SECTION 41 10 02 PROCESS PIPING AND VALVES

PART 1 - GENERAL

1.1 Scope of Work

A. Furnish all labor, materials, equipment and incidentals required to install all Process Piping and Appurtenances as shown on the drawings and specified herein. This specification covers the requirements for process water pipe, piping, pipe supports, valves, fittings, and accessories only. For other civil, mechanical and plumbing related piping specifications Contractor shall refer to other piping specifications. The Contractor shall procure, install, support and test all process piping shown on the Performance Work Statement (PWS) Drawings and described in these specifications.

B. All piping underneath the Perkiomen Creek from vault 1 to vault 2 will be 8” HDPE.

C. All piping from vault 2 to the booster station building will be 8” DI pipe.

D. Water storage tank T-1 fill pipe will be 8” DI pipe. Overflow line provided on water storage tank T-1 will be 8” PVC pipe. Reservoir sensing line to water storage tank T-1 will be 1” SS pipeline. 8” DI drain line will be provided on water storage tank T-1.

E. Drain pipeline from sink to stone infiltration basin will be 4” PVC. Drain pipeline from emergency shower and eyewash station to stone infiltration basin will also be 4” PVC pipeline.

F. Discharge pipeline going out of the booster station building will be 4” DI pipe.

G. All pipe from water storage tank T-1 to high service pump skid will be 8” DI pipe.

H. System connection provided at hydropneumatic tank T-4 will be 3” SS line.

I. All chemical feed piping and tubing are specified in Section 43 32 69, Chemical Feed System - Metering Pumps.

1.2 Related Sections

A. Sections Include:

1. Section 01 33 00 Submittals and Substitutions
2. Section 22 11 13 Facility Water Distribution Piping
3. Section 22 42 13 Plumbing Fixtures
4. Section 31 00 00 Excavation, Backfill & Compaction
5. Section 43 32 69 Chemical Metering Systems

1.3 References

A. The publications listed below form a part of this specification to the extent referenced.

1. American Society of Mechanical Engineers International (ASME)

   B1.1: Unified Inch Screw Threads (UN and UNR Thread Form)
   B1.20.1: Pipe Threads, General Purpose (Inch)
   B1.20.7: Standard for Hose Coupling Screw Threads (Inch)
   B16.11: Forged Fittings, Socket-Welding and Threaded
   B16.21: Nonmetallic Flat Gaskets for Pipe Flanges
   B16.3: Malleable Iron Threaded Fittings, Classes 150 and 300
   B16.39: Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
   B16.5: Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
   B16.9: Standard for Factory-Made Wrought Steel Butt-welding Fittings
   B18.2.1: Square and Hex Bolts and Screws (Inch Series)
   B18.2.2: Standard for Square and Hex Nuts
   B31.3: Process Piping
   B36.19M: Stainless Steel Pipe
   BPVC SEC VIII D1: BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

2. American Society for Testing and Materials (ASTM)

   A181/A181M: Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
   D1784: Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds
   D1785: Standard Specification for Poly (Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
   D2105: Standard Test for Longitudinal Tensile Properties of Reinforced Thermosetting Plastic Pipe and Tube
   D2122: Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
   D 2241: Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
   D2412: Standard Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
   D2464: Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
   D2467: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
   D2564: Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
   D2855: Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
   F2164: Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
   F2620: Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
   F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
   F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
   F656: Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

3. American Welding Society (AWS):

   B3.0: Welding Procedure and Performance Qualification
   A5.11/A5.11M: Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding
   A5.14/A5.14M: Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods
   D1.1/D1.1M: Structural Welding Code – Steel

4. Manufacturers Standardization Society (MSS)

   SP-25: Standard Marking System for Valves, Fittings, Flanges and Unions
   SP-58: Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
   SP-69: Standard for Pipe Hangers and Supports - Selection and Application
   SP-80: Bronze Gate, Globe, Angle, and Check Valves
   SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices

5. Plastics Pipe Institute (PPI)

   TR-21: Thermal Expansion and Contraction in Plastic Piping Systems

6. Rubber Manufacturers Association (RMA)

   IP-2: Hose Handbook

1.4 Submittals

A. The following shall be submitted in accordance with Section 01 33 00 Submittals:

1. Shop Drawings: Shop drawings and support system detail drawings showing piping and appurtenances including mechanical joints, valves, hangers, and pipe supports. Include a complete list of equipment and materials on the drawings.

