 69, Type 33 (heavy-duty), galvanized.
  1. Anvil; Figure 199, 3,000-pound rating.
  2. B-Line; Figure B3067, 3,000-pound rating.
  3. Or equal.
- B. Offset Pipe Clamp:
  1. Anvil; Figure 103, sizes ¾ inch through 8 inches.
  2. B-Line; Figure 3148, sizes ½ inch through 12 inches.
  3. Above models set forth dimension and load carrying requirements. Material requirements are shown on the Drawings.
  4. Or equal.
- C. Channel Type:
  1. Unistrut.
  2. Anvil; Power-Strut.
  3. B-Line; Strut System.
  4. Aickinstrut (FRP).
  5. Or equal.

## 2.05 PIPE CLAMPS

- A. Riser Clamp: MSS SP 58 and MSS SP 69, Type 8.
  1. Anvil; Figure 261, sizes ¾ inch through 24 inches.
  2. B-Line; Figure B3373, sizes ½ inch through 30 inches.
  3. Or equal.

## 2.06 CHANNEL TYPE SUPPORT SYSTEMS

- A. Channel Size: 12-gauge, 1-<sup>5</sup>/<sub>8</sub> inch side minimum steel, or 1-<sup>1</sup>/<sub>2</sub> inch side, minimum FRP.
- B. Members and Connections: Design for load using one-half of manufacturer's allowable loads.
- C. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.
- D. Manufacturers and Products:
  - 1. B-Line; Strut Systems.
  - 2. Unistrut.
  - 3. Anvil; Power-Strut.
  - 4. Aickinstrut (FRP System).
  - 5. Or equal.

## 2.07 SEISMIC RESTRAINTS

- A. Solid pipe bracing attachment to pipe clevis with clevis cross brace and angle rod reinforcement.
- B. Manufacturer: Mason Industries or equal.

## 2.08 ACCESSORIES

- A. Insulation Shields:
  - 1. Type: Galvanized steel or stainless steel, MSS SP 58 and MSS SP 69, Type 40.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 167, sizes <sup>1</sup>/<sub>2</sub> inch through 24 inches.
    - b. B-Line; Figure B3151, sizes <sup>1</sup>/<sub>2</sub> inch through 24 inches.
    - c. Or equal.
- B. Welding Insulation Saddles:
  - 1. Type: MSS SP 59 and MSS SP 69, Type 39.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 160, sizes 1 inch through 36 inches.
    - b. B-Line; Figure Series B3160, sizes <sup>1</sup>/<sub>2</sub> inch through 24 inches.
    - c. Or equal.

- C. Plastic Pipe Support Channel:
  - 1. Type: Continuous support for plastic pipe to increase support spacing.
  - 2. Manufacturer and Product: B-Line; Figure Series B3106V, sizes ½ inch through 4 inches with Figure B3106 Vee bottom hangers; or equal.
  
- D. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.
  
- E. Attachments:
  - 1. I-Beam Clamp: Concentric loading type, MSS SP 58 and MSS SP 69, Type 21, Type 28, Type 29 or Type 30 which engage both sides of the flange.
  - 2. Concrete Insert: MSS SP 58 and MSS SP 69, Type 22.
    - a. Anvil; Figure 66.
    - b. B-Line; Figure B3083.
    - c. Or equal.
  - 3. Welded Beam Attachment: MSS SP 58 and MSS SP 69, Type 22.
    - a. Anvil; Figure 66.
    - b. B-Line; Figure B3083.
    - c. Or equal.
  - 4. U-Channel Concrete Inserts: As specified in Section 05 50 00, Metal Fabrications.
  - 5. Concrete Attachment Plates:
    - a. Anvil; Figure 47, Figure 49 or Figure 52.
    - b. B-Line; Figure B3084, Figure B3085, or Figure B3086.
    - c. Or equal.

## 2.09 INTERMEDIATE PIPE GUIDES

- A. Type: Hold down pipe guide.
  - 1. Manufacturer and Product: B-Line; Figure B3552, 1-½ inches through 30 inches; or equal.
  
- B. Type: U-bolts with double nuts to provide nominal 1/8 inch to ¼ inch clearance around pipe. MSS SP 58 and MSS SP 69, Type 24.
  - 1. Anvil; Figure 137 and Figure 137S.
  - 2. B-Line; Figure B3188 and Figure B3188NS.
  - 3. Or equal.

## 2.10 PIPE ALIGNMENT GUIDES

- A. Type: Spider.
- B. Manufacturers and Products:
  - 1. Anvil; Figure 255, sizes ½ inch through 24 inches.
  - 2. B-Line; Figure B3281 through B3287, sizes: ½ inch through 24 inches.
  - 3. Or equal.

## 2.11 PIPE ANCHORS

- A. Type: Anchor chair with U-bolt strap.
- B. Manufacturer and Product: B-Line; Figure 3147A or Figure 3174B; or equal.

## 2.12 ANCHORING SYSTEMS

- A. Size and Material: Sized by equipment manufacturer, ½-inch minimum diameter.

# **PART 3 EXECUTION**

## 3.01 INSTALLATION

- A. General:
  - 1. Install support systems in accordance with MSS SP 69 and MSS SP 89, unless shown otherwise.
  - 2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
  - 3. Support piping connections to equipment by pipe support and not by equipment.
  - 4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
  - 5. Support no pipe from another pipe.
  - 6. Support pipe at change in direction or elevation, adjacent to flexible joints and couplings, and where shown.
  - 7. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
  - 8. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
  - 9. Install lateral supports for seismic loads at changes in direction.
  - 10. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.

11. Repair mounting surfaces to original condition after attachments are made.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
  - a. Single Pipes: Adjustable swivel-ring, split-ring, or clevis hangers.
  - b. Grouped Pipes: Trapeze hanger system.
2. Horizontal Piping Supported from Walls:
  - a. Single Pipes: Wall brackets or clamps attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
  - b. Stacked Piping: Wall mounted channel systems are acceptable for piping smaller than 3-inches in diameter.
  - c. Piping clamps that resist axial movement of pipe through support are not acceptable. Use cast iron hanging rolls supported from wall bracket.
3. Horizontal Piping Supported from Floors:
  - a. Stanchion Type:
    - 1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
    - 2) Use yoked saddles for piping whose centerline elevation is 18 inches or greater above floor and for exterior installations.
    - 3) Providing minimum 1-½inch grout beneath base plate.
  - b. Floor Mounted Channel Supports:
    - 1) Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal type supports.
    - 2) Attach channel framing to floors with base plate on minimum 1-½ inch grout and with anchor bolts.
    - 3) Attach pipe to channel with clips or pipe clamps.
  - c. Concrete Cradles: Use for piping larger than 3 inches along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.
4. Insulated Pipe:
  - a. Pipe hanger and support shall be on outside of insulation and shall not be enclosed within insulation.
  - b. Provide precut 120-degree sections of rigid insulation (minimum length same as the shield), galvanized steel shields and oversized hangers or insulated saddle system. Anvil; Figure 260 (ISS).
  - c. Wall mounted piping clips not acceptable for insulated piping.
5. Vertical Pipe:
  - a. Support with off-set clamps, wall brackets, and base elbow or riser clamps on floor penetrations.
6. Standard Attachments:
  - a. To Concrete Ceilings: U-Channel Concrete Inserts, U-Channel to Concrete Attachment Plates.
  - b. To Steel Beams: I-beam clamp or welded attachments.



- c. To Wooden Beams: Lag screws and angle clips to members not less than 2-½ inches thick.
- d. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.
- e. To Concrete Beams: U-Channel concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.
- f. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

C. Intermediate and Pipe Alignment Guides:

- 1. Provide pipe alignment guides (or pipe supports that provide same function) at expansion joints and loops.
- 2. Guide piping on each side of expansion joint or loop at 4-pipe and 14-pipe diameters from each joint or loop.
- 3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

D. Accessories:

- 1. Insulation Shield: Install on insulated piping, oversize rollers and supports.
- 2. Welding Insulation Saddle: Install on insulated steel pipe, oversize rollers and supports.
- 3. Dielectric Barrier:
  - a. Provide plastic coated hangers, or isolation tape such as B-Line Iso Pipe, B-Line B1999 Vibra Cushion, or B-Line B3195 Felt Isolators between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and non-stainless steel ferrous metal piping.
  - b. Install ¼-inch by 3-inch neoprene rubber wrap between submerged metal pipe and oversized clamps.

3.02 FIELD FINISHING

- A. Paint atmospheric exposed surfaces hot-dip galvanized steel components as specified in Section 09 90 00, Painting and Coating.

**END OF SECTION**



**SECTION 40 05 33  
PIPE HEAT TRACING**

**PART 1 GENERAL**

1.01 REFERENCES

- A. The following is a list of standards that may be referenced within this specification:
1. Factory Mutual.
  2. Institute of Electrical and Electronics Engineers, Inc. (IEEE) 515, Testing, Design, Installation and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications.
  3. National Electrical Manufacturers' Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  4. Underwriters Laboratories (UL), Inc.

1.02 SUBMITTALS

- A. Action Submittals:
1. Manufacturer's descriptive literature.
  2. Plastic Pipe Installations: Output adjustment factors for heating tape for the services indicated.
  3. Pipe heat loss calculations for each pipe size to be heat traced.

**PART 2 PRODUCTS**

2.01 SYSTEM DESIGN REQUIREMENTS

- A. Design Heating Load:
1. Heating load to be calculated based upon a 50 degree F delta, 20 mph wind if pipes are located outdoors, insulation as specified in Section 40 42 13 and pipe as specified in Section 40 27 00, and shall include a 10 percent safety factor.
  2. Heat loss calculations shall be based on IEEE 515, Equation 1, Page 19.

## 2.02 ELECTRICAL HEATING TAPE

- A. Cable: Self-limiting, parallel circuit construction consisting of continuous inner core of variable resistance conductive heating material between two parallel copper bus wires. Provide tinned copper braid for PVC, FRP, and stainless steel pipe applications.
- B. UL Listing: Listed as self-limiting pipe tracing material for pipe freeze protection application in ordinary conditions.
- C. Maximum Maintenance Temperature: 150 degrees F (65 degrees C).
- D. Maximum Intermittent Temperature: 185 degrees F (85 degrees C).
- E. Service Voltage: As indicated by branch circuits provided for heat tracing on the Drawings.
- F. Manufacturers and Products:
  - 1. Raychem; BTV-CR.
  - 2. Thermon; BSX.
  - 3. Nelson; CL1-J1 or L1-J1.

## 2.03 CONNECTION SYSTEM

- A. Rating: NEMA 250, Type 4 and Factory Mutual approved.
- B. Operating Monitor Light: Furnish with each circuit power connection kit to indicate when heat tracing is energized.
- C. Manufacturers and Products:
  - 1. Power Connection Kit
    - a. Raychem; JBS-100.
    - b. Thermon; PCA-1-SR or DP-L.
    - c. Nelson; PLT-BC.
  - 2. Splice Kit:
    - a. Raychem; S-150.
    - b. Thermon; PCS-1-SR.
    - c. Nelson; PLT-BS.
  - 3. Tee Kit:
    - a. Raychem; T-100.
    - b. Thermon; DS-S.
    - c. Nelson; PLT-BY.

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4. End Seal Kit:
  - a. Raychem; E-150.
  - b. Thermon; DE-S.
  - c. Nelson; LT-ME.
5. Lighted End Seal Kit:
  - a. Raychem; E-100-L.
  - b. Thermon; DLS.
  - c. Nelson; LT-L.

#### 2.04 SECURING TAPE

- A. Plastic Piping Systems:
  1. Type: Aluminum foil coated adhesive tape.
  2. Manufacturers and Products:
    - a. Raychem; AT-180.
    - b. Thermon AL-20P.
    - c. Nelson; AT-50.
- B. Metallic Piping Systems:
  1. Type: Glass or polyester cloth pressure sensitive tape.
  2. Manufacturers and Products:
    - a. Raychem; GS54 or GT566
    - b. Thermon; PF-1.
    - c. Nelson; GT-6 or GT-60.

#### 2.05 PIPE MOUNTED THERMOSTAT

- A. Type: Fixed, nonadjustable, set at 40 degrees F.
- B. Sensor: Fluid-filled with 3-foot capillary.
- C. Enclosure: Glass-filled nylon, NEMA 250, Type 4X weatherproof with gasketed lid.
- D. Switch: SP-ST, UL listed, rated 22 amps, 120 to 240V ac.
- E. Manufacturers and Products:
  1. Raychem; Digitrace Model AMC-F5.
  2. Thermon; E4X-1.
  3. Raychem; DigiTrace Model E507S-LS for hazardous areas.

4. Thermon; E7-25325 for hazardous areas.

## 2.06 AMBIENT THERMOSTAT

- A. Type: Adjustable setting (15 to 140 degrees F).
- B. Sensor: Fluid-filled probe.
- C. Enclosure: Epoxy-coated NEMA 250, Type 4X aluminum enclosure with exposed hardware of stainless steel.
- D. Switch: SP-DT, UL or FM listed, rated 22 amps, 125 to 250V ac.
- E. Manufacturers and Products:
  1. Raychem; DigiTrace Model AMC-1A.
  2. Thermon; B4X-15140.
  3. Raychem; DigiTrace Model AMC-1H for hazardous areas.
  4. Thermon; B7-15140 for hazardous areas.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. General:
  1. Install in accordance with the manufacturer's instructions and recommended practices.
  2. Provide insulation conforming to Section 40 42 13 over all pipe with heat tracing. Insulation shall be "Type 1" with "Type F3 Finish" as defined in Section 40 42 13.
  3. Ground metallic structures or materials used for support of heating cable or on which it is installed in accordance with applicable codes.
  4. Wiring between power connection points of heat tracing cable branch lines shall be provided by heat tracing system supplier.
  5. Provide end of circuit pilot lights on heat tracing circuits for buried piping.

B. Electrical Heating Tape:

1. Determine required length of electrical heating tape by considering length of circuit, number and type of fittings and fixtures, design heating load, and heating tape output.
2. Where design heating load exceeds heating tape capacity, install by spiraling.
3. Derate heating tape capacity when installed on plastic piping.
4. Install on services as follows:
  - a. All chemical lines exposed outdoors.
  - b. All water lines  $\leq$  6-inch exposed outdoors including sample and process lines.
  - c. Sodium Hydroxide lines exposed outdoors or in manholes or vaults.
5. Install additional heating tape at bolted flanges, valves, pipe supports, and other fittings and fixtures as recommended by supplier, but not less than the following:

Item	Heating Tape Length (min. feet)
Bolted flanges (per pair)	Two times pipe diameter
Valves	Four times valve length
Pipe hanger or support penetrating insulation	Three times pipe diameter

C. Heat Tracing Circuits: Limit individual lengths of heat tracing circuits such that maximum single circuit capacity is 20 amps when starting the circuit at 0 degrees F. Provide multiple 20-amp circuits as required at individual heat tracing locations.

D. Thermostats:

1. Install in accordance with manufacturer's instructions and as approved by Engineer.
2. For each group of heat traced circuit, install one ambient thermostat.

3.02 FIELD QUALITY CONTROL

A. Test each circuit with 500-volt insulation tester between circuit and ground with neutrals isolated from ground.

1. Insulation Resistance: Minimum 1,000 megohms per 1,000 feet.

### 3.03 HEAT TRACING SCHEDULE

- A. Provide heat tracing with appropriate insulation and finish at the following locations (exterior above grade piping only).
1. 2" PAC Potable Water Supply Line (Sheet D-0501)
  2. 2" PAC Slurry/Solution Feed Line (Sheet D-0501)
  3. 2" Potable Water Line on West Side of Flocculation Basin Influent Channel for Sludge Line Flushing Water Supply (Sheet D-2102)
  4. 2" Raw Water Sample Pump Supply Line Upstream of 30" Raw Water Flow Meter (Sheet D-2102)
  5. Chemical Feed Piping and Tubing (4 lines, various sizes) at the Raw Water Static Mixer (Sheet D-2102)
  6. 1 ½" Polymer Feed Piping and Tubing Downstream of the Raw Water Static Mixer (Sheet D-2102)
  7. 2" Raw Water Sample Pump Supply Line Downstream of the Static Mixer
  8. 2" Potable Water Supply Lines (2 pipes) for Chemical Piping Flushing Water Located at the North End of the Corridor East of the Flocculation Basins (Sheet D-2102)
  9. Chemical Feed Piping at West Side of Filter Influent Channel (Sheet D - 2107)
  10. Water Supply Lines (3 pipes) for Exterior Emergency Eyewash/Shower Units on East Side of Chemical Storage Areas (Sheet D-2109)
  11. Chemical Feed Piping (12 lines) on North and East Sides of the Chemical Storage Areas (Sheet D-2109)
  12. 2" Raw Water Sample Pump Supply Lines (2 pipes) on the North Side of the Polymer Feed Room (Sheet D-2109)
  13. All Above Grade Exposed Fluoride Piping with the Fluoride Storage & Feed Area (Sheet D-2109)
  14. 2" Potable Water Supply Line on the East Side of the GAC Contactor Structure (Sheet D-3101)
  15. Sample Pump Suction & Discharge Lines (various sizes) Within and Outside of Sample Pump Vault at Southwest Corner of Disinfectant Contact Basin (Sheet D-4103)
  16. 1" Potable Water Sample Line at Northeast Corner of Finished Water Pump Room (Sheet D-4103)
  17. Pressure/Level Transmitter Piping at Elevated Storage Tank (Sheet D-7104)
  18. 1" Sample Water Line at east side of Blower Room (Sheet D-2108)

**END OF SECTION**



**SECTION 40 27 00**  
**PROCESS PIPING, GENERAL**

**PART 1      GENERAL**

**1.01 REFERENCES**

- A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
1. Air Force: A-A-58092, Tape Antiseize, Polytetrafluorethylene.
  2. American Association of State Highway and Transportation Officials (AASHTO): HB-17, Standard Specifications for Highway Bridges.
  3. American Petroleum Institute (API): SPEC 5L, Specification for Line Pipe.
  4. American Society of Mechanical Engineers (ASME):
    - a. Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
    - b. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators.
    - c. B.1.20.1, Pipe Threads, General Purpose (Inch).
    - d. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
    - e. B16.3, Malleable Iron Threaded Fittings Classes 150 and 300.
    - f. B16.5, Pipe Flanges and Flanged Fittings NPS ½ through NPS 24 Metric/Inch Standard.
    - g. B16.9, Factory-Made Wrought Buttwelding Fittings.
    - h. B16.11, Forged Fittings, Socket-Welding and Threaded.
    - i. B16.15, Cast Bronze Threaded Fittings Classes 125 and 250.
    - j. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
    - k. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
    - l. B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500, and 2500.
    - m. B16.25, Butt Welding Ends.
    - n. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
    - o. B3 1.1, Power Piping.
    - p. B3 1.3, Process Piping.
    - q. B3 1.9, Building Services Piping.
    - r. B36.10MY Welded and Seamless Wrought Steel Pipe.
    - s. B36.19MY Stainless Steel Pipe.
  5. American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.

6. American Water Works Association (AWWA):
  - a. C104/A2 1.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
  - b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
  - c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings for Water.
  - d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
  - f. C116/A2 1.16, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
  - g. C151/A21.5 1, Ductile-Iron Pipe, Centrifugally Cast, for Water.
  - h. C153/A2 1.53, Ductile-Iron Compact Fittings for Water Service.
  - i. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
  - j. C606, Grooved and Shouldered Joints.
7. American Welding Society (AWS):
  - a. Brazing Handbook.
  - b. A5.8/A8.5M, Specification for Filler Metals for Brazing and Braze Welding.
  - c. QC1, Standard for AWS Certification of Welding Inspectors.
8. ASTM International (ASTM):
  - a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - c. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
  - d. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
  - e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - f. A135/A135M, Standard Specification for Electric-Resistance-Welded Steel Pipe.
  - g. A139/A139M, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).
  - h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - i. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
  - j. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
  - k. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.

- l. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
- m. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
- n. A197/A197M, Standard Specification for Cupola Malleable Iron.
- o. A21 6/A21 6M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
- p. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- q. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- r. A276, Standard Specification for Stainless Steel Bars and Shapes.
- s. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- t. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- u. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- v. A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
- w. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
- x. A395/A395M, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- y. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
- z. A409/A409M, Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service.
- aa. A536, Standard Specification for Ductile Iron Castings.
- bb. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- cc. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
- dd. A774/A774M, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
- ee. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
- ff. B32, Standard Specification for Solder Metal.
- gg. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
- hh. B61, Standard Specification for Steam or Valve Bronze Castings.
- ii. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- jj. B75, Standard Specification for Seamless Copper Tube.