2. Product Data: Manufacturer's descriptive and technical literature for each piping system, including design recommendations; pressure and temperature ratings; dimensions, type, grade and strength of pipe and fittings and chemical resistance.

3. Material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) for each chemical (solvents, solvent cements, and glues) delivered for use in pipe installation.

4. Pipe Schedule: Provide a list of piping systems, pressure ratings and source of supply for each piping system broken out by material, size and application as indicated on the PWS Drawings. Provide a list of any special tools necessary for each piping system and appurtenance furnished for adjustment, operation, maintenance and disassembly of the system.

5. Valve and Valve Operator Schedule: Provide a list of valve materials, pressure ratings, and valve operator materials and reference identification as indicated in the PWS Drawings. Provide a list of any special tools necessary for each valve type and appurtenances furnished for adjustment, operation, maintenance and disassembly.

6. Test Reports: Submit Pipe Leakage Tests, Hydrostatic Tests, Valve Testing; copies of all field test reports including Pipe Leakage Tests and Hydrostatic Tests.

7. As-built drawings: Show pipe anchors and guides, and layout of piping systems relative to other parts of the work including clearances for maintenance and operation. Submit as-built piping and instrumentation diagrams (P&IDs) identifying and labeling equipment, instrumentation, valves, vents, drains, and all other inline devices. The P&IDs found in the PWS Drawings shall be revised by the Contractor to reflect the constructed process system.

8. Instruction Manuals: Submit sufficient detail in the Operation Manuals to demonstrate the step-by-step procedures required for startup, operation and shutdown of piping systems, and include the manufacturer's name, model number, parts list and brief description of piping components such as valves, fittings, and other appurtenances and their basic operating features. List in the Maintenance Manuals routine maintenance procedures and troubleshooting guides for the piping system and include piping layout and valve locations.

1.5 Delivery, Storage, and Handling

A. Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping shall be capped to keep out dirt and other foreign matter. A material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical delivered for use in pipe installation. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling shall be in accordance with ASTM F 402. Storage facilities shall be classified and marked in accordance with NFPA 704. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendation. Plastic pipe shall be packed, packaged and marked in accordance with ASTM D 3892. No piping shall be stored directly on bare ground. Valves and fittings shall be stored in their shipping crates or boxes until time of installation and be protected from the weather at all times.

1.6 Above Grade Piping Systems (Within Booster Station)

A. Above ground piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure, and installation factors such as insulation, support spans, and ambient temperatures. Consideration shall be given to all operating and service conditions including forces both internal and external to the piping systems.

1.7 Sequencing and Scheduling

A. For wall, and roof penetrations, keep on site pertinent wall pipes and sleeves before they are required for placement in concrete forms. Verify and coordinate the size and location of building pipe penetrations before forming and placing concrete.

1.8 Maintenance

A. Service

A manufacturer's representative who is experienced in the installation, adjustment and operation of the valves specified shall provide inspection services for automatic valve systems. The representative shall inspect the installation and supervise the adjustment and testing of the valves.

B. Extra Materials

Contractor shall provide the manufacturer's recommended spare parts that are expected to be replaced within the first 3 years of service of the piping system.

PART 2 - PRODUCTS

2.1 Materials and Equipment

A. Provide piping materials and appurtenances as specified and as shown on the Drawings. Piping materials, valves, and appurtenances supplied as part of this PWS shall be of equal material and ratings as the connecting pipe, new and unused except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer. The general materials to be used for the piping systems shall be in accordance with the PWS Drawings. Pipe fittings shall be compatible with the applicable pipe materials.