- kk. B88, Standard Specification for Seamless Copper Water Tube.
- ll. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
- mm. B462, Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N0803 1, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
- nn. B464, Standard Specification for Welded UNS N08020, N08024, and N08026 Alloy Pipe.
- oo. B474, Standard Specification for Electric Fusion Welded Nickel and Nickel Alloy Pipe.
- pp. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
- qq. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension.
- rr. D413, Standard Test Methods for Rubber Property Adhesion to Flexible Substrate.
- ss. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
- tt. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
- uu. D1330, Standard Specification for Rubber Sheet Gaskets.
- vv. D 1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- ww. D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- xx. D2000, Standard Classification System for Rubber Products in Automotive Applications.
- yy. D2310, Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- zz. D2464, Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- aaa. D2466, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- bbb. D2467, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- ccc. D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
- ddd. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
- eee. D2996, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

- fff. D3222, Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
- ggg. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- hhh. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
- iii. D4894, Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials.
- jjj. D4895, Standard Specification for Polytetrafluoroethylene (PTFE) Resin Produced from Dispersion.
- kkk. F436, Standard Specification for Hardened Steel Washers.
- lll. F437, Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- mmm. F439, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- nnn. F441/F441M, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- ooo. F493, Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- ppp. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- 9. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-43, Wrought Stainless Steel Butt-Welding Fittings.
- 10. NSF International (NSF): 61 Drinking Water System Components – Health Effects.
- 11. National Electrical Manufacturers Association (NEMA): LI1, Industrial Laminating Thermosetting Products.
- 12. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Service Mains and Their Appurtenances.

## 1.02 DEFINITIONS

### A. Submerged or Wetted:

1. Zone below elevation of liquid surface or within 1 foot above the liquid surface.

## 1.03 DESIGN REQUIREMENTS

- ### A. Where pipe thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
1. Ductile Iron Process Piping: ANSI/AWWA C150/A21.50.
  2. Building Service Piping: Local plumbing code.
  3. Sanitary Building Drainage and Vent Systems: Local plumbing code.
  4. Process Piping Carrying Compressed Gases: ASME 31.3.

5. PVC Piping: Use design guidance published by the PVC Pipe Association.
6. Buried Piping: Use H20-S16 traffic load with 1.5 impact factor, AASHTO HB-17, as applicable.
7. Thrust Restraints:
  - a. Design for test pressure shown in Piping Schedule
  - b. Thrust blocks are not allowed except were specifically shown or approved by Engineer.
  - c. For ductile iron pipe use design guidance published by the Ductile Iron Pipe Research Association.
  - d. For PVC pressure pipe use design guidance published by the PVC Pipe Association.

#### 1.04 SUBMITTALS

##### A. Action Submittals:

1. Submit cut sheets and catalog information for all types of pipe and fittings which demonstrate compliance with the Specifications. Submittals shall also address linings, coatings, gaskets, bolts and other related materials.
2. Shop Fabricated Piping:
  - a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information
  - b. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
3. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete encased installations for Contractor-designed piping.
4. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
5. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
6. Pipe Corrosion Protection: Product data.

##### B. Informational Submittals:

1. Manufacturer's Certification of Compliance:
  - a. Pipe and fittings.
  - b. Welding electrodes and filler materials.
  - c. Factory applied resins and coatings.
2. Qualifications:
  - a. Weld Inspection and Testing Agency: Certification and qualifications.
  - b. Welding Inspector: Certification and qualifications.
  - c. Welders:
    - 1) List of qualified welders and welding operators.

- 2) Current test records for qualified welder(s) and weld type(s) for factory and field welding.
3. Weld Procedures: Records in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
4. Nondestructive inspection and testing procedures.
5. Test logs.
6. Pipe coating applicator certification.

## 1.05 QUALITY ASSURANCE

### A. Qualifications:

1. Independent Inspection and Testing Agency:
  - a. Ten (10) years experience in field of welding and welded pipe and fittings testing required for this Project.
  - b. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
  - c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.
  - d. Testing Personnel: Qualified for nondestructive test methods to be performed.
  - e. Inspection Services: Qualified welding inspector.
2. Welding Inspector: AWS certified, AWS QC1 qualified, with prior inspection and experience of welds specified.
3. Welder and Welding Operator Qualifications:
  - a. Qualified by accepted inspection and testing agency before starting work in accordance with Section IX, Article III for the ASME Boiler and Pressure Vessel Code.
  - b. Qualified to perform groove welds in Positions 2G and 5G for each welding process and pipe material specified.
  - c. Qualification tests may be waived by Engineer based on evidence of prior qualification.
  - d. Retesting: Upon Engineer's written request, retest qualified welder(s).
4. Solvent Welder For Double Wall Containment Piping: Qualified in accordance with Chapter VII of the ASME B31.3 Code, Part 9, Paragraph A328.

- B. Quality Control: Provide services of independent inspection and testing agency for welding operations.

## 1.06 DELIVERY, STORAGE, AND HANDLING

### A. In accordance with Section 01 61 00, Common Product Requirements, and:

1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plug or caps.

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3. Linings and Coatings: Prevent excessive drying.
4. Cold Weather Storage: Located products to prevent coating from freezing to ground.
5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

## **PART 2 PRODUCTS**

### **2.01 PIPING**

- A. As specified on Piping Data Sheets and Piping Schedule located at the end of this section as Supplement.
- B. Diameters Shown:
  1. Standardized Products: Nominal size.

### **2.02 GASKET LUBRICANT**

- A. Lubricant shall be supplied by pipe manufacturer and no substitute or “or-equal” will be allowed.

### **2.03 PIPE CORROSION PROTECTION**

- A. Coatings: See Section 09 90 00, Painting and Coating, for details of coating requirements.
- B. Wraps and encasements are specified herein and in Piping Data Sheets.

### **2.04 THRUST BLOCKS**

- A. Thrust blocks are not allowed on this Project except where specifically shown on the Drawings or approved by the Engineer.

### **2.05 SAMPLE, VENT, AND DRAIN VALVES**

- A. Pipelines 2-Inch Diameter and Smaller: ½-inch vent, 1-inch drain, unless shown otherwise.
- B. Pipelines 2-½ Inch Diameter and Larger: ¾-inch vent, 1-inch drain, unless shown otherwise.



## 2.06 FABRICATION

- A. Mark each pipe length on outside with the following:
  - 1. Size or diameter and class.
  - 2. Manufacturer's identification and pipe serial number.
  - 3. Location number on laying drawing.
  - 4. Date of manufacture.
- B. Code markings according to approved shop drawings.
- C. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machined tightened on matching threaded pipe by the manufacturer.

## 2.07 FINISHES

- A. Factory prepare, prime and finish coat in accordance with Pipe Data Sheets and Piping Schedule, and Section 09 90 00, Painting and Coating.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Verify size, material, joint types, elevation, horizontal location, and pipe service all pipelines and equipment.
- B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.
- C. Welding Electrodes: Verify proper grade and type, free of moisture and dampness, and that coating is undamaged.

### 3.02 PREPARATION

- A. See Piping Data Sheets, Piping Schedule, and Section 09 90 00, Painting and Coating, for additional requirements.
- B. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- C. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

### 3.03 WELDING

- A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.3 for Pressure Piping, as may be specified on Piping Data Sheets, and if recommended by piping or fitting manufacturer.
- B. Weld Identification: Mark each weld with symbol identifying welder.
- C. Pipe End Preparation:
  - 1. Machine Shaping: Preferred.
  - 2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
  - 3. Beveled Ends for Butt Welding: ASME B16.25.
- D. Surfaces:
  - 1. Clean and free of paint, oil, rust, scale, slag or other material detrimental to welding.
  - 2. Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
  - 3. Thoroughly clean each layer of deposited metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.
- E. Alignment and Spacing:
  - 1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
  - 2. Root Opening of Joint: As stated in qualified welding procedure.
  - 3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1 inch, whichever is greater.
- F. Climatic Conditions:
  - 1. Do not perform welding if there is impingement of any rain, snow, sleet or high wind on the weld area, or if the ambient temperature is below 32 degrees F.
  - 2. Stainless Steel: If the ambient temperature is less than 32 degrees F, local preheating to a temperature warm to the hand is required.
- G. Tack Welds: Performed by qualified welder using same procedures as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

- H. Surface Defects: Chip or grind out those affecting soundness of weld.
- I. Weld Passes: As required in welding procedure.
- J. Weld Quality: Free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity, slag inclusions, and other defects in excess of limits shown in applicable piping code.

### 3.04 INSTALLATION - GENERAL

- A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
- B. Remove foreign objects prior to assembly and installation.
- C. Flanged Joints:
  - 1. Install perpendicular to pipe centerline.
  - 2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
  - 3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
  - 4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
  - 5. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
  - 6. Verify compatibility of mating flange to adapter flange gasket prior to selecting adapter flanging.
  - 7. Threaded flanged joints shall be shop fabricated and delivered to site with flanges in-place and properly faced.
  - 8. Manufacturer: Same as pipe manufacturer.
- D. Threaded and Coupled Joints:
  - 1. Conform to ASME B1.20.1.
  - 2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
  - 3. Countersink pipe ends, ream and clean chips and burrs after threading.
  - 4. Make connections with not more than three threads exposed.
  - 5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. Soldered Joints:

1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

F. Pipe Connections at Concrete Structures: As specified in piping flexibility provisions in Section 40 27 01, Process Piping Specialties.

G. PVC and CPVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded equipment, valves or fittings. Provide PVC flanges where necessary to connect to flanged equipment, valves, or fittings.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
3. Do not thread Schedule 40 pipe.

H. Ductile Iron Piping:

1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive blade cutter. Do not flame cut.
2. Dressing Cut Ends:
  - a. General: As required for the type of joint to be made.
  - b. Rubber Gasketed Joints: Remove sharp edges or projections.
  - c. Push-On Joints: Bevel, as recommended by pipe manufacturer.
  - d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End Pipe Couplings: As recommended by the coupling or adapter manufacturer.

### 3.05 INSTALLATION – EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 40 05 15, Piping Support Systems.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

- D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each shut-off valve to facilitate installation and removal.
- E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.
- F. Piping clearance, unless otherwise shown:
  - 1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
  - 2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
  - 3. From Adjacent Work: Minimum 1 inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
  - 4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
  - 5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
  - 6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
  - 7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

### 3.06 INSTALLATION – BURIED PIPE

- A. Joints:
  - 1. Dissimilar Buried Pipes: Provide flexible mechanical compression joints for pipe, restrained as required.
  - 2. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown.
- B. Placement:
  - 1. Keep trench dry until pipe laying and joining are completed.
  - 2. Pipe Base and Pipe Zone: As specified in Section 31 23 23.15, Trench Backfill.
  - 3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
  - 4. Measure for grade at pipe invert or centerline, not at top of pipe.

5. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.
6. Prevent foreign material from entering pipe during placement.
7. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
8. Lay pipe upgrade with bell ends pointing in direction of laying.
9. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
  - a. Shorter pipe lengths.
  - b. Special mitered joints.
  - c. Standard or special fabricated bends.
10. After joint has been made, check pipe alignment and grade.
11. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
12. Prevent uplift and floating of pipe prior to backfilling

C. PVC Pipe Placement:

1. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
2. Do not lay pipe when temperature is below 40 degrees F, or above 90 degrees F when exposed to direct sunlight.
3. Shield ends to be joined from direct sunlight prior to and during the laying operation.

D. Tolerances:

1. Deflection From Horizontal Line: Maximum 2 inches.
2. Deflection From Vertical Grade: Maximum ¼ inch.
3. Joint Deflection: Maximum of 75 percent of manufacturer's recommendations.
4. Pipe Cover: Minimum 3 feet, unless otherwise shown.

### 3.07 INSTALLATION – CONCRETE ENCASED

- A. Provide reinforced concrete pipe encasement where shown on Drawings and where otherwise required. Some piping may be required to be concrete encased for pipe strength requirements that are included in the Specifications. Piping under and within the influence of buildings, utility trenches, vaults, slabs and other structures shall be concrete encased. See details on Drawings for encasement requirements.
- B. Where concrete encased piping crosses structure construction and expansion joints provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

### 3.08 PIPE CORROSION PROTECTION

#### A. Ductile Iron Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating, and as shown in Piping Schedule.
2. Buried: Wrap with polyethylene bagging when shown on Drawings or required in Piping Schedule. Install in accordance with ANSI/AWWA C105/A2.15.
3. Submerged: Coat with NSF epoxy as specified in Section 09 90 00, Painting and Coating.
4. Provide protection for related valves and fittings in a manner consistent with the protection provided for adjacent pipe.

#### B. PVC Pipe, Exposed: As specified in Section 09 90 00, Painting and Coating.

#### C. Piping Accessories

1. Exposed:
  - a. Field paint black and galvanized steel, brass, copper, and bronze piping components as specified in Section 09 90 00, Painting and Coating, as applicable to base metal material.
  - b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.
2. Buried:
  - a. Ferrous Metal Components: Coat with coal-tar epoxy as specified in Section 09 90 00, Painting and Coating.
  - b. Bolts, Nuts, and Similar Items: Coat with bituminous paint.
  - c. Flexible Couplings, Grooved Couplings, and Similar Items: Wrap with heat shrink wrap.
  - d. Cement-Coated Pipelines: Cement coat appurtenances same as pipe.

#### D. Polyethylene Encasement: Install in accordance with AWWA C105/A21.5 and manufacturer's instructions.

#### E. Tape Coating System: As specified in Section 09 90 00, Painting and Coating.

#### F. Heat Shrink Wrap: Apply in accordance with manufacturer's instructions to surfaces that are cleaned, prepared and primed.

#### G. Insulating Flanges, Couplings and Unions:

1. Applications:
  - a. Dissimilar metal piping connections.
  - b. Cathodically protected piping penetrations to buildings and watertight structures.

- c. Where required for electrically insulated connection.
- 2. Pipe Installation:
  - a. Submerged carbon steel, ductile iron, or galvanized piping in reinforced concrete shall be isolated from the concrete reinforcement steel.
  - b. Align and install insulation joints as shown on the Drawings and according to manufacturer's recommendations. Bolt lubricants that contain graphite or other metallic or electrically conductive components that can interfere with the insulating capabilities of the completed flange shall not be used.

### 3.09 THRUST RESTRAINT

#### A. Location

- 1. Buried Piping: Where shown and where required to restrain force developed at pipeline tees, plugs, caps, bends, valves, and other locations where unbalanced forces exist because of hydrostatic testing and normal operating pressures.
- 2. Exposed Piping: At all joints in piping.

B. Method: Provide thrust restraint using thrust ties, flanges, proprietary restrained joints, or mechanical joint anchor gland followers. Thrust blocks, welded joints, and grooved end joints are only allowed where specifically shown on the Drawings or where approved by the Engineer.

C. Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping: Use mechanical joint valves and appropriate restrained joint follower glands specified in Piping Data Sheet for ductile iron pipe.

### 3.10 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

D. Application and Installation: As shown on the Drawings and specified in Section 40 27 01, Process Piping Specialties.

### 3.11 BRANCH CONNECTIONS

- A. Do not install branch connections smaller than ½-inch nominal pipe size, including instrument connections, unless otherwise shown.
- B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first shut-off valve in the line carrying the lower pressure, unless otherwise shown.
- C. Threaded Pipe Tap Connections:



1. Ductile Iron Piping: Direct taps 1-inch and smaller are acceptable in piping, 12 inches and larger otherwise. Connect with service saddle or at a tapping boss of a fitting, valve body, or equipment casting.
2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.

### 3.12 VENTS AND DRAINS

- A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines at all low and high point locations.

### 3.13 DISINFECTION

- A. See Section 33 13 00, Disinfecting of Water Utility Structures and Piping.

### 3.14 FIELD FINISHING

- A. Notify Engineer at least 3 days prior to start of any surface preparation or coating application work.
- B. As specified in Section 09 90 00, Painting and Coating.

### 3.15 PIPE IDENTIFICATION

- a. As specified in Section 09 90 00, Painting and Coating.

### 3.16 FIELD QUALITY CONTROL

- A. Pressure Leakage Testing: As specified in Section 40 80 01, Process Piping Leakage Testing.
- B. Minimum Duties of Welding Inspector:
  1. Job material verification and storage.
  2. Qualification of welders.
  3. Certify conformance with approved welding procedures.
  4. Maintenance of records and preparation of reports in a timely manner.
  5. Notification to Engineer of unsatisfactory weld performance within 24 hours of weld test failure.
- C. Required Weld Examinations:
  1. Perform examinations in accordance with Piping Code, ASME B3 1.3.
  2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this Section.

3. Examine at least one of each type and position of weld made by each welder or welding operator.
4. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory.

D. Test containment piping leak detection system in accordance with system manufacturer's instructions and recommendations to verify proper operation.

### 3.17 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at site in accordance with Section 01 43 33, Manufacturers' Field Services, to assist with unloading of the double wall containment piping system, system tests, containment pipe joint closure, installation and testing of leak detection system, and training of Owner's personnel in operation and maintenance of leak detection system. Manufacturer's representative shall complete a Manufacturer's Certificate of Proper Installation. Inspection and examination practices shall be according to ASME B31.3 for normal fluid service.

### 3.18 CLEANING

- A. Following assembly and testing, and prior to disinfection and final acceptance flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.
- B. Blow clean of loose debris plant process air and instrument air-lines with compressed air at 4,000 fpm; do not flush with water.
- C. Immediately after cleaning instrument air piping, dry to minus 40 degrees F dew point with dry compressed instrument air or compressed commercial grade nitrogen.
- D. If impractical to flush large diameter pipe at 2.5 fps or blow at 4,000 fpm velocity, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.
- E. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.
- F. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

### 3.19 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Piping Schedule.
2. Data Sheets.

Number	Title
40 27 00.01	Cement-Mortar-Lined Ductile Iron Pipe and Fittings.
40 27 00.03	Carbon Steel Pipe and Fittings
40 27 00.08	Stainless Steel Pipe and Fittings – General Service
40 27 00.10	Polyvinyl Chloride (PVC) Pipe and Fittings

**END OF SECTION**

## Piping Schedule

Service	Drawings Label	Materials										Pressure/Thickness Class	Test Pressure (psig)
		Above Grade					Below Grade						
		Pipe	Interior Lining	Joints	Exterior Protection	Spec Section	Pipe	Lining	Joints	Exterior Protection	Spec Section		
Raw Water Main	RWM	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	125
Settled Water	SW	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	15
Filtered Water	FW	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	15
GAC Effluent	FW	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	15
Finished Water - Upstream of Finished Water Pumps	-	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	15
Finished Water - Downstream of Finished Water Pumps	FWM	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating/PE Wrap Per Drawings	40 27 00.01	Push-On or Mechanical Joint: PC 250 (minimum) Flanged: Class 53	190
Overflow - Pretreatment or Finished Water Storage	OF	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	15
Potable Water 4" & Larger	PW	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 250 (minimum) Flanged: Class 53	190
Potable Water 3" & Smaller	PW	Copper	N/A	Threaded or Solder	Finish Coating in Field	40 27 00	PVC	N/A	Solvent Weld	N/A	40 27 00.10	Copper: Type K PVC: Schedule 80	190
Backwash Supply	BWS	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	100
Spent Backwash Water	SBW	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	15
Air Release Valve Discharges/Filter & GAC Contactor Vents	-	Galvanized Steel	N/A	Flanged or Threaded Per Drawings	Finish Coating in Field	40 27 00.03	Galvanized Steel	N/A	Flanged or Threaded Per Drawings	Finish Coating in Field	40 27 00.03	Schedule 40	N/A
Backwash Air Supply	-	Type 316L Stainless Steel	N/A	Welded or Flanged per Drawings	N/A	40 27 00.08	N/A	N/A	N/A	N/A	N/A	Schedule 5S	10
Sludge - Thickened & Unthickened (Gravity Service)	SW, TSL & SBSL	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	15
Sludge - Thickened & Unthickened (Pump Service)	TSL & SBSL	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	50
Supernatant -From Thickener or Spent Backwash Water Storage Tank	TSN & WWSN	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	15
Tank & Process Drains (Flocculation & Sedimentation Basins)	DR	N/A	N/A	N/A	N/A	N/A	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	15
Sample, Floor, and Vault Drains	DR	N/A	N/A	N/A	N/A	N/A	PVC	N/A	Push-On or Solvent Weld	N/A	40 27 00.10	SDR 26	N/A
Filtrate - Underdrain	SF	N/A	N/A	N/A	N/A	N/A	PVC	N/A	Push-On or Solvent Weld	N/A	40 27 00.10	SDR 26	N/A
Filtrate - Forcemain	SF	Ductile Iron	Cement Mortar	Flanged	Shop Prime/Finish Coating in Field	40 27 00.01	Ductile Iron	Cement Mortar	Push-On or Mechanical	Asphaltic Coating	40 27 00.01	Push-On or Mechanical Joint: PC 150 (minimum) Flanged: Class 53	50
Sanitary Sewer	-	N/A	N/A	N/A	N/A	N/A	PVC	N/A	Push-On or Solvent Weld	N/A	40 27 00.10	SDR 26	N/A
Sanitary Force Main to Septic Tank	-	N/A	N/A	N/A	N/A	N/A	PVC	N/A	Solvent Weld	N/A	40 27 00.10	Schedule 80	50
Chemical Feed Lines, Drains, Overflows, & Vents (Excluding Tubing)	-	PVC	N/A	Solvent Weld	Finish Coating in Field	40 27 00.10	PVC	N/A	Solvent Weld	N/A	40 27 00.10	Schedule 80 for Pipe - Refer to Section 40 27 00.10 for Tubing Associated with Chemical Feed Systems	100
Sample Lines	-	PVC	N/A	Solvent Weld	Finish Coating in Field	40 27 00.10	PVC	N/A	Solvent Weld	N/A	40 27 00.10	Schedule 80	100
Compressed Air & Instrument Air Tubing	IA	Type 316L Stainless Steel	N/A	Welded	N/A	40 27 00.08	Type 316L Stainless Steel	N/A	Welded	N/A	40 27 00.08	Minimum Wall Thickness: 0.065"	200
Hydraulic Oil	-	Black Carbon Steel	N/A	Threaded	Shop Prime/Finish Coating in Field	40 27 00.03	N/A	N/A	N/A	N/A	40 27 00.03	Schedule 40	200
Generator Exhaust	-	Black Carbon Steel	N/A	Flanged	N/A	40 27 00.03	N/A	N/A	N/A	N/A	N/A	Schedule 40	N/A
Sump Pump Discharge	-	PVC	N/A	Solvent Weld	Finish Coating in Field	40 27 00.10	PVC	N/A	Solvent Weld	N/A	40 27 00.10	Schedule 80	N/A

**SECTION 40 27 00.01  
CEMENT-MORTAR-LINED  
DUCTILE IRON PIPE AND FITTINGS**

<b>Item</b>	<b>Description</b>
General	Materials in contact with potable water shall conform to NSF 61 Standards.
Pipe	<p>Below Grade Pipe Using Push-On, Mechanical, or Proprietary Restrained Joints: AWWA C111/A21.11, and AWWA C151/A21.51, working pressure as specified on Piping Schedule located at the end of this Section. Follower glands shall be ductile iron.</p> <p>Above Grade Pipe Using Flanged Joints: AWWA C115/A21.15, thickness Class 53 minimum, 200 psi minimum working pressure as specified on Piping Schedule located at the end of this Section.</p>
Interior Lining	Cement-Mortar: AWWA C104/A21.4. (No asphaltic seal coating)
Special Fittings	<p>Lined and coated same as pipe.</p> <p>Mechanical: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53 gray or ductile iron, 250 psi minimum working pressure. Follower glands shall be ductile iron.</p> <p>Proprietary Restrained: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53, ductile iron, 250 psi minimum working pressure. Assembled joints shall be rated for deflection in operation at rated pressure. Rated deflection shall not be less than 1-½ degrees for 36-inch and smaller pipe. Rated deflection shall not be less than ½ degree for 42-inch and larger pipe. American Cast Iron Pipe Co., Flex-Ring or U.S. Pipe, TR Flex or HP Lok. Restrained joints relying on metal teeth molded into the gasket to prevent joint separation under pressure will not be accepted.</p> <p>Flanged: AWWA C110/A21.10 ductile iron, faced and drilled, Class 125 flat face or ASME B16.1, Class 250 raised face. Gray cast iron will not be allowed.</p> <p>Welded-On Outlets: In lieu of mechanical joint or flanged fittings, welded-on outlets with appropriate joints may be used for air release valves and in the following applications:</p> <ul style="list-style-type: none"> <li>• Raw water pump discharge manifold</li> <li>• Filtered water collection, backwash water supply, and spent backwash water collection manifolds within the filter building</li> <li>• Effluent water collection, backwash water supply, and spent backwash water collection manifolds in the GAC contactor building</li> <li>• Finished water pump discharge manifolds</li> </ul> <p>Welded-on outlets shall be fabricated at the same location that the pipe is manufactured and subjected to a hydrostatic pressure that results in a stress equal to 75% of the yield strength of the pipe material. Each outlet shall be rated for a working pressure equal to or greater than the rated working pressure of the pipe.</p>

**SECTION 40 27 00.01  
CEMENT-MORTAR-LINED  
DUCTILE IRON PIPE AND FITTINGS**

<b>Item</b>	<b>Description</b>
Exterior Coating	<p>Buried: Asphaltic coating per ANSI/AWSWA A21.51/C151.</p> <p>Exposed: Shop prime per Section 09 91 00, Painting and Coatings.</p> <p>Polyethylene Encasement: Per ANSI/AWWA A21.5/C105 where called for on Drawings. Use black polyethylene tube with 8-mil minimum thickness. Provide taping per pipe manufacturer's recommendations.</p>
Joints	<p>Push-On: 250 psi minimum working pressure, AWWA C110/A21.10 and AWWA C111/A21.11. American Cast Iron Pipe Co., Fastite Joint; U.S. Pipe and Foundry, Tyton Joint.</p> <p>Mechanical: 250 psi minimum working pressure, AWWA C110/A21.10 and AWWA C111/A21.11.</p> <p>Proprietary Restrained: 250 psi minimum working pressure. American Cast Iron Pipe Co., Flex-Ring or U.S. Pipe, TR Flex or HP Lok, Megalug Series 1100. The use of restraining gaskets or similar devices for the purpose of restraint is allowed on pipes 30 inches in size and smaller.</p> <p>Restraining gaskets shall be American Fast Grip Gasket or US Pipe Field Lok 350 Gaskets.</p> <p>Flange: Class 125 flat face, or Class 250 raised face, ductile iron, threaded conforming to AWWA C115/A21.15. Gray cast iron will not be allowed.</p> <p>Branch connections 3-inches and smaller shall be made with service saddles as specified in Section 40 27 01, Process Piping Specialties.</p>
Bolting	<p>Mechanical and Proprietary Restrained: Manufacturer's standard.</p> <p>Class 125 Flat-Faced Flange: ASTM A307, Grade A carbon steel hex head bolts and ASTM A563, Grade A carbon steel hex head nuts.</p> <p>Flanges: ASTM A307, Grade B carbon steel hex head bolts and ASTM A536, Grade A carbon steel heavy hex head nuts.</p>
Gaskets	<p>Push-On, Mechanical, and Proprietary Restrained Joints; Water and Sewage Service: Rubber conforming to AWWA C111/A21.11.</p> <p>Flanged, Water and Sewage Service: 1/8-inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ASME B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2. Full face for Class 125 flat-faced flanges, flat-ring type for Class 250 raised-face flanges. Blind flanges shall be gasketed covering the entire inside face with the gasket cemented to the blind flange.</p> <p>Gasket pressure rating to equal or in excess of the system hydrostatic test pressure.</p>
Joint Lubricant	Manufacturer's standard.

40 27 00.01 - 2

**SECTION 40 27 00.01  
CEMENT-MORTAR-LINED  
DUCTILE IRON PIPE AND FITTINGS**

<b>Item</b>	<b>Description</b>
Manufacturer	American Cast Iron Pipe Company or US Pipe. Manufactured in the USA.
Factory Hydrostatic Pressure Test	All pipe 30-inch diameter or greater shall be subjected to a hydrostatic pressure test equal to 75% of the minimum yield strength. Provide written certification that this testing has been successfully completed to Owner or Owner's Representative.

**END OF SECTION**

40 27 00.01 - 3

Cement-Mortar-Lined Ductile Iron Pipe and Fittings  
Tt #200-11740-10003

Bid Set  
Tetra Tech, Inc.





**SECTION 40 27 00.03  
CARBON STEEL PIPE AND FITTINGS**

<b>Item</b>	<b>Service/ Size</b>	<b>Description</b>
Pipe/Joint	Air Release Valve Discharge & Filter & GAC Contactor Vent Piping	Black carbon steel, Schedule 40, ASTM A53/A53M, Grade B seamless or ERW, galvanized, threaded.
	Generator Exhaust	Black carbon steel, Schedule 40, ASTM A106/A106M, Grade B seamless, no galvanizing, flanged.
Fittings	Threaded	150- or 300-pound malleable iron, ASTM A197/A197M or ASTM A47/A47M, dimensions in accordance with ASME B16.3. Galvanize fittings if adjacent pipe is galvanized.
	Flanged	Forged carbon steel, ASTM A105/A105M. Galvanize fittings if adjacent pipe is galvanized.
Flanges	2" & smaller	Forged carbon steel, ASTM A105/A105M, Grade II, ASME B16.5 Class 150 or Class 300 socket-weld or threaded, <sup>1</sup> / <sub>16</sub> -inch raised face. Galvanize flanges if adjacent pipe is galvanized.
	2- <sup>1</sup> / <sub>2</sub> " & larger	Butt-Welded Systems: Forged carbon steel, ASTM A105/A105M, ASME B16.5 Class 150 or Class 300 slip-on or welding neck, <sup>1</sup> / <sub>16</sub> -inch raised face; weld neck bore to match pipe internal diameter. Use weld neck flanges when abutting butt-weld fittings. Galvanize flanges if adjacent pipe is galvanized.  Cast Iron Mating Flange: AWWA C207, Class D or E, hub or ring type to mate with ASME B16.1, Class 125 cast-iron flange. AWWA C207 Class F hub type or ASTM A105/105M, ASME B16.5 Class 300 to mate with ASME B16.1 Class 250 cast-iron flange. Galvanize flanges if adjacent pipe is galvanized.
Unions	2" & smaller	Threaded malleable iron, ASTM A197/A197 or ASTM A47/47M, 150- or 300-pound WOG, meeting the requirements of ASME B16.3. Galvanize unions if adjacent pipe is galvanized.
Couplings	2- <sup>1</sup> / <sub>2</sub> " & larger	Screwed End: Malleable iron, ASTM A197/A197M or ASTM A47/47M. Galvanize couplings if adjacent pipe is galvanized.
Bolting	All	Flanges: Carbon steel ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts. Galvanize bolts if flanges are galvanized.

**SECTION 40 27 00.03  
CARBON STEEL PIPE AND FITTINGS**

<b>Item</b>	<b>Service/ Size</b>	<b>Description</b>
Gaskets	All	Water, Steam and Air Services: $\frac{1}{16}$ -inch thick, compressed inorganic fiber with nitrile binder, rated to 700 degrees F and 1,000 psi.  Blind flanges shall be gasketed covering the entire inside face with the gasket cemented to the blind flange.
Thread Lubricant	All	General Service: 100 percent virgin PTFE Teflon tape.

**END OF SECTION**

**SECTION 40 27 00.08  
STAINLESS STEEL PIPE AND FITTINGS – GENERAL SERVICE**

<b>Item</b>	<b>Size</b>	<b>Description</b>
Pipe & Fittings	Wall Pipes, Wall Sleeves & Pipe 2-1/2" & smaller	Schedule 40S with welded socket fittings: ASTM A312/A312M, Type 316L seamless, pickled and passivated. Provide welded wall collars on wall pipes and wall sleeves.
	3" thru 6"	Schedule 10S with flanged or welded fittings per Drawings: ASTM A778, "as-welded" grade, Type 316L, pickled and passivated.
	Larger than 6"	Schedule 5S with flanged or welded fittings per Drawings: ASTM A778, "as-welded" grade, Type 316L, pickled and passivated.
Tubing	All	ASTM A269, Type 316L stainless steel, seamless, fully annealed hydraulic tubing, 0.065-inch wall thickness minimum.
Pipe Joints	2 1/2" & smaller	Butt welded at fittings and threaded or flanged at equipment as required or shown.
	3" & larger	Butt welded or flanged at fittings and flanged at valves and equipment.
Flanged	All	Use weld-neck flanges conforming to ANSI B16.5 to connect to flanged valves, fittings, or equipment. Flanges shall be Class 150 or ANSI B16.5 unless specified otherwise. Material for flanges shall conform to ASTM A182, Grade 316L. Slip-on flanges and Van Stone angle-type face rings with backing flanges are acceptable in lieu of weld-neck flanges for backwash air piping.
Tubing Fittings	All	Flareless Compression Type Forged: ASTM A182/A182M, Grade F316, Parker-Hannifin Ferulok, Flodar BA Series.
Bolting	All	Type 316 stainless steel, ASTM A320/A320M Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.

**SECTION 40 27 00.08  
STAINLESS STEEL PIPE AND FITTINGS – GENERAL SERVICE**

<b>Item</b>	<b>Size</b>	<b>Description</b>
Gaskets	All Flanges	<p>Flanged, Water and Sewage Service: 1/8-inch thick, unless otherwise specified, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ASME B16.21, AWWA C207, and ASTM D1330, Grade 1 and Grade 2.</p> <p>Hot Air, and Fuel Gas Service: 1/8-inch thick, unless otherwise specified, homogeneous black rubber (EPDM), hardness 60 (Shore A), rated to 300 degrees F, conforming to ASME B16.21 and ASTM D1330 Steam Grade.</p> <p>Blind flanges shall be gasketed covering entire inside face with gasket cemented to blind flange.</p>
Thread Lubricant	2" & smaller	General Service: 100% virgin PTFE Teflon tape.

**END OF SECTION**

**SECTION 40 27 00.10  
POLYVINYL CHLORIDE (PVC) PIPE, TUBING, AND FITTINGS**

<b>Item</b>	<b>Service</b>	<b>Description</b>
General	All	Materials in contact with potable water shall conform to NSF Standard 61.
Piping	Chemical Feed Lines, Sample Lines & Secondary Containment	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection.
	Sanitary Sewer & Drains Upstream of Filtrate Pump Station	SDR 26 conforming to ASTM D3034
	Underdrains	SDR 26 conforming to ASTM D3034. Perforation shall comply with ASTM F-758.
	Threaded Nipples	Schedule 80 PVC.
Tubing	Chemical Feed	Provide black PVC tubing with nylon braid reinforcement embedded in the wall of the tubing with smooth inside bore and smooth outside where PVC tubing is called for in the Drawings. Design for continuous indoor and outdoor (ultraviolet-resistant) service. Minimum operating pressure shall be 200 psi for tubing 1/2 inch and smaller, 150 psi for 3/4 inch, 100 psi for 1 and 1-1/4 inches, and 75 psi for 1-1/2 inches. Burst pressure shall be at least 4.0 times the specified operating pressure. Join tubing to pipe with a single-barb male adapter fitting. Secure tubing to the fitting with a stainless steel hose clamp. Connect tubing sections by means of barbed insert-type hose fittings with stainless steel clamp. Products: Ryan-Herco "Herco-Chemical Black PVC Hose" or Engineer approved equal. Test pressure for PVC tubing shall be the same as the PVC piping to which it is connected.
Fittings	All	Schedule, SDR, or pressure class of fittings shall match adjacent pipe. Solvent weld fittings shall conform to ASTM D2467. Threaded fittings shall conform to ASTM D2464. Exposed fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	Chemical Feed & Sample Lines	Solvent socket weld except where connection to threaded or flanged valves and equipment may require future disassembly.
	Drains Upstream of Filtrate Pump Station	Push-on joints conforming to ATM D-3212.
	Underdrains	Solvent socket weld or push-on joints.

**SECTION 40 27 00.10  
POLYVINYL CHLORIDE (PVC) PIPE, TUBING, AND FITTINGS**

<b>Item</b>	<b>Service</b>	<b>Description</b>
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with "Fittings" above, 125-pound ASME B16.1 drilling.
Bolting	All	ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A914M Grade 8M hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch thick ethylene propylene (EPR) rubber.  Raised Face Mating Flange: Flat ring 1/8-inch thick ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	Socket type joints shall be made employing solvent cement that meets or exceeds the requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656 and as recommended by pipe and fitting manufacturer, except solvent weld cement for PVC pipe joints in sodium hypochlorite service shall be free of silica filler and shall be certified by the manufacturer to be suitable for that service. Certification shall be submitted.
Thread Lubricant	All	Teflon tape.
Secondary Containment Piping	Selected Chemical Feed Lines in Certain Locations	Schedule 80 pre-engineered, factory fabricated, tested and assembled double-wall containment piping furnished such that field assembly is minimized primarily to straight runs of pipe. Two-piece clamshell style containment fittings are not acceptable. Containment systems shall be as manufactured by Asahi, Ipex Guardian, or an approved equal. Carrier pipe shall be Schedule 80 PVC.

**END OF SECTION**

**SECTION 40 27 00.11  
CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS**

<b>Item</b>	<b>Size</b>	<b>Description</b>
Piping	All	Schedule 80 CPVC: Type IV, Grade I or Class 23447-B conforming to ASTM D1784 and ASTM F441. Pipe shall be manufactured with titanium dioxide for ultraviolet protection.  Threaded nipples shall be Schedule 80.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM F349 for socket weld type and Schedule 80 ASTM F437 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type CPVC flat face flange in accordance with Fittings above, 125-pound ASME B16.1 drilling.
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A914M Grade 8M hex head nuts.  Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts and ASTM A563 Grade A heavy hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced $\frac{1}{8}$ -inch thick ethylene propylene (EPR) rubber.  Raised Face Mating Flange: Flat ring $\frac{1}{8}$ -inch thick ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	All socket type joints shall be made employing primer and solvent cements that meet or exceed the requirements of ASTM F493 and primers that meet or exceed requirements of ASTM F656 and as recommended by pipe and fitting manufacturer, except solvent weld cement for CPVC pipe joints in sodium hypochlorite service shall be free of silica filler and shall be certified by the manufacturer to be suitable for that service. Certification shall be submitted. Solvent cement and primer shall be listed by NSF for use with potable water.

**SECTION 40 27 00.11  
CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS**

<b>Item</b>	<b>Size</b>	<b>Description</b>
Thread Lubricant	All	Teflon tape.

**END OF SECTION**



**SECTION 40 27 01  
PROCESS PIPING SPECIALTIES**

**PART 1 GENERAL**

**1.01 REFERENCES**

- A. The following is a list of standards which may be referenced in this Section:
1. American Society of Mechanical Engineers (ASME):
    - a. B 16.1, Gray Iron Pipe Flanges and Flanged Fittings.
    - b. B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24.
  2. American Water Works Association (AWWA):
    - a. C153, A21.53, Ductile-Iron Compact Fittings for Water Service.
    - b. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
    - c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
    - d. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
    - e. C800, Underground Service Line Valves and Fittings
    - f. Manual M11, Steel Pipe-A Guide for Design and Installation.
  3. ASTM International (ASTM):
    - a. A153/A153M7 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
  4. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
  5. NSF International (NSF): NSF 61, Drinking Water System Components-Health Effects.

**1.02 SUBMITTALS**

- A. Manufacturer's data on materials, construction, end connections, ratings, overall lengths, and live lengths (as applicable) per Section 01 33 00, Submittal Procedures.
- B. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A. Provide required piping specialty items, whether shown or not shown on Drawings, as required by applicable codes and standard industry practice.
- B. Rubber ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints are considered flexible joints; welded, screwed, and flanged pipe joints are not considered flexible.
- C. All products shall be suitable for contact with potable water or chemicals that will be added to potable water pursuant to NSF Standard 61.

### **2.02 CONNECTORS**

- A. Elastomer Bellows Connectors or Expansion Joints in Exposed Piping:
  - 1. Type: Fabricated spool with single filled arch.
  - 2. Materials: Elastomeric tube with reinforcement, lining, and cover.
  - 3. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with full elastomer face and galvanized steel retaining rings.
  - 4. Working Pressure Rating:
    - a. All Applications Except Finished Water Pumps: 150 psi.
    - b. Finished Water Pumps: 225 psi.
  - 5. Thrust Restraint: Galvanized steel control rods to limit travel of elongation and compression. Number and size of rods shall be sufficient to restrain against force developed as a result of pressure test.
  - 6. Manufacturers and Products:
    - a. Red Valve.
    - b. General Rubber.
    - c. Or equal.

### **2.03 COUPLINGS**

- A. General:

1. Couplings shall be rated for working pressure not less than the test pressure set forth in Piping Schedule for the service and not less than 150 psi.
2. Couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213.
3. Provide restraint appropriate for test and operating pressures.
4. Sleeve type couplings shall conform to AWWA C219 and shall be hydraulically expanded beyond minimum yield for accurate sizing and proofing of tensile strength.