B. Piping systems shall be rated for at least 1.5 times the deadhead pressure of the pump feeding the piping.

C. Standard Products: Provide material which are the standard products of a manufacturer regularly engaged in the manufacturing of the products and that essentially duplicate items that have been in satisfactory use for at least 10 years prior to bid opening. Nominal sizes for standardized products shall be used.

D. Identification and Tagging: Each piece of pipe shall bear the ASTM designation and all other markings required for that designation. The service, valve identification number shown on the PWS Drawings, the manufacturer's name, and the valve model number shall be displayed. Valves shall be marked an shall bear an identification tag securely attached using plastic straps designed for that purpose. Identification tags shall be 1.375-inch minimum diameter, made of engraved laminated plastic. Major process piping shall be labeled with the fluid service name and flow direction arrow. Letters for labeling pipes shall be easily readable from 10 feet away and shall be no smaller in height than 1 inch for pipes less than 2 inches in diameter and no smaller in height than 2 inches for all other size piping.

E. Pipe Supports: Pipe shall be provided with supports spaced not farther than the manufacturer's recommended spacing for 70°F service. For PVC pipe 2" or smaller, supports shall be every 5' or less; for 3" pipe every 6'; for 4" pipe every 8', and for pipe, 6" and larger supports shall be every 10' or less. Provide pipe flanges of the same material as shown on the drawings to be able to dismantle sections of PVC pipe for maintenance. Piping shall be pitched to drain.

F. The Contractor shall provide slip-type PVC expansion joints with joint material as recommended by the manufacturer for the type of service. Joints shall be installed not more than 100 feet apart only on all straight runs of pipe that exceed 100 feet.

2.2 Plastic and Ductile Iron Pipping and fitting for Water Process Service

A. PVC Pipe: PVC pipe shall be Schedule 80, seamless, unplasticized polyvinyl chloride normal impact type, conforming to ASTM D-1784, Class 12454-B and D-1785, PVC 1120, for Type I, Grade 1. PVC pipe system shall be as manufactured by CertainTeed Corp, JM Eagle, North American Pipe, Harvel Pipe, or approved equal.

B. PVC Joints: The piping system shall be joined by flanged or mechanical connections except where connecting to unions, valves, and equipment with threaded connections that may require future disassembly. Connections at those points shall be threaded.

C. PVC Fittings: The schedule rating for the fittings shall not be less than that for the associated pipe. All pipe and fittings shall conform to ASTM D2467 and joints shall be solvent socket welded where threaded or flanged fittings are not used.

D. Flanged Fittings: Flanges shall be used at all valves, pumps, equipment, tanks, and vessels. Flanges will be of the same material as the piping. Flanges shall be the Van-Stone type complete with gaskets, bolts, and nuts. Flanges will be flat face to match the flanges of the valves, pumps, equipment and vessels. Flanges will be drilled to ANSI B16.1, class 150 conforming to ASTM A182 and ANSI B16.5. Gaskets for flanged joints shall be Viton. Flange bolts shall be of the number and size in accordance with ANSI B16.1. All bolts, nuts and washers shall be Type 316 stainless steel.

E. PVC Solvent Cement: Joints shall be assembled using approved solvent cement in accordance with the manufacturer's recommendations and ASTM D2564 and ASTM D2855. No cementing shall be done in the rain or when the air temperature is below 40°F or above 90°F.

F. The Contractor is cautioned to exercise care in handling, loading, unloading, and storing plastic pipe, valves, and fittings. All plastic pipe, valves, and fittings shall be stored under cover before using and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subject to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged shall be discarded.