B. Flexible Sleeve Type Coupling:

1. Pressure Rating: Per Paragraph 2.03A1 above.
2. Thrust Restraint: Galvanized steel control rods to restrain force developed by specified test pressure.
3. Manufacturers and Products:
  - a. Steel Pipe:
    - 1) Dresser Piping Specialties Style 38.
    - 2) Smith-Blair, Inc. Style 411.
  - b. Ductile Iron Pipe:
    - 1) Dresser Piping Specialties Style 253.
    - 2) Smith-Blair, Inc. Style 411.

C. Restrained Flange Adapter:

1. Pressure Rating:
  - a. Pressure Rating: Per Paragraph 2.03A1 above.
  - b. Safety Factor: Not less than two times working pressure and shall be supported by manufacturer's proof testing.
2. Thrust Restraint:
  - a. Provide hardened steel wedges that bear against and engage outer pipe surface, and allow articulation of pipe joint after assembly while wedges remain in their original setting position on pipe surface.
  - b. Products employing set screws that bear directly on pipe are acceptable.
3. Manufacturers: EBAA Iron Sales Co.; Dresser, Smith-Blair or an approved equal.

## 2.04 QUICK CONNECT COUPLINGS

### A. Quick Connect Couplings:

1. Type: Twin cam arm- actuated, male and female per Drawings.
2. Materials: PTFE, PVDF or other material suitable for intended chemical services.
3. End Connections: NPT threaded or flanged to match piping connections.
4. Plugs and Caps: Female dust cap for each male end; male dust plug for each female end.
5. Pressure Rating: 125 psi, minimum.

## 2.05 SERVICE SADDLES AND APPURTENANCES

### A. Double-Strap Iron Service Saddles

1. Pressure Rating: Capable of withstanding 150 psi internal pressure without leakage or over stressing.
2. Run Diameter: Compatible with outside diameter of pipe on which saddle is installed.
3. Taps: Iron pipe threads.
4. Materials:
  - a. Body: Malleable or ductile iron.
  - b. Straps: Galvanized steel.
  - c. Hex Nuts and Washers: Steel.
  - d. Seal: Rubber.
5. Manufacturers and Products:
  - a. Smith-Blair; Series 313 or 366.
  - b. Dresser; Style 91.

### B. Corporation Stops

1. Products shall conform to AWWA C800 and Huntsville Utilities Facility Specifications
2. Material: Brass

### C. Curb Stops

1. Products shall conform to AWWA C800 and Huntsville Utilities Facility Specifications

2. Material: Brass

D. Service Line: Polyethylene per Huntsville Utilities Facility Specifications.

## 2.06 SLEEVED WALL AND FLOOR PENETRATIONS

A. Wall Sleeves:

1. Minimum Thickness: Schedule 40.

2. Factory Finish: Galvanizing, hot-dip applied meeting requirements of ASTM A153/A153M.

B. Compression Type Wall Seal:

1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.

2. Fabrication:

a. Assemble interconnected rubber links with ASTM A276, Type 316 stainless steel bolts and nuts.

b. Pressure plates shall be reinforced nylon polymer.

3. Size: According to manufacturer's instructions for size of pipes shown to provide a watertight seal between pipe and wall sleeve opening, and to withstand a hydrostatic head of 40 feet of water.

4. Manufacturer: Thunderline Corp., Link-Seal Division or an approved equal.

C. Insulated Wall Thimbles

1. Minimum Insulation Thickness: 2 inches

2. Material: Type 316 stainless steel construction

3. NFPA rated for 2,300 degrees F.

## 2.07 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS FOR CARRIER PIPES

A. Ductile Iron Wall Pipe:

1. Diameter and Ends: Per Drawings.
  2. Thickness: Equal to or greater than adjacent piping.
  3. Collars: Ductile iron cast integral with wall pipe wherever possible or welded attachment to wall pipe.
  4. Manufacturers:
    - a. American Cast Iron Pipe Co.
    - b. U.S. Pipe and Foundry Co.
- B. Steel or Stainless Steel Wall Pipe:
1. Same material and wall thickness as adjacent pipe, except ¼-inch minimum thickness.
  2. Lining: Same as connecting pipe.
  3. Collars:
    - a. Outside Diameter: Unless otherwise shown, 3 inches greater than outside diameter of wall pipe.
    - b. Continuously fillet welded on each side all around.

## 2.08 MISCELLANEOUS SPECIALTIES

- A. Strainers, Water Service, 2 Inches and Smaller:
1. Type: Bronze body, Y-pattern, 200 psi nonshock rated, with screwed gasketed bronze cap.
  2. Screen: Heavy-gauge Type 304 stainless steel or Monel, 20-mesh.
  3. Manufacturers and Products
    - a. Armstrong International; Inc.; Model F.
    - b. Mueller Steam Specialty; Model 1351M.
    - c. Approved equal.
- B. Strainers, Water Service, 2 ½ Inches and Larger:
1. Type: Cast iron or ductile iron body, Y-pattern, 175 psi nonshock rated with flanged gasketed iron cap.
  2. Screen: Heavy-gauge Type 316 stainless steel, 0.045-inch perforations.
  3. Manufacturers and Products:
    - a. Armstrong International, Inc.; Model A7FL 125.

- b. Mueller Steam Specialty; Model 751.
- c. Approved equal.

C. Strainers, Plastic Piping Systems, 4 Inches and Smaller:

- 1. Type: Y-pattern PVC body, 150 psi nonshock rated with screwed PVC cap and Viton seals.
- 2. End Connections: Screwed or solvent weld for strainers 2 inches and smaller. Class 150 ANSI flanged for strainers 2 ½ inches and larger.
- 3. Screen: Heavy-gauge PVC, 1/32-inch mesh, minimum 2 to 1 screen area to pipe size ratio.
- 4. Manufacturers
  - a. Hayward.
  - b. Spears
  - c. Approved equal.

D. Water Hose:

- 1. Furnish eight (8) 50-foot lengths of 1-inch and ten (10) 50-foot lengths of 1-1/2-inch rubber hose. Hoses shall have EPDM black cover and EPDM tube and be reinforced with two textile braids. Provide each length with brass male and female NST hose thread couplings to fit hose nozzle and hose valve.
- 2. Rated minimum working pressure of hose shall be 200 psi.
- 3. Manufacturers:
  - a. Goodyear.
  - b. Boston.
  - c. Approved equal.

E. Hose Nozzles:

- 1. Furnish eight (8) 1-inch and eight (8) 1 ½ inch cast brass, satin finish, nozzles with adjustable fog, straight-stream, and shut-off feature and rubber bumper. Provide nozzles with female NST hose thread.
- 2. Manufacturers:
  - a. Croker.
  - b. Elkhart.
  - c. Approved equal.

F. Pressure Gauge Assemblies

1. Process Duty Pressure Gauges: Pressure gauges shall have the following design features: silicone oil filled, aluminum dial with black numerals on white background, Type 316 stainless steel bourdon tube and internal movement, 330 Series stainless steel case and ring, safety glass lens, threaded lens retaining ring, adjustable pointer, either friction or gear adjustable, blowout protection, 1/2-inch Type 316 stainless steel stem mounting, and 1.0 percent accuracy based on full scale. No stop pins shall be permitted on the dial face. Internal stop pins shall be required to prevent the sector gear from becoming disengaged from the geared needle post as a result of over or under pressure range. Provide Type 316 stainless steel pressure snubbers and diaphragm seals per the Pressure Gauge Schedule. Provide a supply of replacement fill liquid for all gauges supplied for the entire Project. Pressure gauges shall be as manufactured by U.S. Gauge, Ashcroft, H.O. Trerice, Marshalltown, Marsh, Wika, or approved equal. Each pressure gauge assembly shall be furnished with an isolation ball valve. Body, stem, and all other parts of valves shall be manufactured of Type 316 stainless steel. Valve packing shall be high-density TFE. Valve connections shall be 1/2-inch female NPT threaded connections. Ball valves for pressure gauge assembly isolation shall be 45 Series as manufactured by the Whitey Company, or an equal approved by the Engineer.
  
2. Severe Duty Pressure Gauges: Pressure gauges shall be silicon oil filled with plastic case, aluminum dial with black numerals on white background, Type 316 stainless steel bourdon tube and interval movement, safety glass lens, blowout protection and 1/2-inch Type 316 stainless steel threaded connection. Gauges shall be as manufactured by U.S. Gauge, Ashcroft, H.O. Trerice, Marshalltown, Marsh, Wika, or approved equal. Provide plastic snubbers and diaphragm seals per the Pressure Gauge Schedule. Snubbers and diaphragm seals shall be non-metallic, suitable for the intended service and manufactured by Plastomatic or an approved equal.



### Pressure Gauge Schedule

Location	Service	Gauge Diameter (minimum)	Range	Diaphragm Seal	Snubber
10-P-1A Discharge	Process Duty/Raw Water	4"	0 – 100 psi	Yes	Yes
10-P-2A Discharge	Process Duty/Raw Water	4"	0 – 100 psi	Yes	Yes
10-P-3B Discharge	Process Duty/Raw Water	4"	0 – 100 psi	Yes	Yes
Raw Water Header - East	Process Duty/ Raw Water	4"	0 – 100 psi	Yes	Yes
Raw Water Header - West	Process Duty/ Raw Water	4"	0 – 100 psi	Yes	Yes
22-B-1 Discharge	Process Duty/Air	By Blower Manufacturer/Supplier			
22-B-2 Discharge	Process Duty/Air	By Blower Manufacturer/Supplier			
23- MP-1A & 1B Discharge	Severe Duty/Alum	2"	0 – 30 psi	Yes	Yes
23- MP-1A & 1B Flushing	Severe Duty/ Potable Water	2"	0 – 150 psi	No	Yes
24-MP-1A & 1B Discharge	Severe Duty/NaOCl	2"	0 – 30 psi	Yes	Yes
24-MP-1A & 1B Flushing	Severe Duty/ Potable Water	2"	0 – 150 psi	No	Yes
24-MP-2A & 2B Discharge	Severe Duty/NaOCl	2"	0 – 30 psi	Yes	Yes
24-MP-2A & 2B Flushing	Severe Duty/ Potable Water	2"	0 – 150 psi	No	Yes
24-MP-4A & 4B Discharge	Severe Duty/NaOCl	2"	0 – 30 psi	Yes	Yes
24-MP-4A & 4B Flushing	Severe Duty/ Potable Water	2"	0 – 150 psi	No	Yes
25-MP-1B Discharge	Severe Duty/NaOH	2"	0 – 30 psi	Yes	Yes
25-MP-1B Flushing	Severe Duty/Potable Water	2"	0 – 150 psi	No	Yes
25-MP-1C Discharge	Severe Duty/NaOH	2"	0 – 30 psi	Yes	Yes
25-MP-1C Flushing	Severe Duty/ Potable Water	2"	0 – 150 psi	No	Yes
25-MP-2A & 2B Discharge	Severe Duty/NaOH	2"	0 – 30 psi	Yes	Yes
25-MP-2A & 2B Flushing	Severe Duty/ Potable Water	2"	0 – 150 psi	Yes	Yes
26- MP-1A & 1B Discharge	Severe Duty/Corr. Inhibitor	2"	0 – 30 psi	Yes	Yes
26- MP-1A & 1B Flushing	Severe Duty/ Potable Water	2"	0 – 150 psi	No	Yes
27- MP-1A & 1B Discharge	Severe Duty/Fluoride	2"	0 – 30 psi	Yes	Yes
27- MP-1A & 1B Flushing	Severe Duty/ Potable Water	2"	0 – 150 psi	No	Yes
28- PB-1 PW Supply	Severe Duty/Polymer	2"	0 – 150 psi	No	Yes
28- PB-2 PW Supply	Severe Duty/Polymer	2"	0 – 150 psi	No	Yes
29- MP-1A & 1B Discharge	Severe Duty/Sodium Thio.	2"	0 – 30 psi	Yes	Yes
29- MP-1A & 1B Flushing	Severe Duty/Potable Water	2"	0 – 150 psi	No	Yes
40-P-1 Discharge	Process Duty/Potable Water	4"	0 – 150 psi	No	Yes
40-P-2 Discharge	Process Duty/Potable Water	4"	0 – 150 psi	No	Yes
40-P-3 Discharge	Process Duty/Potable Water	4"	0 – 150 psi	No	Yes
41-P-1 Discharge	Process Duty/Potable Water	4"	0 – 60 psi	No	Yes
Elevated Tank Riser	Process Duty/Potable Water	4"	0 – 60 psi	No	Yes
51-P-1 Discharge	Process Duty/Sludge	4"	0 – 30 psi	Yes	Yes
51-P-2 Discharge	Process Duty/Sludge	4"	0 – 30 psi	Yes	Yes
52-P-1 Discharge	Process Duty/Sludge	4"	0 – 30 psi	Yes	Yes
61-P-1 Discharge	Process Duty/Filtrate	4"	0 – 30 psi	Yes	Yes
61-P-2 Discharge	Process Duty/Filtrate	4"	0 – 30 psi	Yes	Yes

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Provide accessibility to piping specialties for control and maintenance.

### **3.02 PIPING FLEXIBILITY PROVISIONS**

- A. General:
  - 1. Thrust restraint shall be provided as specified in Section 40 27 00, Process Piping-General.
  - 2. Install flexible couplings to facilitate piping installation, in accordance with approved shop drawings.
- B. Flexible Joints at Concrete Backfill or Encasement: Install within 18 inches or one-half pipe diameter, whichever is less, from the termination of any concrete backfill or concrete encasement.
- C. Flexible Joints at Concrete Structures:
  - 1. Install 18 inches or less from face of structures; joint may be flush with face.

### **3.03 COUPLINGS**

- A. General:
  - 1. Install in accordance with manufacturer's written instructions.
  - 2. Before installation clean pipe holdback area of oil, scale, rust, and dirt.
  - 3. Do not remove pipe coating. If damaged, repair before joint is made.

### **3.04 SLAB, FLOOR, ROOF, AND WALL PENETRATIONS**

- A. Installation:
  - 1. Support securely in formwork to prevent contact with reinforcing steel and tie-wires.
  - 2. Caulk joint with specified sealant in non-submerged applications and seal below grade and submerged applications with wall penetration seal.

**END OF SECTION**

40 27 01 - 10

**SECTION 40 27 02**  
**PROCESS VALVES AND OPERATORS**

**PART 1      GENERAL**

**1.01    REFERENCES**

- A.     The following is a list of standards which may be referenced in this Section:
1.     American National Standards Institute (ANSI): B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
  2.     American Society of Sanitary Engineers (ASSE): 1011, Performance Requirements for Hose Connection Vacuum Breakers.
  3.     American Water Works Association (AWWA):
    - a.     C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    - b.     C504, Rubber-Seated Butterfly Valves.
    - c.     C507, Ball Valves.
    - d.     C508, Swing-Check Valves for Waterworks Service.
    - e.     C509, Resilient-Seated Gate Valves for Water Supply Service.
    - f.     C510, Double Check Valve, Backflow Prevention Assembly.
    - g.     C511, Reduced-Pressure Principle Backflow Prevention Assembly.
    - h.     C541, Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates
    - i.     C550, Protective Interior Coatings for Valves and Hydrants.
    - j.     C800, Underground Service Line Valves and Fittings.
  4.     ASTM International (ASTM):
    - a.     A276, Standard Specification for Stainless Steel Bars and Shapes.
    - b.     A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
    - c.     A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
    - d.     B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
    - e.     B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
    - f.     B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
    - g.     B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
    - h.     B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
    - i.     B584, Standard Specification for Copper Alloy Sand Castings for General Applications.

- j. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
- k. D1784, Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
- 5. FM Global (FM).
- 6. Food and Drug Administration (FDA).
- 7. International Association of Plumbing and Mechanical Officials (IAPMO).
- 8. Manufacturers Standardization Society (MSS):
  - a. SP-80, Bronze Gate, Globe, Angle and Check Valves.
  - b. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- 9. NSF International (NSF): Standard 61, Drinking Water System Components- Health Effects.
- 10. Occupational Safety & Health Administration (OSHA): Regulation 29 CFR 1910.147, The Control of Hazardous Energy (Lockout/Tagout) – Inspection Procedures and Interpretive Guidance.
- 11. Underwriters Laboratories (UL).
- 12. USC Foundation for Cross-Connection Control and Hydraulic Research.

## 1.02 SUBMITTALS

### A. Action Submittals:

- 1. Shop Drawings:
  - a. Product data sheets for each make and model. Indicate valve type number, applicable tag number, and facility name/number or service where used.
  - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
  - c. Power and control wiring diagrams, including terminals and numbers.
  - d. For each electric, pneumatic, or hydraulic actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.
  - e. Sizing calculations for open-close/throttle and modulating valves.

### B. Informational Submittals:

- 1. Manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services for:
  - a. Pneumatic actuators; full compliance with AWWA C541.
  - b. Butterfly valves; full compliance with AWWA C504.
  - c. Finished Water Pump Control Valves; full compliance with AWWA C507.

- d. Pressure Relief and Surge Anticipator Valves.
- e. Pressure Reducing Valves.
- f. Swing Check Valves.
- g. Air Release Valves.
2. Tests and inspection data.
3. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
4. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, chain, wrench, and accessories to allow a complete operation from the intended operating level.
- B. Valves are to be suitable for intended service.
- C. Valve shall be same size as adjoining pipe, unless otherwise called out on Drawings or in Valve Schedule.
- D. Valve ends to suit adjacent piping.
- E. Resilient seated valves shall have no leakage (drop-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this Section or in stated valve standard.
- F. Size operators and actuators to operate valve for the full range of pressures and velocities.
- G. Valves to open by turning counterclockwise.
- H. Factory mount operator, actuator, and accessories to maximum extent that is practical.
- I. Valves for water and chemical service shall be NSF Standard 61 certified for the intended application.

### **2.02 MATERIALS**

- A. Bronze and brass valve components and accessories that have surfaces in contact with water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.

1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B64, B194, and B127.
2. Stainless steel Alloy 18-8 may be substituted for bronze.

## 2.03 FACTORY FINISHING

### A. Epoxy Lining and Coating:

1. Use where specified for individual valves described herein.
2. In accordance with AWWA C550 unless otherwise specified.
3. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as "fusion" or "fusion epoxy".
4. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

### B. Exposed Valves:

1. Paint in accordance with Section 09 90 00, Painting and Coating.
2. Safety isolation valves and lockout valves with handles, handwheels, or chain wheels shall be "safety yellow".

## 2.04 VALVES

### A. Gate Valves:

1. Gate Valves Smaller than 2 Inches, Buried or Above-Grade Service:
  - a. All bronze, screwed bonnet, packed gland, single solid wedge gate, nonrising stem, Class 125 rated 200 psi CWP, compliant with MSS SP-80 Type 1, threaded ends.
  - b. Manufacturers:
    - 1) Crane.
    - 2) Stockham.
    - 3) Approved equal.
2. Resilient Seated Gate Valve 2 Inches to 12 Inches, Buried Service:
  - a. Iron body, resilient seat, bronze stem and stem nut, nonrising stem, in accordance with AWWA C509, 2-inch operating nut, full port, fusion-epoxy coated inside and outside per AWWA C550, mechanical joint ends for 3-inch and larger valves, screwed ends for 2-1/2-inch and smaller valves, NSF 61 certified, minimum design working water pressure of 200 psig. Tapping valves shall conform to the above requirements and have one flanged end

designed for connection to a tapping sleeve and one mechanical joint end for connection to the branch piping.

- b. Manufacturers:
  - 1) American Flow Control.
  - 2) M&H Valve.
  - 3) Approved equal.
- 3. Resilient Seated Gate Valve 2 Inches to 12 Inches, Above-Grade Service:
  - a. Iron body, resilient seat, bronze stem and stem nut, nonrising stem, in accordance with AWWA C509, handwheel operator, full port, fusion-epoxy coated inside and outside per AWWA C550, ANSI Class 125 flanged ends for 3 inch and larger valves, screwed ends for 2-1/2-inch and smaller valves, minimum design working water pressure 200 psig, NSF 61 certified.
  - b. Manufacturers:
    - 1) American Flow Control.
    - 2) M&H Valve.
    - 3) Approved equal.

B. Ball Valves:

- 1. Ball Valves 2 Inches and Smaller for General Liquid Service:
  - a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, compliant with MSS SP-110.
  - b. Manufacturers:
    - 1) Conbraco Apollo.
    - 2) Nibco.
    - 3) Approved equal.
- 2. Ball Valves 2 Inches and Smaller for Equipment Air Service:
  - a. Two-piece, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, safety exhaust port, zinc-coated steel hand lever operator with vinyl grip, rated 150 psi.
  - b. Meet OSHA Regulation 29 CFR Part 1910.147 requirements.
  - c. Manufacturers:
    - 1) Conbraco Apollo.
    - 2) Nibco.
    - 3) Approved equal.
- 3. Stainless Steel Ball Valves 2 Inches and Smaller for Corrosion Resistant Service:
  - a. Two-piece, full port, ASTM A276 GR 316 or ASTM A351 GR CF8M stainless steel body and end piece, NPT threaded ends, ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats, seals and packing, adjustable packing gland, blow-out proof

- stainless steel stem, stainless steel hand lever operator with vinyl grip, 1,000 psi CWP, compliant with MSS SP-110.
- b. Manufacturers:
    - 1) Conbraco Apollo.
    - 2) Nibco.
    - 3) Approved equal.
4. Ball Valves 2 Inches and Smaller for Air/Oil Accumulator System Service:
    - a. Two-piece, full port, brass body and end piece, threaded ends at connections to piping, union ends at connections to tubing, stainless steel ball, PTFE seats, seals, and packing, blowout-proof brass stem, adjustable packing gland, steel hand lever operator with vinyl grip, rated 400 psi working pressure.
    - b. Manufacturers:
      - 1) Conbraco Apollo.
      - 2) Nibco.
      - 3) Approved equal.
  5. Ball Valves 2-1/2 Inches and Larger for Air/Oil Accumulator System Service:
    - a. Two-piece, full port, brass body and end piece, threaded ends, stainless steel ball, PTFE seats, seals, and packing, blowout-proof brass stem, adjustable packing gland, steel hand lever operator with vinyl grip, rated 400 psi working pressure.
    - b. Manufacturers:
      - 1) Conbraco Apollo.
      - 2) Nibco.
      - 3) Approved equal.
  6. PVC Ball Valves for Chemical and Sampling Service:
    - a. Rated 150 psi at 73 degrees F, ASTM D1784 Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends or threaded ends unless shown otherwise, flanged ends where specifically required on Drawings or as needed to connect to equipment, elastomer seat suitable for intended service, Viton or Teflon O-ring stem seals, suitable to block flow in both directions. Provide pressure relief hole drilled on low pressure side of ball.
    - b. Manufacturers:
      - 1) Nibco; Chemtrol.
      - 2) ASAHI/America.
      - 3) Spears; True Union.
      - 4) Approved equal.



C. Finished Water Pump Control Valves (Ball Valves):

1. Valves:

- a. Resilient, rubber, or metal seated ball valves, rated 250 psi minimum, fully compliant with AWWA C507, cast or ductile iron body with ANSI B16.1 Class 125 flanges, cast or ductile iron ball, stainless steel shaft. Provide drop-tight closure in two directions. NSF 61 compliant. All valve castings shall be manufactured in the United States.
- b. Additional Base Bid Requirements: Valves furnished under the Base Bid shall feature one-piece body construction and have a top access cover and seat access cover. The access covers shall facilitate maintenance activities, including seat replacement, without removing the valve from the pipeline. The valve shall also contain a hydraulically activated seat.
- c. Additional Deductive Bid Alternate Requirements: Valves furnished under the Deductive Bid Alternate may be furnished with multiple body pieces and do not need to have the access covers described above.
- d. Manufacturers
  - 1) Base Bid: GA Industries
  - 2) Deductive Alternates:
    - i. DeZurik
    - ii. Val-Matic

2. Hydraulic Actuators:

- a. Hydraulic cylinder actuators shall be traveling nut design with characterized closure sized to position the valve with an oil supply pressure of 80-150 psi and built in accordance with AWWA C541.
- b. Rotating mechanism shall consist of a lever and traveling nut directly connected to the cylinder rod.
- c. Cylinder rod, heads and barrel shall be constructed of stainless steel or non-metallic material for water service.
- d. Rod and piston seals shall be of the self-adjustable, wear-compensating type. The piston shall be one-piece with a wear strip.
- e. Control Panels:
  - 1) Provide hydraulic and electric control panels for each valve as shown on the Drawings.
  - 2) Pilot solenoid valve shall be two-position, four-way normal with manual operator, independently adjustable opening and closing speed controls, two-way emergency solenoid pilots with separate adjustable emergency closing speed control, pilot strainer or filter and pilot isolating valves, suitable for 120 VAC service.
  - 2) Provide SPDT limit switches to indicate full open, full closed and an intermediate "pump motor off" signal.

- 3) Mount hydraulic control panel components in NEMA 4X Type 316 stainless steel enclosure.
  - 4) Piping shall be brass pipe and copper tubing.
  - 5) Normal opening and closing speeds shall be independently controlled between 60 and 300 seconds.
  - 6) Emergency closing speeds shall be 10 to 30 seconds.
  - 7) Hydraulic panel shall be equipped with a supply isolation valve and pressure gauge.
  - 8) Electrical panel shall display valve position and provide a pump safety circuit, include Start and Stop DPDT relays and a 5-minute timing relay, NEMA 4X Type 316 stainless steel enclosure, panel door shall contain "OPEN", "CLOSE", "RUN" and "STOP" transformer-type pilot lights and "EMERGENCY STOP" and "RESET" push buttons, timer shall automatically shut down and lock out pump circuit if the pump fails to develop pressure or the pump control valve fails to open, suitable for 120 VAC service.
3. Skid-Mounted Oil Accumulator System:
- a. General:
    - 1) Oil accumulator system shall automatically supply pressurized hydraulic oil from a vertical air-over-oil cylinder pressure tank.
    - 2) Two (2) motor driven oil pumps shall deliver oil to the pressure tank from a fabricated oil sump tank.
    - 3) Two (2) air compressors shall provide compressed air to the top of the pressure tank.
    - 4) Pressure tank, sump tank and electrical control cabinet shall be piped and mounted to a fabricated steel floor skid with lifting holes.
    - 5) Design to use a petroleum-based hydraulic oil with a viscosity of 90 SUS at 100 degrees F.
    - 6) Size system to satisfactorily close six (6) 20-inch pump control valves at a water system pressure of 150 psi in a power outage without the need for supplemental compressed air.
    - 7) In order to minimize the potential for contamination of the finished water in the event of a leak, the oil used in the system shall be food grade hydraulic oil.
  - b. Pressure Tank:
    - 1) Constructed and tested in accordance with the latest ASME Code for Unfired Pressure Vessels and code stamped.
    - 2) Tank shall be sized to supply sufficient oil between 80 and 150 psig to operate the designated hydraulic cylinder actuated valves after power failure as specified above.

- 3). Equip with a relief valve, level gauge, float switch, drain, and a cleanout hole.
- c. Oil Pumps:
  - 1) Provide with relief valves, isolation valves, and suction filters.
  - 2) Oil pumps shall be sized to pump the usable oil volume in less than 15 minutes.
- d. Sump Tank: Sized to receive the oil stored in the pressure tank. It shall be equipped with a level gauge, a low level float switch, a drain valve, and a screened fill cover.
- e. Compressors:
  - 1) Compressors shall be sized to recharge the pressure tank in less than 15 minutes.
  - 2) Compressors shall be equipped with relief valves, isolation valves, and an outlet filter with automatic drain.
  - 3) The oil accumulator skid shall include a refrigerated air dryer system sized to accommodate the design air flow from both compressors. The dryer shall be designed to deliver compressed air with a pressure dew point temperature of 39 ° +/- 2° F and reheat the air temperature 15-20° F below the inlet air temperature. The dryer shall be an air-cooled system with integral controls designed to provide complete automatic operation of the system and it shall include an automated condensate drain system that will eject condensate. Particulate and coalescing air filters shall also be furnished as part of the compressed air system and shall be integral to the oil accumulator skid.
- f. Piping:
  - 1) Piping between the hydraulic components shall be steel pipe or tubing. Pneumatic piping shall be brass or copper pipe or tubing.
  - 2) The piping shall include the necessary isolation valves, check valves, filters, and gauges sized to assure minimum pressure loss at the emergency cylinder flow rate.
  - 3) The supply and drain connections shall be sized for a maximum fluid velocity of 8 feet per second at the emergency cylinder flow rate.
- g. Electrical Panel and Controls:
  - 1) An electrical panel shall be provided to control the operation of the oil pumps and air compressors in alternating lead/lag circuits and shall include a main circuit breaker, motor circuit breakers, motor starters, a control transformer, alarm reset button, Hand/Off/Automatic switch, transformer-type pilot lights, plug-in control relays with LED indication, terminal strip, 6 in. diameter pressure gauge, and control pressure switches.

- 2) System shall be designed to operate on 460 volt, 3 phase, 60 Hertz power.
  - 3) Electrical controls shall automatically start the oil pumps when the pressure drops below 120 psig and stop the oil pumps when the proper oil level is reached. The controls shall then start an air compressor if the pressure is below 120 psig. The start and stop setpoints for the pumps and compressors shall be field adjustable.
  - 4) Alarm lights, contacts, and reset buttons shall be provided for low oil level and low pressure conditions.
  - 5) Panel shall be NEMA 12 control cabinet and constructed of 14-gauge Type 316 stainless steel with Square-D Class 9001 pilot lights and control switches.
  - 6) Panel shall include appropriate input and output for interface with the plant SCADA system as shown on the Electrical and Instrumentation Drawings. Signals to include the following dry contacts:
    - In-Auto (Hand Switch set to Auto)
    - System Active (power on and functioning, motors may not be running)
    - Oil Pump #1, Running
    - Oil Pump #2, Running
    - Air Compressor #1, Running
    - Air Compressor #2, Running
    - System Warning
    - System Fault
    - Low Oil Level
    - Low PressureSignals to include the following analog (4-20 mA) outputs:
    - Oil Pressure
    - Air Pressure
- h. Motors: Oil pump and air compressor motors shall of TEFC or ODP construction.

D. Plug Valves:

1. Valves:

- a. Nonlubricated, 175 psi CWP, drip-tight shutoff in either direction, cast iron body, welded nickel seats, cast iron plug with Buna-N facing, stainless steel or bronze bearings, flanged ends for exposed service, mechanical joint ends for buried service. Ports shall provide an unobstructed port area equal to at least 80 percent of the nominal pipe size cross sectional area. All valve castings shall be manufactured in the United States.
- b. Manufacturers:

- 1) DeZurik.
  - 2) Milliken.
  - 3) Homestead.
  - 4) Val-Matic.
  - 5) Clow.
  - 3) Approved equal.
2. Manual Operators:
    - a. Above Grade or in Vault, Smaller than 4 inches: Lever.
    - b. Above Grade or in Vault, 4 inches and Larger: Gear operator with handwheel as indicated on Drawings or in Valve Schedule.
    - c. Below Grade, Smaller than 4 Inches: 2-inch Square nut.
    - d. Below Grade, 4 inches and Larger: Gear operator with 2-inch square nut.
  3. Pneumatic Operators (Sludge Blowdown Valves): Open/close service pneumatic as indicated in Valve Schedule.

E. Butterfly Valves:

1. General: In full compliance with AWWA C504 and following requirements:
  - a. Suitable for throttling operations and infrequent operation after periods of inactivity.
  - b. Elastomer seats which are bonded or vulcanized to the body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM C429, Method B.
  - c. Bubble-tight with rated pressure applied from either side. Test valves with pressure applied in both directions.
  - d. No travel stops for disc on interior of body.
  - e. Self-adjusting V-type or O-ring shaft seals.
  - f. Isolate metal-to-metal thrust bearing surfaces from flowstream.
  - g. Valve actuators to meet the requirements of AWWA C504.
  - h. Provide linings and coatings per AWWA, unless otherwise indicated on the Drawings or specified herein.
  - i. Valves to be in full compliance with NSF 61.
2. Butterfly Valves for General Liquid Service 3 Inches to 72 Inches:
  - a. AWWA C504, Class 150B cast-iron body, cast or ductile iron disc, short body type, Type 304 stainless steel shafts, Buna-N or NBR rubber seat bonded or molded in body or mechanically retained on the valve disc, stainless steel seating surface, epoxy lining in compliance with AWWA C550, flanged ends for exposed service, mechanical joint ends for buried service. Valves used in finished water services downstream of finished water pumps shall be suitable for a field hydrostatic pressure of 190 psi even though the nominal working pressure will be 125 psi. Such valves shall have a 190 psi factory hydrostatic test and shall demonstrate drip-tight

capability. All valve castings shall be manufactured in the United States.

- b. Operators:
    - 1) Buried Manually Operated Valves: Provide gear operator with 2-inch square operating nut.
    - 2) Exposed Manually Operated Valves: Provide gear operator with handwheel as indicated on Drawings or in Valve Schedule.
    - 3) Provide open/close or modulating pneumatic operators where shown on Drawings or in Valve Schedule.
  - c. Manufacturers:
    - 1) DeZurik.
    - 2) Val-Matic.
    - 3) Mosser.
    - 4) Kennedy.
3. Butterfly Valves for Backwash Air Service:
- a. Cast iron body, cast or ductile iron disc, high-temperature seat, rated for at least 200 degrees F, Type 304 stainless steel shaft.
  - b. Operators:
    - 1) Manually Operated Valves: Provide hand lever with locking mechanism.
    - 2) Pneumatically Actuated Valves: Provide open/close pneumatic actuators as shown on Drawings or in Valve Schedule.
  - c. Manufacturers:
    - a. DeZurik.
    - b. Tyco.
    - c. Milliken.
    - d. Approved equal from list in Paragraph 2.04 E 2 c.
4. PVC Butterfly Valves 1-1/2 Inches to 4 Inches for Chemical Service:
- a. Wafer body type, pressure rated 150 psi at 70 degrees F CWP, solid ASTM D1784, Type I, Grade I polyvinyl chloride body and contoured PVC or polypropylene valve disc, stainless steel valve stem, Viton seat, lever operator.
  - b. Manufacturers:
    - 1) ASAHI/America.
    - 2) Spears.
    - 3) Approved equal.

F. Check Valves:

- 1. Double Check Valve Backflow Prevention Assembly 3/4 Inch to 10 Inches:
  - a. Two resilient seated check valves, two nonrising stem resilient seated isolation gate valves, test cocks, in accordance with AWWA C510, rated 175 psi maximum working pressure, compliant with

- requirements of USC Foundation For Cross-Connection Control and Hydraulic Research. Provide OS&Y gates for fire protection application.
- b. Manufacturers:
    - 1) FEBCO.
    - 2) Danfoss Flomatic.
    - 3) Watts.
    - 4) Approved equal.
2. Rubber Flapper Check Valves:
- a. Full body, 150 psi rating, cast or ductile iron body, rubber flapper type design, flanged ends.
  - b. Manufacturers:
    - 1) Apco.
    - 2) Val-Matic.
    - 3) Milliken.
    - 4) GA Industries.
    - 5) Approved equal.
4. Cushioned Swing Check Valves:
- a. Wafer style, cast iron body, 150 psi rating, Type 316 stainless steel disc, Buna-N seal, outside lever & weight, air cushioning dashpot.
  - b. Manufacturers:
    - 1) Tyco/Prince.
    - 2) KF Valves.
    - 3) Approved equal.
5. PVC Ball Check Valves:
- a. ASTM D1784 Type I Grade I polyvinyl chloride body, double union solvent weld or threaded socket ends, elastomer seat suitable for intended service.
  - b. Manufacturers:
    - 1) Nibco, Chemtrol.
    - 2) ASAHI/American.
    - 3) Spears.
    - 4) Approved equal.

G. Self-Regulated Automatic Valves:

- 1. Combination Air/Vacuum Release Valves 4 Inches to 16 Inches:
  - a. Equipped with anti-slam device to throttle flow of water into air valve. Design anti-slam device to permit full, unrestricted flow of air into and out of air valve but reduce flow area for water to approximately 10 percent.
  - b. Rated 150 psi working pressure, cast-iron or ductile iron body and cover, stainless steel float and trim, built and tested to AWWA C512, ASME B16.1 Class 125 flanged inlet and plain outlet with protective hood.

- c. Provide air release valve and isolation gate valve to meet rated working pressure.
  - d. Valve shall release air during pipeline filling, admit air during pipeline draining, and release small pockets of air under pressurized operation.
  - e. Manufacturers:
    - 1) A.R.I.
    - 2) Val-Matic.
    - 3) Apco.
    - 4) Approved equal.
2. Vertical Turbine Pump Air Release Valves:
- a. Equip with anti-slam device and throttling provisions.
  - b. Cast-iron or ductile iron body and cover, stainless steel float and trim, built and tested to AWWA C512, ASME B16.1 Class 125 flanged or threaded inlet as indicated on the Drawings or in the Valve Schedule.
    - 1) Raw Water Pump Application: 150 psi minimum pressure rating.
    - 2) Finished Water Pump Application: 250 psi minimum pressure rating.
  - c. Provide air release valve and isolation gate valve to meet rated working pressure.
  - d. Valve shall release air during pump startup and admit air after pump shutdown.
  - e. Manufacturers:
    - 1) A.R.I.
    - 2) Val-Matic.
    - 3) Apco.
    - 4) Approved equal.
3. Pressure Relief and Surge Anticipator Valves
- a. Designed to control high pressures resulting from power failure surges via bypassing system pressure that exceeds the high pressure control setting by opening a preset amount when sensed pressure decreases below a preset minimum in anticipation of a surge.
  - b. Rated 250 psi working pressure, ductile iron body in accordance with ASTM A536, ANSI B16.42 Class 150 flanged inlet and outlet.
  - c. Manufacturers:
    - 1) CLA-VAL.
    - 2) Bermad.
    - 3) OCV.
    - 4) Ross Valve.
    - 5) Singer.
    - 6) Approved equal.



4. Pressure Reducing/Pressure Sustaining Valves
    - a. Designed to provide a constant downstream pressure regardless of variations in upstream flow and pressure. Also, designed to maintain a minimum upstream pressure.
    - b. Rated 250 psi working pressure, ductile iron body in accordance with ASTM A536, ANSI B16.42 Class 150 flanged inlet and outlet.
    - c. Manufacturers:
      - 1) CLA-VAL.
      - 2) Bermad.
      - 3) OCV.
      - 4) Ross Valve.
      - 5) Singer.
      - 6) Approved equal
- H. Miscellaneous Valves:
1. Mud Valves:
    - a. Cast iron body, frame, disc, and yoke, nonrising bronze stem and stem nut, flanged end, stem extension with guide to valve box or floor stand as indicated on Drawings or in Valve Schedule, 2-inch square operating nut.
    - b. Manufacturers:
      - 1) Waterman
      - 2) Clow
      - 3) Approved equal
  2. Diaphragm Valves:
    - a. Weir type with PVDF body, Viton (FKM) diaphragm, flanged ends, handwheel operator, position indicator, adjustable travel stop, clear molded acrylic stem cap.
    - b. Manufacturers:
      - 1) ASAH/AMERICA.
      - 2) ITT Engineered Valves.
      - 3) Saunders Valve.
      - 4) Approved equal.
  3. Needle Valves:
    - a. PVC needle valves shall be rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, needle and stem, and TFE sealing disc, with threaded ends.
    - b. Manufacturers:
      - 1) Hayward or equal.
  4. Globe Valves:
    - a. NPT threaded ends, bronze body, PTFE seats, fiber and graphite packing, bronze packing gland, handwheel operator, 200 psi CWP.
    - b. Manufacturers:
      - 1) Conbraco Apollo.
      - 2) Nibco.

- 3) Approved equal.
5. Solenoid Valves:
  - a. NPT threaded ends, 150 psi pressure rating, brass body, power to open (normally closed), designed for operation on 120 VAC power.
  - b. Manufacturers:
    - 1) ASCO.
    - 2) Approved equal.

## 2.05 OPERATORS AND ACTUATORS

### A. Manual Operators:

1. General: For AWWA valves, operator force shall not exceed the requirements of the applicable valve standard. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under any operating condition, including initial breakaway. Provide gear reduction operator to meet these requirements
2. Exposed Operators:
  - a. Handwheels: Galvanized and painted.
  - b. Levers: Provide with locking mechanism unless otherwise specified.
  - c. Provide chain wheel and guide with tieback, extension stem, floor stand, and other accessories as required to permit operation from normal operation level as specified herein.
  - d. Valve handles shall accept a padlock, and wheels a chain and padlock.
3. Chain Wheels and Guides:
  - a. Provide chain wheel and guide assemblies or chain lever assemblies on manually operated valves over 6 feet 9 inches above finish floor.
  - b. Chains shall be installed to within 3 feet 0 inch of finish floor.
  - c. Where chains hang in normally traveled areas, provide appropriate "L" type tie-back anchors.
  - d. Chains shall be installed to within operator horizontal reach of 2 feet 6 inches maximum, measured from normal operator standing location or station.
4. Buried Operators:
  - a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
  - b. Design buried service operators for quarter-turn valves to withstand 450 foot-pounds of input torque at the FULLY OPEN or

FULLY CLOSED positions. Operators shall be grease packed and gasketed to withstand a submersion in water to 10 psi.

- c. Buried valves shall have extension stems, bonnets, and valve boxes.
- d. Extension Stems for Operators: Where the depth of the valve operating nut is 3 feet or greater below finish grade, furnish an operating extension stem with 2-inch operating nut to bring operating nut to a point within 6 inches of finish grade.

B. Pneumatic Actuators:

1. General:

- a. Furnish actuator complete with air sets, exhaust mufflers speed controls, safety vented isolation valves, hoses, couplings, tubing, and accessories.
- b. Operators shall be suitable for full operation range of valve at air supply pressure indicated.
- c. Upon loss of power or signal, actuators shall position their respective valves as set forth below:
  - 1) Influent valves for the filters and GAC contactors shall remain in their current position.
  - 2) Effluent valves and filter to waste valves for the filters and GAC contactors shall remain in their current position.
  - 3) Backwash flow control valves for the filters and GAC contactors shall remain in their current position.
  - 4) Washwater supply and backwash drain valves for the filters and GAC contactors shall close.
  - 5) Air supply and blow-off valves for the air backwash system associated with the filters shall close.
  - 6) Sludge wasting (blowdown) valves shall close.

2. Cylinder Actuators:

- a. Pneumatic cylinder actuators shall be designed for an air supply pressure of 80 psig and built in accordance with AWWA C541.
- b. All actuators shall be double acting:
  - 1) Nonmetallic for operation with nonlubricated air.
  - 2) Provide handwheel override independent of cylinder.
  - 3) Service shall be on/off, open/stop/close, or modulating as indicated in the Valve Schedule.
- c. Manufacturers:
  - 1) DeZurik.
  - 2) Rotork.
  - 3) Morin.
  - 4) Val-Matic.
  - 5) Bettis.
  - 6) Approved equal.

3. Accessories Required for Actuators:
- a. Air Set: Pressure regulator with internal relief, filter, pressure gauge, and adjustable reduced pressure range as required by the valve actuator.
    - 1) Safety vented lockout isolation valve.
    - 2) Gauge range 30% to 200% of maximum operating pressure.
  - b. Air Exhaust Muffler: Provide in the exhaust port of actuator pilot solenoid valves.
  - c. Aluminum body and handwheel.
  - d. Limit Switches:
    - 1) Provide two (2) limit switches on each valve actuator designated for OPEN/CLOSED service.
    - 2) SPDT type, rated 10 amps at 120 VAC.
    - 3) Housed in NEMA 4X enclosure.
    - 4) Adjustable for OPEN and CLOSED valve positions.
  - e. Positioner:
    - 1) Positioner for modulating actuators shall be pneumatic force balance instruments to control valve position as a function of input signal. Accomplish positive positioning of valve by a mechanical feedback connection from the valve actuating mechanism. Provide position feedback through a characterized linear cam to allow adjustment of valve positioning and input signal. Positioner shall be suitable for double acting actuator.
    - 2) Positioner shall have zero and span adjustment and be field reversible for direct or reverse action.
    - 3) Provide gauges for supply and output pressure and for input signal pressure.
    - 4) Positioner shall be designed for 4 to 20 mA dc input signal as indicated.
    - 5) Positioner for dc input signal with transducers shall convert electrical signal to the appropriate pneumatic signal. Transducer shall be integral with positioner or a separate component. If separate, factory mount transducer on pneumatic operator. Line electric power shall not be required for transducer.
    - 6) A 4 – 20 mA dc feedback device shall be provided on each modulating actuator to provide a feedback signal that indicates valve position.
    - 7) Corrosion-resistant enclosures for positioners and transducers shall be splash and moisture proof with gasketed covers.
  - f. Pilot Solenoid Valve:
    - 1) Solenoid valve shall pilot control actuator in the appropriate configuration for type of actuator being

- controlled. Double acting actuator shall have four-way solenoid valve.
- 2) Provide pilot operated diaphragm type solenoid valve with brass body and resilient seat. Valve shall have minimum operating pressure differential no greater than 10 psig and maximum operating pressure differential no less than 150 psig. Internal parts shall be corrosion-resistant. Solenoid valve shall have Class F molded coils for operation on 120 VAC, unless otherwise indicated. House in NEMA 4X enclosure.
4. Alternative Actuators: Pneumatic rotary vane actuators may be supplied in lieu of the cylinder actuators specified above. Rotary vane devices shall provide equivalent function to the cylinder actuators and be designed in accordance with the criteria set forth for the cylinder units. Any additional piping or electrical work necessary to accommodate the rotary vane actuators shall be furnished by the Contractor at no additional cost to the Owner. Rotary vane actuators shall be K-TORK as manufactured by Rotork.

## 2.06 ACCESSORIES

- A. Tagging: Provide 1½-inch diameter heavy brass or stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve operator, bearing valve tag number shown on Valve Schedule.
- B. T-Handled Operating Wrench:
  1. Provide two (2) galvanized operating wrenches, 4 feet long.
  2. Provide two (2) galvanized operating keys for cross handled valves.
- C. Extension Bonnet for Valve Operator: Complete with enclosed stem, extension, support brackets, and accessories for valve and operator as shown on the Drawings and set forth in the Valve Schedule.
- D. Floor Stand:
  1. Nonrising, heavy pattern, indicating type.
  2. Complete with solid extension stem, coupling, handwheel, stem guide brackets, and yoke attachment. Stem length as required to connect valve operating nut and floor stand.
  3. Stem Guide: Space such that stem L/R ratio does not exceed 200.
  4. Anchor Bolts: Type 316 stainless steel.
- E. Cast-Iron Valve Box: Designed for traffic loads, sliding type, with minimum of 5-1/4-inch ID shaft.

1. Box: Cast iron with minimum depth of 9 inches.
2. Lid: Cast iron, minimum depth 3 inches, nonlocking type, marked to indicate service.
3. Extensions: Cast iron.
4. Two-piece box and lid for valves 4 inches through 12 inches, three-piece box and lid for valves larger than 12 inches with base sized for valve.
5. Valve extension stem for valves with operating nuts 3 feet or greater below finish grade.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. General: Install valves, manual operators, pneumatic and hydraulic actuators, and related equipment in accordance with the manufacturer's recommendations.
- B. Flanged Ends:
  1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
  2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.
- C. Screwed Ends:
  1. Clean threads by wire brushing or swabbing.
  2. Apply joint compound.
- D. Solvent Weld PVC Valves: Install using solvents approved for valve service conditions.
- E. Valve Installation and Orientation:
  1. General:
    - a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
    - b. Install valves in location for easy access for routine operation and maintenance.
    - c. Install valves per manufacturer's recommendations.
  2. Gate, Globe, and Ball Valves:
    - a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.

- b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
  - 3. Butterfly Valves:
    - a. When butterfly valve actuation will result in the disc being in conflict with adjacent valves, fittings, or equipment provide spool pieces to resolve conflicts and maintain proper clearances.
    - b. When installed immediately downstream of a swing check valve, install valve with shaft perpendicular to swing check shaft.
    - c. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.
  - 4. Check Valves:
    - a. Install valve in horizontal piping only for liquid services.
    - b. Install valve in horizontal or vertical flow (up) piping for gas services.
    - c. Install swing check valve with shaft in horizontal position.
- F. Install safety isolation valves on compressed air lines.
- G. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access when necessary.
- H. Torque Tube: Where operator for quarter-turn valve is located on floor stand, furnish extension stem torque tube of a type properly sized for maximum torque capacity of valve.

### 3.02 TESTS AND INSPECTION

- A. Valves may be either tested while testing pipelines, or as a separate step.
- B. Test that valves open and close smoothly under operating pressure conditions. Demonstrate that two-way valves open and close smoothly under operating pressure conditions from both directions.
- C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.
- D. Count and record number of turns to open and close valve; account for any discrepancies with manufacturer's data.
- E. Set, verify, and record set pressures for relief and regulating valves.
- F. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Engineer.

- G. Test hydrostatic relief valve seating; record leakage. Adjust and retest to maximum leakage of 0.1 gpm per foot of seat periphery.

### 3.03 MANUFACTURER'S SERVICES

- A. The valve(s) as listed below require manufacturer's field services:
  - 1. Combination Air/Vacuum Release Valves.
  - 2. Pressure Relief and Surge Anticipator Valves.
  - 3. Pressure Reducing Valves
  - 4. Finished Water Pump Control Valves.
  - 5. Pneumatically Actuated Valves
  
- B. Manufacturer's Representative: Present at site for minimum number of days listed below, travel time excluded:
  - 1. One (1) for each type of valve listed above except for pneumatically actuated butterfly valves.
  - 2. Five (5) days for pneumatically actuated butterfly valves.
  
- C. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

### 3.04 SUPPLEMENTS

- A. The supplements listed below, following "End of Section", are part of this Specification.
  - 1. Valve Schedule.

**END OF SECTION**



**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Plumbing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connection	Actuator	Remarks
<b>Valves Associated with Raw Water Intake Pump Station</b>								
10-CV-1A	RW Intake Pump Room/Above Grade/Indoors	Raw Water	16"	Check, Wafer Style w/ Dashpot	70 psi	Flanged	N/A	Cushioned Wafer Check Valve for Raw Water Pump No. 1A
10-CV-2A	RW Intake Pump Room/Above Grade/Indoors	Raw Water	20"	Check, Wafer Style w/ Dashpot	70 psi	Flanged	N/A	Cushioned Wafer Check Valve for Raw Water Pump No. 2A
10-CV-1B	RW Intake Pump Room/Above Grade/Indoors	Raw Water	16"	Check, Wafer Style w/ Dashpot	70 psi	Flanged	N/A	Cushioned Wafer Check Valve for Raw Water Pump No. 3B
10-BFV-1A-1	RW Intake Pump Room/Above Grade/Indoors	Raw Water	16"	Butterfly	70 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Raw Water Pump No. 1A
10-BFV-1A-2	RW Intake Chamber/Submerged	Raw Water	16"	Butterfly	70 psi	Flanged	Manual/Gear/Shaft Extension w/ 2" Nut	Surge Anticipator Discharge to Intake Chamber 1
10-BFV-1B-2	RW Intake Chamber/Submerged	Raw Water	16"	Butterfly	70 psi	Flanged	Manual/Gear/Shaft Extension w/ 2" Nut	Surge Anticipator Discharge to Intake Chamber 1
10-BFV-2A-1	RW Intake Pump Room/Above Grade/Indoors	Raw Water	20"	Butterfly	70 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Raw Water Pump No. 2A
10-BFV-2A-2	RW Intake Chamber/Submerged	Raw Water	16"	Butterfly	70 psi	Flanged	Manual/Gear/Shaft Extension w/ 2" Nut	Surge Anticipator Discharge to Intake Chamber 2
10-BFV-2B-2	RW Intake Chamber/Submerged	Raw Water	16"	Butterfly	70 psi	Flanged	Manual/Gear/Shaft Extension w/ 2" Nut	Surge Anticipator Discharge to Intake Chamber 2
10-BFV-3B-1	RW Intake Pump Room/Above Grade/Indoors	Raw Water	16"	Butterfly	70 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Raw Water Pump No. 3B
10-BFV-3A-2	RW Intake Chamber/Submerged	Raw Water	16"	Butterfly	70 psi	Flanged	Manual/Gear/Shaft Extension w/ 2" Nut	Surge Anticipator Discharge to Intake Chamber 3
10-BFV-3B-2	RW Intake Chamber/Submerged	Raw Water	16"	Butterfly	70 psi	Flanged	Manual/Gear/Shaft Extension w/ 2" Nut	Surge Anticipator Discharge to Intake Chamber 3
10-BFV-4	RW Intake Pump Room/Above Grade/Indoors	Raw Water	42"	Butterfly	70 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for 42" Discharge Manifold
10-BFV-5	RW Intake Pump Room/Above Grade/Indoors	Raw Water	42"	Butterfly	70 psi	Flanged	Manual/Gear/Handwheel	Isolation valve for 42" Discharge Manifold
10-BFV-6	RW Intake Pump Room/Above Grade/Indoors	Raw Water	16"	Butterfly	70 psi	Flanged	Manual/Gear/Handwheel	Isolation valve for Surge Anticipator Valve
10-PRV-1	RW Intake Pump Room/Above Grade/Indoors	Raw Water	16"	Surge Anticipator	70 psi	Flanged	N/A	Surge Anticipator Valve
10-ARV-1A	RW Intake Pump Room/Above Grade/Indoors	Raw Water	3"	Well Pump Air Release	70 psi	Flanged	Manual/Lever (For Isolation Valve)	Well Pump Air Release Valve for Raw Water Pump No. 1A
10-ARV-2A	RW Intake Pump Room/Above Grade/Indoors	Raw Water	6"	Well Pump Air Release	70 psi	Flanged	Manual/Lever (For Isolation Valve)	Well Pump Air Release Valve for Raw Water Pump No. 2A
10-ARV-3B	RW Intake Pump Room/Above Grade/Indoors	Raw Water	3"	Well Pump Air Release	70 psi	Flanged	Manual/Lever (For Isolation Valve)	Well Pump Air Release Valve for Raw Water Pump No. 3B
10-ARV-4	RW Intake Pump Room/Above Grade/Indoors	Raw Water	6"	Combination Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Combination Air Release for 42" Discharge Manifold, Provide 6" Gate Valve for Isolation
10-ARV-5	RW Intake Pump Room/Above Grade/Indoors	Raw Water	6"	Combination Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Combination Air Release for 42" Discharge Manifold, Provide 6" Gate Valve for Isolation

**Valve Schedule**  
 (Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Plumbing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connection	Actuator	Remarks
<b>Valves Associated with Mixing, Flocculation, &amp; Sedimentation Facilities</b>								
20-BFV-1	Upstream of Raw Water Static Mixer/Above Grade/Outdoors	Raw Water	30"	Butterfly	10 psi	Flanged	Manual/Gear/Handwheel	N/A
20-BFV-2	Downstream of Raw Water Static Mixer/Above Grade/Outdoors	Raw Water	30"	Butterfly	10 psi	Flanged	Manual/Gear/Handwheel	N/A
20-PV-1A	North End of Flocc Basin No. 1/Inside Blowdown Box/Outdoors	Unthickened Sludge	4"	Plug	10 psi	Flanged	Pneumatic - Opens/Closes	Possible Valve Submergence, Extension Bonnet for Operator
20-PV-1B	North End of Flocc Basin No. 1/Inside Blowdown Box/Outdoors	Unthickened Sludge	4"	Plug	10 psi	Flanged	Pneumatic - Opens/Closes	Possible Valve Submergence, Extension Bonnet for Operator
20-PV-1C	West End of Flocc Basin No. 1/Buried	Raw Water/Unthickened Sludge	12"	Plug	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Flocculation/Sedimentation Basin No. 1 Drain
20-PV-2A	North End of Flocc Basin No. 2/Inside Blowdown Box/Outdoors	Unthickened Sludge	4"	Plug	10 psi	Flanged	Pneumatic - Opens/Closes	Possible Valve Submergence, Extension Bonnet for Operator
20-PV-2B	North End of Flocc Basin No. 2/Inside Blowdown Box/Outdoors	Unthickened Sludge	4"	Plug	10 psi	Flanged	Pneumatic - Opens/Closes	Possible Valve Submergence, Extension Bonnet for Operator
20-PV-2C	West End of Flocc Basin No. 2/Buried	Raw Water/Unthickened Sludge	12"	Plug	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Flocculation/Sedimentation Basin No. 2 Drain
20-PV-3	Northeast Corner of Flocc Basin No. 1/Buried	Raw Water/Unthickened Sludge	12"	Plug	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Drain Diversion Valve - Directs Flow to Thickener or Spent Backwash Water Tank
20-PV-4	Northeast Corner of Flocc Basin No. 1/Buried	Raw Water/Unthickened Sludge	12"	Plug	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Drain Diversion Valve - Directs Flow to Thickener or Spent Backwash Water Tank
20-PV-5	Northeast Corner of Flocc Basin No. 1/Buried	Raw Water/Unthickened Sludge	12"	Plug	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Drain Diversion Valve - Directs Flow to Thickener or Spent Backwash Water Tank
20-MUV-1A	West End of Flocc Basin No. 1/Submerged	Raw Water/Unthickened Sludge	12"	Mud	10 psi	Flanged	Manual/2" Operating Nut/Stem Extension	Flocculation Basin No. 1 West Drain
20-MUV-1B	East End of Flocc Basin No. 1/Submerged	Raw Water/Unthickened Sludge	12"	Mud	10 psi	Flanged	Manual/2" Operating Nut/Stem Extension	Flocculation Basin No. 1 East Drain
20-MUV-1C	West End of Sed Basin No. 1/Submerged	Raw Water/Unthickened Sludge	12"	Mud	10 psi	Flanged	Manual/2" Operating Nut/Stem Extension	Sedimentation Basin No. 1 West Drain
20-MUV-2A	West End of Flocc Basin No. 2/Submerged	Raw Water/Unthickened Sludge	12"	Mud	10 psi	Flanged	Manual/2" Operating Nut/Stem Extension	Floc Basin No. 2 West Drain
20-MUV-2B	East End of Flocc Basin No. 2/Submerged	Raw Water/Unthickened Sludge	12"	Mud	10 psi	Flanged	Manual/2" Operating Nut/Stem Extension	Flocculation Basin No. 2 East Drain
20-MUV-2C	West End of Sed Basin No. 2/Submerged	Raw Water/Unthickened Sludge	12"	Mud	10 psi	Flanged	Manual/2" Operating Nut/Stem Extension	Sedimentation Basin No. 2 West Drain
<b>Valves Associated with Conventional Filtration Facilities</b>								
21-BFV-1A	Filter No. 1 Influent Channel/Submerged/Outdoors	Settled Water	36"	Butterfly	5 psi	Flanged	Pneumatic - Opens/Closes	Submerged Valve with Neck Extension For Operator
21-BFV-2A	Filter No. 2 Influent Channel/Submerged/Outdoors	Settled Water	36"	Butterfly	5 psi	Flanged	Pneumatic - Opens/Closes	Submerged Valve with Neck Extension For Operator
21-BFV-3A	Filter No. 3 Influent Channel/Submerged/Outdoors	Settled Water	36"	Butterfly	5 psi	Flanged	Pneumatic - Opens/Closes	Submerged Valve with Neck Extension For Operator

**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Flaring, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
21-BFV-1A	Filter No. 4 Influent Channel/Submerged/Outdoors	Settled Water	36"	Butterfly	5 psi	Flanged	Pneumatic - Open/Close	Submerged Valve with Neck Extension For Operator
21-BFV-1B	Filter Pipe Gallery/Above Grade/Indoors	Finished Water	36"	Butterfly	40 psi	Flanged	Pneumatic - Open/Close	Filter No. 1 Wash Water Supply Valve
21-BFV-2B	Filter Pipe Gallery/Above Grade/Indoors	Finished Water	36"	Butterfly	40 psi	Flanged	Pneumatic - Open/Close	Filter No. 2 Wash Water Supply Valve
21-BFV-3B	Filter Pipe Gallery/Above Grade/Indoors	Finished Water	36"	Butterfly	40 psi	Flanged	Pneumatic - Open/Close	Filter No. 3 Wash Water Supply Valve
21-BFV-4B	Filter Pipe Gallery/Above Grade/Indoors	Finished Water	36"	Butterfly	40 psi	Flanged	Pneumatic - Open/Close	Filter No. 4 Wash Water Supply Valve
21-BFV-1C	Filter Pipe Gallery/Above Grade/Indoors	Filtered Water	16"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	Filter No. 1 Effluent Flow Control Valve
21-BFV-2C	Filter Pipe Gallery/Above Grade/Indoors	Filtered Water	16"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	Filter No. 2 Effluent Flow Control Valve
21-BFV-3C	Filter Pipe Gallery/Above Grade/Indoors	Filtered Water	16"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	Filter No. 3 Effluent Flow Control Valve
21-BFV-4C	Filter Pipe Gallery/Above Grade/Indoors	Filtered Water	16"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	Filter No. 4 Effluent Flow Control Valve
21-BFV-1D	Filter Pipe Gallery/Above Grade/Indoors	Filtered Water	19"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	Filter No. 1 Filter to Waste Flow Control Valve
21-BFV-2D	Filter Pipe Gallery/Above Grade/Indoors	Filtered Water	10"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	Filter No. 2 Filter to Waste Flow Control Valve
21-BFV-3D	Filter Pipe Gallery/Above Grade/Indoors	Filtered Water	10"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	Filter No. 3 Filter to Waste Flow Control Valve
21-BFV-4D	Filter Pipe Gallery/Above Grade/Indoors	Filtered Water	10"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	Filter No. 4 Filter to Waste Flow Control Valve
21-BFV-1E	Filter Pipe Gallery/Above Grade/Indoors	Spent Backwash Water	36"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	Filter No. 1 Dirty Backwash Water Drain Valve
21-BFV-2E	Filter Pipe Gallery/Above Grade/Indoors	Spent Backwash Water	36"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	Filter No. 2 Dirty Backwash Water Drain Valve
21-BFV-3E	Filter Pipe Gallery/Above Grade/Indoors	Spent Backwash Water	36"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	Filter No. 3 Dirty Backwash Water Drain Valve
21-BFV-4E	Filter Pipe Gallery/Above Grade/Indoors	Spent Backwash Water	36"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	Filter No. 4 Dirty Backwash Water Drain Valve
21-BFV-1F	Filter Pipe Gallery/Above Grade/Indoors	Compressed Air	12"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	Filter No. 1 Air Backwash Supply Valve
21-BFV-2F	Filter Pipe Gallery/Above Grade/Indoors	Compressed Air	12"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	Filter No. 2 Air Backwash Supply Valve
21-BFV-3F	Filter Pipe Gallery/Above Grade/Indoors	Compressed Air	12"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	Filter No. 3 Air Backwash Supply Valve
21-BFV-4F	Filter Pipe Gallery/Above Grade/Indoors	Compressed Air	12"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	Filter No. 4 Air Backwash Supply Valve
21-BFV-5	Filter Pipe Gallery/Above Grade/Indoors	Finished Water	20"	Butterfly	40 psi	Flanged	Pneumatic - Modulating	Main Filter Backwash Water Flow Control Valve

**Valve Schedule**  
 (Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Plumbing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
<b>Valves in Backwash Blower Room</b>								
22-CV-1	Blower Room/Blower No. 1 Discharge/Above Grade/Indoors	Compressed Air	12"	Check	10 psi	Flanged	N/A	Check Valve for Blower No. 1
22-CV-2	Blower Room/Blower No. 2 Discharge/Above Grade/Indoors	Compressed Air	12"	Check	10 psi	Flanged	N/A	Check Valve for Blower No. 2
22-BFV-1	Blower Room/Blower No. 1 Discharge/Above Grade/Indoors	Compressed Air	12"	Butterfly	10 psi	Flanged	Manual/Lever	Butterfly Valve for Blower No. 1
22-BFV-2	Blower Room/Blower No. 2 Discharge/Above Grade/Indoors	Compressed Air	12"	Butterfly	10 psi	Flanged	Manual/Lever	Butterfly Valve for Blower No. 2
22-BFV-3	Blower Room/Common Blower Discharge Piping/Above Grade/Indoors	Compressed Air	12"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	Backwash Air Blow-OFF Valve
<b>Valves Associated with GAC Contactor Structure</b>								
30-BFV-1A	GAC Contactor No. 1 Influent Channel/Submerged/Outdoors	Filtered Water	24"	Butterfly	5 psi	Flanged	Pneumatic - Open/Close	Submerged Valve with Neck Extension For Operator
30-BFV-2A	GAC Contactor No. 2 Influent Channel/Submerged/Outdoors	Filtered Water	24"	Butterfly	5 psi	Flanged	Pneumatic - Open/Close	Submerged Valve with Neck Extension For Operator
30-BFV-3A	GAC Contactor No. 3 Influent Channel/Submerged/Outdoors	Filtered Water	24"	Butterfly	5 psi	Flanged	Pneumatic - Open/Close	Submerged Valve with Neck Extension For Operator
30-BFV-4A	GAC Contactor No. 4 Influent Channel/Submerged/Outdoors	Filtered Water	24"	Butterfly	5 psi	Flanged	Pneumatic - Open/Close	Submerged Valve with Neck Extension For Operator
30-BFV-1B	GAC Contactor Pipe Gallery/Above Grade/Indoors	Finished Water	30"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	GAC Contactor No. 1 Wash Water Supply Valve
30-BFV-2B	GAC Contactor Pipe Gallery/Above Grade/Indoors	Finished Water	30"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	GAC Contactor No. 2 Wash Water Supply Valve
30-BFV-3B	GAC Contactor Pipe Gallery/Above Grade/Indoors	Finished Water	30"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	GAC Contactor No. 3 Wash Water Supply Valve
30-BFV-4B	GAC Contactor Pipe Gallery/Above Grade/Indoors	Finished Water	30"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	GAC Contactor No. 4 Wash Water Supply Valve
30-BFV-1C	GAC Contactor Pipe Gallery/Above Grade/Indoors	Filtered Water	16"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	GAC Contactor No. 1 Effluent Flow Control Valve
30-BFV-2C	GAC Contactor Pipe Gallery/Above Grade/Indoors	Filtered Water	16"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	GAC Contactor No. 2 Effluent Flow Control Valve
30-BFV-3C	GAC Contactor Pipe Gallery/Above Grade/Indoors	Filtered Water	16"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	GAC Contactor No. 3 Effluent Flow Control Valve
30-BFV-4C	GAC Contactor Pipe Gallery/Above Grade/Indoors	Filtered Water	16"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	GAC Contactor No. 4 Effluent Flow Control Valve
30-BFV-1D	GAC Contactor Pipe Gallery/Above Grade/Indoors	Filtered Water	10"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	GAC Contactor No. 1 Filter to Waste Flow Control Valve
30-BFV-2D	GAC Contactor Pipe Gallery/Above Grade/Indoors	Filtered Water	10"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	GAC Contactor No. 2 Filter to Waste Flow Control Valve
30-BFV-3D	GAC Contactor Pipe Gallery/Above Grade/Indoors	Filtered Water	10"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	GAC Contactor No. 3 Filter to Waste Flow Control Valve

**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Plumbing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
30-BFV-4D	GAC Contactor Pipe Gallery/Above Grade/Indoors	Filtered Water	10"	Butterfly	10 psi	Flanged	Pneumatic - Modulating	GAC Contactor No. 4 Filter to Waste Flow Control Valve
30-BFV-1E	GAC Contactor Pipe Gallery/Above Grade/Indoors	Spent Backwash Water	30"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	GAC Contactor No. 1 Dirty Backwash Water Drain Valve
30-BFV-2E	GAC Contactor Pipe Gallery/Above Grade/Indoors	Spent Backwash Water	30"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	GAC Contactor No. 2 Dirty Backwash Water Drain Valve
30-BFV-3E	GAC Contactor Pipe Gallery/Above Grade/Indoors	Spent Backwash Water	30"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	GAC Contactor No. 3 Dirty Backwash Water Drain Valve
30-BFV-4E	GAC Contactor Pipe Gallery/Above Grade/Indoors	Spent Backwash Water	30"	Butterfly	10 psi	Flanged	Pneumatic - Open/Close	GAC Contactor No. 4 Dirty Backwash Water Drain Valve
30-BFV-5	GAC Contactor Pipe Gallery/Above Grade/Indoors	Finished Water	16"	Butterfly	40 psi	Flanged	Pneumatic - Modulating	Main GAC Contactor Backwash Water Flow Control Valve
<b>Valves Associated with Finished Water Static Mixer, Disinfectant Contact Basin, &amp; Clearwell</b>								
40-BFV-1	Upstream of Finished Water Static Mixer/Buried	Finished Water	42"	Butterfly	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Static Mixer
40-BFV-2	Downstream of Finished Water Static Mixer/Buried	Finished Water	42"	Butterfly	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Static Mixer
40-BFV-3	Upstream of Disinfectant Contact Basin/Buried	Finished Water	48"	Butterfly	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Disinfectant Contact Basin
40-BFV-4	Upstream of Clearwell/Buried	Finished Water	48"	Butterfly	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Clearwell
40-FV-1	Disinfectant Contact Basin/Clearwell Overflow Discharge/Above Grade/Outdoors	Finished Water	36"	Flap	N/A	Flanged	N/A	Flap Valve at Disinfectant Contact Basin/Clearwell Overflow to Drainage System
40-FV-2	Disinfectant Contact Basin/Clearwell Overflow Discharge/Above Grade/Outdoors	Finished Water	36"	Flap	N/A	Flanged	N/A	Flap Valve at Disinfectant Contact Basin/Clearwell Overflow to Drainage System
<b>Valves Associated with Backwash Water Supply Pump &amp; Finished Water Interconnect</b>								
41-CV-1	Downstream of Backwash Water Supply Pump No. 1/Above Grade/Indoors	Finished Water	16"	Check, Water Style w/ Dashedport	125 psi	Flanged	N/A	Cushioned Wafer Swing Check Valve for Backwash Water Supply Pump No. 1
41-BFV-1	Downstream of Backwash Water Supply Pump No. 1/Above Grade/Indoors	Finished Water	16"	Butterfly	125 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Backwash Water Supply Pump No. 1
41-ARV-1	Downstream of Backwash Water Supply Pump No. 1/Above Grade/Indoors	Finished Water	3"	Air Release	125 psi	Flanged	Manual/Lever (For Isolation Valve)	Air Release Valve for Backwash Water Supply Pump No. 1/Provide Isolation Butterfly Valve
41-PRV-1	Between Backwash & Finished Water Pumps/Above Grade/Indoors	Finished Water	24"	Pressure Reducing/Sustaining	125 psi	Flanged	N/A	Pressure Reducing/Sustaining Valve for Alternate Backwash Water Supply
41-BFV-2	Upstream of 41-PRV-1/Above Grade/Outdoors	Finished Water	24"	Butterfly	125 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for 41-PRV-1
41-BFV-3	Downstream of 41-PRV-1/Above Grade/Indoors	Finished Water	24"	Butterfly	125 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for 41-PRV-1
<b>Valves Associated with Finished Water Pumps &amp; Finished Water Flow Meter</b>								
42-BV-1	Downstream of Finished Water Pump No. 1/Above Grade/Indoors	Finished Water	20"	Ball	125 psi	Flanged	Hydraulic - Controlled Closing	Check Valve for Finished Water Pump No. 1

**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Plumbing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
42-BV-2	Downstream of Finished Water Pump No. 2/Above Grade/Indoors	Finished Water	20"	Ball	125 psi	Flanged	Hydraulic - Controlled Closing	Check Valve for Finished Water Pump No. 2
42-BV-3	Downstream of Finished Water Pump No. 3/Above Grade/Indoors	Finished Water	20"	Ball	125 psi	Flanged	Hydraulic - Controlled Closing	Check Valve for Finished Water Pump No. 3
42-BFV-1	Downstream of Finished Water Pump No. 1/Above Grade/Indoors	Finished Water	20"	Butterfly	125 psi	Flanged	Manual/Gear/ Handwheel	Isolation Valve for Finished Water Pump No. 1
42-BFV-2	Downstream of Finished Water Pump No. 2/Above Grade/Indoors	Finished Water	20"	Butterfly	125 psi	Flanged	Manual/Gear/ Handwheel	Isolation Valve for Finished Water Pump No. 2
42-BFV-3	Downstream of Finished Water Pump No. 3/Above Grade/Indoors	Finished Water	20"	Butterfly	125 psi	Flanged	Manual/Gear/ Handwheel	Isolation Valve for Finished Water Pump No. 3
42-BFV-4	Downstream of Finished Water Pump No. 4/Above Grade/Indoors	Finished Water	20"	Butterfly	125 psi	Flanged	Manual/Gear/ Handwheel	Isolation Valve for Finished Water Pump No. 4
42-BFV-5	Downstream of Finished Water Pump No. 5/Above Grade/Indoors	Finished Water	20"	Butterfly	125 psi	Flanged	Manual/Gear/ Handwheel	Isolation Valve for Finished Water Pump No. 5
42-BFV-6	Downstream of Finished Water Pump No. 6/Above Grade/Indoors	Finished Water	20"	Butterfly	125 psi	Flanged	Manual/Gear/ Handwheel	Isolation Valve for Finished Water Pump No. 6
42-BFV-7	Downstream of Finished Water Flow Meter/Buried	Finished Water	42"	Butterfly	125 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Flow Meter
42-BFV-8	Finished Water Pump Room	Hydraulic Oil	4"	Butterfly	150 psi	Flanged	Manual/Lever	Isolation Valve for Air/Oil Accumulator System
42-BFV-9	Finished Water Pump Room	Hydraulic Oil	4"	Butterfly	150 psi	Flanged	Manual/Lever	Isolation Valve for Air/Oil Accumulator System
42-ARV-1	Downstream of Finished Water Pump No. 1/Above Grade/Indoors	Finished Water	3"	Well Pump Air Release	125 psi	Flanged	Manual/Lever (For Isolation Valve)	Well Pump Air Release Valve for Finished Water Pump No. 1/Provide Isolation Butterfly Valve
42-ARV-2	Downstream of Finished Water Pump No. 2/Above Grade/Indoors	Finished Water	3"	Well Pump Air Release	125 psi	Flanged	Manual/Lever (For Isolation Valve)	Well Pump Air Release Valve for Finished Water Pump No. 2/Provide Isolation Butterfly Valve
42-ARV-3	Downstream of Finished Water Pump No. 3/Above Grade/Indoors	Finished Water	6"	Well Pump Air Release	125 psi	Flanged	Manual/Lever (For Isolation Valve)	Well Pump Air Release Valve for Finished Water Pump No. 3/Provide Isolation Butterfly Valve
42-GV-1	At 42" X 8" Tapping Sleeve Near Finished Water Pump Station/Buried	Finished Water	8"	Gate (Tapping Valve)	125 psi	Flanged X Mech. Joint	Manual/2" Operating Nut/Valve Box	Tapping Valve For On-Site Water Supply System
42-GV-2	Northeast of GAC Contactor/Buried	Finished Water	6"	Gate	125 psi	Mechanical Joint	Manual/2" Operating Nut/Valve Box	Gate Valve for Fire Hydrant
42-GV-3	West of GAC Contactor/Buried	Finished Water	6"	Gate	125 psi	Mechanical Joint	Manual/2" Operating Nut/Valve Box	Gate Valve for Fire Hydrant
42-GV-4	East of Main Entrance to Operations Building/Buried	Finished Water	8"	Gate	125 psi	Mechanical Joint	Manual/2" Operating Nut/Valve Box	Gate Valve for Fire Protection System
42-GV-5	East of Main Entrance to Operations Building/Buried	Finished Water	3"	Gate	125 psi	Mechanical Joint	Manual/2" Operating Nut/Valve Box	Gate Valve for Domestic Water Service for Operations Building
42-GV-6	North of Chemical Storage Area/Buried	Finished Water	6"	Gate	125 psi	Mechanical Joint	Manual/2" Operating Nut/Valve Box	Gate Valve for Fire Hydrant
42-GV-5	East of Spent Backwash Water Storage Tank/Buried	Finished Water	6"	Gate	125 psi	Mechanical Joint	Manual/2" Operating Nut/Valve Box	Gate Valve for Fire Hydrant

Valves Associated with Gravity Thickener

**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Plumbing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
50-PV-1	West Side of Gravity Thickener/Buried	Unthickened Sludge	12"	Plug	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Thickener - Influent
50-PV-2	Northeast Side of Gravity Thickener/Buried	Thickened Sludge	8"	Plug	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Thickener - Sludge
<b>Valves Associated with Thickened Sludge Pumps</b>								
51-PV-1A	1/Upstream of Thickened Sludge Pump No. 1/Above Grade/Indoors	Thickened Sludge	8"	Plug	10 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Thickened Sludge Pump No. 1 - Suction Side
51-PV-2A	1/Upstream of Thickened Sludge Pump No. 2/Above Grade/Indoors	Thickened Sludge	8"	Plug	10 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Thickened Sludge Pump No. 2 - Suction Side
51-CV-1	1/Downstream of Thickened Sludge Pump No. 1/Above Grade/Indoors	Thickened Sludge	6"	Check	20 psi	Flanged	N/A	Rubber Flapper Swing Check Valve for Thickened Sludge Pump No. 1
51-CV-2	2/Downstream of Thickened Sludge Pump No. 1/Above Grade/Indoors	Thickened Sludge	6"	Check	20 psi	Flanged	N/A	Rubber Flapper Swing Check Valve for Thickened Sludge Pump No. 2
51-PV-1B	1/Downstream of Thickened Sludge Pump No. 1/Above Grade/Indoors	Thickened Sludge	6"	Plug	20 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Thickened Sludge Pump No. 1 - Discharge Side
51-PV-2B	2/Downstream of Thickened Sludge Pump No. 1/Above Grade/Indoors	Thickened Sludge	6"	Plug	20 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Thickened Sludge Pump No. 2 - Discharge Side
51-PV-3	Valve Pit in Sludge Pump Building/Indoors	Thickened Sludge	8"	Plug	10 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Thickened Sludge Pumps
51-PV-4	1/Downstream of Thickened Sludge Pump Discharge Manifold/Buried	Thickened Sludge	6"	Plug	20 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Diversion Valve - Directs Flow to Sludge Drying Beds or Spent Backwash Water Tank
51-PV-5	1/Downstream of Thickened Sludge Pump Discharge Manifold/Buried	Thickened Sludge	6"	Plug	20 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Diversion Valve - Directs Flow to Sludge Drying Beds or Spent Backwash Water Tank
51-GV-1	Thickened Sludge Pump Room	Potable Water	6"	Gate	150 psi	Flanged	Manual/Handwheel	Isolation valve for Siamese connection
<b>Valves Associated with Sludge Recycle Pumps</b>								
52-PV-1A	1/Upstream of Sludge Recycle Pump No. 1/Above Grade/Indoors	Sludge	8"	Plug	10 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Sludge Recycle Pump No. 1 - Suction Side
52-CV-1	1/Downstream of Sludge Recycle Pump No. 1/Above Grade/Indoors	Sludge	6"	Check	20 psi	Flanged	N/A	Rubber Flapper Swing Check Valve for Sludge Recycle Pump No. 1
52-PV-1B	1/Downstream of Sludge Recycle Pump No. 1/Above Grade/Indoors	Sludge	6"	Plug	20 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Thickened Sludge Pump No. 1 - Discharge Side
52-PV-3	Valve Pit in Sludge Pump Building/Indoors	Sludge	8"	Plug	10 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Sludge Recycle Pump (PV-2 reserved for future pump)
52-PV-4	1/Downstream of Sludge Recycle Pump Discharge Manifold/Buried	Sludge	6"	Plug	20 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Diversion Valve - Directs Flow to Thickener or Sludge Drying Beds
52-PV-5	1/Downstream of Sludge Recycle Pump Discharge Manifold/Buried	Sludge	6"	Plug	20 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Diversion Valve - Directs Flow to Thickener or Sludge Drying Beds
<b>Valves Associated with Sludge Drying Beds</b>								
60-PV-1	On 6" TSL from TSL/Recycle Pump Station West of Row A/Buried	Thickened Sludge	6"	Plug	10 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Sludge Drying Beds Isolation Valve for Row A/Buried

**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Flushing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
60-PV-2	On 6" TSL from TSL/Recycle Pump Station Between Row B and C/Buried	Thickened Sludge	6"	Plug	10 psi	Mechanical Joint	Manual/Clear/2" Operating Nut/Valve Box	Sludge Drying Beds Isolation Valve for Row B & C/Buried
60-PV-3	On 6" TSL from TSL/Recycle Pump Station Between Row D and E/Buried	Thickened Sludge	6"	Plug	10 psi	Mechanical Joint	Manual/Clear/2" Operating Nut/Valve Box	Sludge Drying Beds Isolation Valve for Row D & E/Buried
60-PV-4	On 6" TSL from TSL/Recycle Pump Station Between Row F and G/Buried	Thickened Sludge	6"	Plug	10 psi	Mechanical Joint	Manual/Clear/2" Operating Nut/Valve Box	Sludge Drying Beds Isolation Valve for Row F & G/Buried
60-PV-5	On 6" TSL from TSL/Recycle Pump Station Between Row H and I/Buried	Thickened Sludge	6"	Plug	10 psi	Mechanical Joint	Manual/Clear/2" Operating Nut/Valve Box	Sludge Drying Beds Isolation Valve for Row H & I/Buried
60-PV-6	On 6" TSL from TSL/Recycle Pump Station East of Row I/Buried	Thickened Sludge	6"	Plug	10 psi	Mechanical Joint	Manual/Clear/2" Operating Nut/Valve Box	Sludge Drying Beds Isolation Valve for Row
60-PV-A-1	Sludge Drying Beds A1 & A2/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds A1 & A2/Above Grade/Outdoors
60-PV-A-2	Sludge Drying Beds A3 & A4/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds A3 & A4/Above Grade/Outdoors
60-PV-A-3	Sludge Drying Beds A5 & A6/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds A5 & A6/Above Grade/Outdoors
60-PV-A-4	Sludge Drying Beds A7 & A8/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds A7 & A8/Above Grade/Outdoors
60-PV-A-5	Sludge Drying Beds A9 & A10/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds A9 & A10/Above Grade/Outdoors
60-PV-B-1	Sludge Drying Beds B1 & B2/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds B1 & B2/Above Grade/Outdoors
60-PV-B-2	Sludge Drying Beds B3 & B4/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds B3 & B4/Above Grade/Outdoors
60-PV-B-3	Sludge Drying Beds B5 & B6/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds B5 & B6/Above Grade/Outdoors
60-PV-B-4	Sludge Drying Beds B7 & B8/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds B7 & B8/Above Grade/Outdoors
60-PV-B-5	Sludge Drying Beds B9 & B10/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds B9 & B10/Above Grade/Outdoors
60-PV-C-1	Sludge Drying Beds C1 & C2/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds C1 & C2/Above Grade/Outdoors
60-PV-C-2	Sludge Drying Beds C3 & C4/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds C3 & C4/Above Grade/Outdoors
60-PV-C-3	Sludge Drying Beds C5 & C6/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds C5 & C6/Above Grade/Outdoors
60-PV-C-4	Sludge Drying Beds C7 & C8/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds C7 & C8/Above Grade/Outdoors
60-PV-C-5	Sludge Drying Beds C9 & C10/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds C9 & C10/Above Grade/Outdoors
60-PV-D-1	Sludge Drying Beds D1 & D2/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds D1 & D2/Above Grade/Outdoors
60-PV-D-2	Sludge Drying Beds D3 & D4/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds D3 & D4/Above Grade/Outdoors



**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Plumbing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
60-PV-D-3	Sludge Drying Beds D5 & D6/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds D5 & D6/Above Grade/Outdoors
60-PV-D-4	Sludge Drying Beds D7 & D8/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds D7 & D8/Above Grade/Outdoors
60-PV-D-5	Sludge Drying Beds D9 & D10/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds D9 & D10/Above Grade/Outdoors
60-PV-E-1	Sludge Drying Beds E1 & E2/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds E1 & E2/Above Grade/Outdoors
60-PV-E-2	Sludge Drying Beds E3 & E4/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds E3 & E4/Above Grade/Outdoors
60-PV-E-3	Sludge Drying Beds E5 & E6/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds E5 & E6/Above Grade/Outdoors
60-PV-E-4	Sludge Drying Beds E7 & E8/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds E7 & E8/Above Grade/Outdoors
60-PV-E-5	Sludge Drying Beds E9 & E10/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds E9 & E10/Above Grade/Outdoors
60-PV-F-1	Sludge Drying Beds F1 & F2/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds F1 & F2/Above Grade/Outdoors
60-PV-F-2	Sludge Drying Beds F3 & F4/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds F3 & F4/Above Grade/Outdoors
60-PV-F-3	Sludge Drying Beds F5 & F6/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds F5 & F6/Above Grade/Outdoors
60-PV-F-4	Sludge Drying Beds F7 & F8/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds F7 & F8/Above Grade/Outdoors
60-PV-F-5	Sludge Drying Beds F9 & F10/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds F9 & F10/Above Grade/Outdoors
60-PV-G-1	Sludge Drying Beds G1 & G2/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds G1 & G2/Above Grade/Outdoors
60-PV-G-2	Sludge Drying Beds G3 & G4/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds G3 & G4/Above Grade/Outdoors
60-PV-G-3	Sludge Drying Beds G5 & G6/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds G5 & G6/Above Grade/Outdoors
60-PV-G-4	Sludge Drying Beds G7 & G8/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds G7 & G8/Above Grade/Outdoors
60-PV-G-5	Sludge Drying Beds G9 & G10/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds G9 & G10/Above Grade/Outdoors
60-PV-H-1	Sludge Drying Beds H1 & H2/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds H1 & H2/Above Grade/Outdoors
60-PV-H-2	Sludge Drying Beds H3 & H4/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds H3 & H4/Above Grade/Outdoors
60-PV-H-3	Sludge Drying Beds H5 & H6/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds H5 & H6/Above Grade/Outdoors
60-PV-H-4	Sludge Drying Beds H7 & H8/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds H7 & H8/Above Grade/Outdoors

**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Flaming, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
60-PV-H-5	Sludge Drying Beds 19 & 110/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 19 & 110/Above Grade/Outdoors
60-PV-I-1	Sludge Drying Beds 11 & 12/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 11 & 12/Above Grade/Outdoors
60-PV-I-2	Sludge Drying Beds 13 & 14/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 13 & 14/Above Grade/Outdoors
60-PV-I-3	Sludge Drying Beds 15 & 16/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 15 & 16/Above Grade/Outdoors
60-PV-I-4	Sludge Drying Beds 17 & 18/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 17 & 18/Above Grade/Outdoors
60-PV-I-5	Sludge Drying Beds 19 & 110/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 19 & 110/Above Grade/Outdoors
60-PV-J-1	Sludge Drying Beds 11 & 12/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 11 & 12/Above Grade/Outdoors
60-PV-J-2	Sludge Drying Beds 13 & 14/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 13 & 14/Above Grade/Outdoors
60-PV-J-3	Sludge Drying Beds 15 & 16/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 15 & 16/Above Grade/Outdoors
60-PV-J-4	Sludge Drying Beds 17 & 18/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 17 & 18/Above Grade/Outdoors
60-PV-J-5	Sludge Drying Beds 19 & 110/Above Grade/Outdoors	Thickened Sludge	4"	Plug	10 psi	Flanged	Manual/Lever	Isolation Valve for Sludge Drying Beds 19 & 110/Above Grade/Outdoors
<b>Valves Associated with Filtrate Pump Station</b>								
61-CV-1	Valve Vault @ Filtrate Pump Station	Filtrate	8"	Check	20 psi	Flanged	N/A	Rubber Flapper Check Valve for Filtrate Pump No. 1
61-CV-2	Valve Vault @ Filtrate Pump Station	Filtrate	8"	Check	20 psi	Flanged	N/A	Rubber Flapper Check Valve for Filtrate Pump No. 2
61-PV-1	Valve Vault @ Filtrate Pump Station	Filtrate	8"	Plug	20 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Filtrate Pump No. 1
61-PV-2	Valve Vault @ Filtrate Pump Station	Filtrate	8"	Plug	20 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Filtrate Pump No. 2
61-PV-3	Valve Vault @ Filtrate Pump Station	Filtrate	8"	Plug	20 psi	Flanged	Manual/Gear/Handwheel	Isolation Valve for Emergency Filtrate Pump Connection
<b>Valves Associated with Spent Backwash Water Storage Tank</b>								
70-BFV-1	North Side of Spent Backwash Water Storage Tank/Buried	Supernatant	16"	Butterfly	10 psi	Mechanical Joint	Manual/Gear/2" Nut/Valve Box	Isolation Valve for Spent Backwash Water Tank - Supernatant
70-BFV-2	East Side of Spent Backwash Water Storage Tank/Buried	Supernatant	16"	Butterfly	10 psi	Mechanical Joint	Manual/Gear/2" Nut/Valve Box	Isolation Valve for Spent Backwash Water Tank - Supernatant
<b>Valves Associated with Elevated Backwash Water Storage Tank</b>								
71-BFV-1	Backwash Water Storage Tank/Above Grade/Outdoors	Finished Water	24"	Butterfly	40 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Backwash Water Supply Isolation Valve

**Valve Schedule**  
 (Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Flushing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
71-BFV-2	Backwash Water Storage Tank/Above Grade/Outdoors	Finished Water	30"	Butterfly	40 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Backwash Water Flow Meter Isolation Valve
71-BRV-3	Backwash Water Storage Tank/Above Grade/Outdoors	Finished Water	30"	Butterfly	40 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Backwash Water Flow Meter Isolation Valve
71-FV-1	Backwash Water Storage Tank/Above Grade/Outdoors	Finished Water	10"	Flap	N/A	Flanged	N/A	Flap Valve at Storage Tank Overflow to Drainage System
<b>Raw Water Main Air Release Valves</b>								
RW-ARV-1	Station 126+25	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-2	Station 136+50	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-3	Station 139+70	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-4	Station 147+88	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-5	Station 153+10	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-6	Station 178+50	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-7	Station 192+50	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-8	Station 216+00	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-9	Station 257+80	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-10	Station 274+00 (36.92L)	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-11	Station 274+00 (44.92L)	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-12	Station 292+96	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-13	Station 293+01	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
RW-ARV-14	Station 458+00	Raw Water	6"	Air Release	70 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Raw Water Main/Provide Isolation Gate Valve
<b>Raw Water Main Isolation Valves</b>								
RW-BFV-1	Station 261+25	Raw Water	42"	Butterfly	70 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Raw Water Main
RW-BFV-2	Station 261+30	Raw Water	42"	Butterfly	70 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Raw Water Main
RW-BFV-3	Station 261+36	Raw Water	42"	Butterfly	70 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Raw Water Main

**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Plumbing, Fire Protection, & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
FW-BFV-4	Station 499+97	Raw Water	42"	Butterfly	70 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Raw Water Main
<b>Finished Water Main Isolation Valves</b>								
FW-BFV-1	Station 799+71	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-2	Station 800+34	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-3	Station 854+75	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-4	Station 870+51	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-5	Station 873+91	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-6	Station 975+75	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-7	Station 1052+27	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-8	Station 1075+26	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-9	Station 1111+38	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-10	Station 1130+37	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-11	Station 1150+89	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-12	Station 3973+47	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
FW-BFV-13	Station 3988+00	Finished Water	48"	Butterfly	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Isolation Valve for Finished Water Main
<b>Finished Water Main Air Release Valves</b>								
FW-ARV-1	Station 792+00	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-2	Station 802+00	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-3	Station 808+90	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-4	Station 840+05	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-5	Station 870+40	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-6	Station 874+00	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve

**Valve Schedule**  
(Process Valves 3" & Larger - Excluding Chemical Feed, Compressed Air, Plumbing, Fire Protection & Fuel System Valves)

Valve Number	General Location & Environment	Service	Valve Size	Valve Type	Nominal Operating Pressure	End Connections	Actuator	Remarks
FW-ARV-7	Station 906+37	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-8	Station 971+90	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-9	Station 1000+59	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-10	Station 1027+38	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-11	Station 1040+30	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-12	Station 1060+86	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve
FW-ARV-13	Station 1113+56	Finished Water	6"	Air Release	150 psi	Flanged	Manual/Handwheel (For Isolation Valve)	Air Release Valve for Finished Water Main/Provide Isolation Gate Valve

**Finished Water Main Fire Hydrant Valves**

FW-FHV-1	Station 802+24	Finished Water	6"	Gate Valve	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Gate valve for fire hydrant
FW-FHV-2	Station 854+65	Finished Water	6"	Gate Valve	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Gate valve for fire hydrant
FW-FHV-3	Station 907+00	Finished Water	6"	Gate Valve	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Gate valve for fire hydrant
FW-FHV-4	Station 959+50	Finished Water	6"	Gate Valve	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Gate valve for fire hydrant
FW-FHV-5	Station 1010+75	Finished Water	6"	Gate Valve	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Gate valve for fire hydrant
FW-FHV-6	Station 1061+00	Finished Water	6"	Gate Valve	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Gate valve for fire hydrant
FW-FHV-6	Station 1112+00	Finished Water	6"	Gate Valve	150 psi	Mechanical Joint	Manual/Gear/2" Operating Nut/Valve Box	Gate valve for fire hydrant

**NOTES:**

- Valves associated with chemical feed, compressed air, plumbing, fire protection, and fuel systems are not addressed in this schedule.
- All valves shown on the various Drawings shall be furnished and installed regardless of whether or not they are included in this schedule.



**SECTION 40 42 13**  
**PROCESS PIPING INSULATION**

**PART 1 GENERAL**

**1.01 REFERENCES**

- A. The following is a list of standards which may be referenced in this Section:
1. American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
  2. ASTM International (ASTM):
    - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
    - b. C165 Standard Test Method for Measuring Compressive Properties of Thermal Insulation.
    - c. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
    - d. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
    - e. C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
    - f. C547, Standard Specification for Mineral Fiber Pipe Insulation.
    - g. C552, Specification for Cellular Glass Thermal Insulation.
    - h. C585, Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
    - i. C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
    - j. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
    - k. E96, Standard Test Methods for Water Vapor Transmission of Materials.
  3. International Code Council (ICC) International Energy Conservation Code (IECC).
  4. Manufacturers Standardization Society (MSS): SP-69, Pipe Hangers and Supports.
  5. Underwriters Laboratories Inc. (UL).

## 1.02 SUBMITTALS

- A. Action Submittals: Manufacturer's descriptive literature.
- B. Informational Submittals: Maintenance information.

## PART 2 PRODUCTS

### 2.01 PIPE INSULATION

- A. Type 1-Elastomeric:
  - 1. Material: Flexible elastomeric pipe insulation, closed-cell structure in accordance with ASTM C534.
  - 2. Temperature Rating: Minus 40 degrees F to 180 degrees F.
  - 3. Nominal Density: 6 pcf.
  - 4. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.27 Btu-in/hr-square foot degrees F at 75 degrees F per ASTM C177 or ASTM C518.
  - 5. Minimum water vapor transmission of 0.08 perm-inch per ASTM E96, Procedure A.
  - 6. Joints: Manufacturer's adhesive.
  - 7. Flame Spread Rating: Less than 25 per ASTM E84.
  - 8. Smoke Developed Index: Less than 50 per ASTM E84.
  - 9. Manufacturers and Products:
    - a. Rubatex; Insul-Tube 180 or Insul-Sheet 1800.
    - b. Armstrong; Armaflex AP.
    - c. Approved equal.
- B. Type 2-Fiberglass:
  - 1. Material: UL rated, preformed, sectional bonded fiberglass per ASTM C585 with factory applied Kraft paper with aluminum foil vapor barrier jacket with pressure-sensitive self-sealing lap.
  - 2. Temperature Rating: Zero to 850 degrees F.
  - 3. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.27 Btu-in/hr-square foot degrees F.
  - 4. Jacketing per ASTM C1136 with minimum water vapor transmission for jacket of 0.02 perm-inch per ASTM E96.
  - 5. Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
  - 6. Flame Spread Rating: Less than 25 per ASTM E84.
  - 7. Smoke Developed Index: Less than 50 per ASTM E84.
  - 8. Manufacturers and Products:
    - a. Owens Corning Fiberglass; ASJ/SSL-11.



- b. John Manville; Micro-Lock 650 with AP-T Jacket.
- c. Approved equal.

C. Type 3—Foamglass:

- 1. Material: Cellular glass per ASTM C552.
- 2. Nominal Density: 7.5 pcf.
- 3. Compressive strength: 90 psi per ASTM C165.
- 4. Temperature Rating: Minus 290 to 900 degrees F.
- 5. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.29 Btu-in/hr-square foot degrees F.
- 6. Minimum water vapor transmission for insulation of 0.00 perm-inch per ASTM E96.
- 7. Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
- 8. Flame Spread Rating: 0 per ASTM E84.
- 9. Smoke Developed Index: 0 per ASTM E84.
- 10. Follow manufacturer's recommendation, based upon temperature of piping to be insulated.
- 11. Manufacturer and Product: Pittsburgh Corning Foamglass or approved equal.

## 2.02 FITTING INSULATION

A. Type 1: Same as pipe.

B. Type 2:

- 1. Wired in-place premolded insulation or mitered segments, or soft fiberglass insulation inserts covered with premolded 20-mil minimum thickness PVC fitting covers.
- 2. Manufacturers:
  - a. Manville Zeston.
  - b. Speedline.
  - c. Proto.
  - d. Ceel-Co.
  - e. Approved equal.

C. Type 3: Same as pipe.

## 2.03 INSULATION AT PIPE HANGERS AND SUPPORTS

A. Refer to Section 40 05 15, Piping Support Systems.

B. Copper, Ductile Iron, and Nonmetallic Pipe: High density inserts, thickness equal to adjoining insulation, of Type 3 or other rigid insulation or

manufactured pre-insulated pipe hangers and insulation shields per MSS SP-69, Table 5 at support locations. Extend inserts beyond shields.

- C. Steel Pipe: Insulation saddles or high density inserts, thickness equal to adjoining insulation, of Type 3 or other rigid insulation or manufactured pre-insulated pipe hangers and insulation shields per MSS SP-69, Table 5 at support locations. Extend inserts beyond shields.

## 2.05 INSULATION FINISH SYSTEMS

### A. Type F1—PVC:

- 1. Polyvinyl chloride (PVC) jacketing, white, for straight run piping and fitting locations, temperatures to 159 degrees F.
- 2. Manufacturers and Products:
  - a. Johns Manville; Zeston.
  - b. Approved equal.

### B. Type F2—Paint:

- 1. As specified in Section 09 90 00, Painting and Coating

### C. Type F3—Aluminum:

- 1. Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100, or 3105 to ASTM B209 with H-14 temper, minimum 0.016 inch thickness, with smooth mill finish.
- 2. Vapor Barrier: Provide factory applied vapor barrier, consisting of 40-pound Kraft paper with 1-mil thick low density polyethylene film, heat and pressure bonded to inner surface of aluminum jacketing.
- 3. Fitting Covers: Material as for aluminum roll jacketing, premolded, one or two piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
- 4. Manufacturers:
  - a. RPR Products; Insul-Mate.
  - b. Childers.
  - c. Pabco
  - d. Approved equal.

### D. Type F4—Foamglass Jacketing:

- 1. Type 3 Insulation-Buried and Up to 1 Foot Above Grade: Jacket system to be Pittsburgh Corning-Pittwrap SS, 70-mil bituminous resin with woven, glass fabric, aluminum foil layer, and plastic film coating, heat-sealed at overlap or approved equal.

2. Type 3 Insulation-Greater than 1 Foot Above Grade: Jacket system to be Pittsburgh Corning-Pittwrap CW30, 30-mil modified bituminous membrane with manual jacket pressure seals or approved equal.

## **PART 3 EXECUTION**

### **3.01 APPLICATION**

#### **A. General:**

1. Insulate valve bodies, flanges, and pipe couplings.
2. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
3. Do not insulate flexible pipe couplings and expansion joints.
4. Service and Insulation Thickness: Refer to Section 40 05 33 – Pipe Heat Tracing.

### **3.02 INSTALLATION**

#### **A. General:**

1. Install in accordance with manufacturer's instructions and as specified herein.
2. Install insulation after piping system has been pressure tested and leaks corrected.
3. Apply insulation over clean dry surfaces.
4. Do not allow insulation to cover nameplates or code inspection stamps.
5. Run insulation or insulation inserts continuously through pipe hangers and supports, wall openings, ceiling openings, and pipe sleeves, unless otherwise shown.
6. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
7. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
8. Personnel Protection: Install on pipes from floor to 8 feet high. Install on pipes within 4 feet of platforms and to 8 feet high above platforms.

**B. Connection to Existing Piping:** Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.

**C. Cold Surfaces:** Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.

- D. Placement:
1. Slip insulation on pipe or tubing before assembly when practical to avoid longitudinal seams.
  2. Insulate valves and fittings with sleeved or cut pieces of same material.
  3. Seal and tape joints.
- E. Insulation at Hangers and Supports: Insulation or insulation inserts to be continuous through hanger or support.
- F. Heat Traced Piping: Apply insulation after heat-tracing work is completed and inspected.
- G. Roof Drains: Insulate vertical drops from roof drain to horizontal pipe, exposed and concealed horizontal piping, and 2 feet down on vertical risers from horizontal pipe.
- H. Roof and Overflow Drain Sumps: Insulate underside.
- I. Vapor Barrier:
1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
  2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
  3. Do not use staples and screws to secure vapor sealed system components.
- J. Aluminum Jacket:
1. Use continuous friction type joint to hold jacket in place, providing positive weatherproof seal over entire length of jacket.
  2. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
  3. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
  4. Do not use screws or rivets to fasten the fitting covers.
  5. Install removable prefabricated aluminum covers on exterior flanges and unions.
  6. Caulk and seal exterior joints to make watertight.

### 3.03 FIELD FINISHING

- A. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.
- B. Where pipe labels or banding are specified for a piping system they shall be applied to the finished insulation and not to the pipe.