G. All PVC piping, fittings, and valves shall not be painted.

2.3 Valves and Specialties

A. General.

The Contractor shall furnish and install all valves and specialties as specified herein and shown on the Drawings. In addition, valve-operator and other accessories shall be furnished and installed by the Contractor where specified for various system packages. All valves shall be new and of current manufacture. All valves, specialties, etc. shall be installed with sufficient unions and/or flange joints to permit replacement without the need to cut the pipes. Valves and fittings 2 inch and smaller (chemical feed lines) shall have union joints. Valves shall include operator, actuator, handwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and all other accessories required for a complete operation. The valves shall be suitable for the intended service. Valves shall be the same size as adjoining pipe. Valve ends shall be compatible with the adjacent piping system. An operator shall be sized to operate the associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise.

Altitude Valve and strainer. Furnish One-Way Altitude valve bearing Cla-Val Model 610-13 BPSRYKCHX DS BSB 150AG DT0540 PPA000100 PPB000060 RM020200 CS3SM or Approved equal. Altitude valve shall be reduced port version, where the end connections are 8” to adapt to the existing 8” piping. The main valve will have a 6” internal seat. The main valve will be commanded to open or close via electrical signal to the included solenoid control. The solenoid will be tied in to receive command signals in conjunction with a level transmitter in the tank. This will also be used to perform a delayed opening function. The valve should have hydraulic altitude pilot control, which will serve as a back-up to prevent the tank from overflowing if the solenoid control does not do so. This pilot valve setpoint would be above the height at which the solenoid valve will typically close the main valve. Under high pressure drop, backpressure pilot will be required in order to limit the flow rate through the valve, and not fill the tank too quickly. The pressure sustaining pilot valve shall be adjustable in the field to maintain a minimum upstream pressure, which will throttle the main valve further closed to achieve flow rate of 300 gpm. The hydraulic altitude pilot shall have a 1” stainless steel reservoir sensing line installed, connecting it to the base of the tank. The altitude valve will be provided with a an electronic VC-22D valve controller that will be provided with a touch screen for input and adjustment of setpoints. The altitude valve will have the following properties:

- ductile iron make, globe pattern, reduced port, 150 # ANSI flanged ends,
- interior and exterior heat fusion bonded epoxy coating,
- stainless steel trim,
- Buna nitrile rubber seals,
- stainless steel tubing and fittings,
- pilot system isolation cocks,
- inlet and outlet pressure gauges,
- speed control,
- reservoir tester gauge with trip valve,
- pilot system strainer,
- heavy cover spring,
- CRL5A backpressure pilot,
- valve position indicator,
- CDS6A hydraulic altitude pilot,
- CS3SM 3-way solenoid

Strainer. Furnish Cla-Val-H-style strainer (X43H) or approved equal. The strainer shall effectively remove unwanted solid particles in pipeline flow thereby preventing fouling, debris and particle buildup in the automatic control valve. Optional accessories that can be added to the strainer include differential pressure switch and differential pressure gauge assembly. Maintenance should be fast and easy, requiring only top cover removal.

1. Ends:

   Flanged, ANSI Class 150 and 300
   Max Pressure Rating: 150# - 250 psi, 300# - 400 psi
   Temperature: Maximum 175°F

2. Materials:

   Body & Cover: Ductile Iron ANSI B16.42; Fusion Bonded Epoxy Coating Standard
   Cover Seal: Buna-N® Synthetic Rubber
   Strainer: 316 Stainless Steel; Ductile Iron, Epoxy Coated Frame
   Strainer Mesh Sizes: Standard 10 mesh / 2000 Micron / Openings 0.078 inch
   Drain/Blow-Off: Connection furnished with Standard Stainless-Steel Plug
   Cover Fasteners: Stainless Steel

B. Check Valves

Wafer Check Valves manufactured by Flomatic 888S6VFD 316-SS or equal. Valve will be designed for installation with varying flow rates for VFD controlled booster pump system. Silent wafer style check valve will be manufactured by Flomatic- Model 888S6VFD or approved equal. The spring-loaded valve shall begin to close as flow is reduced and fully close at zero velocity stopping reverse flow, thus reducing water hammer shock. Valve will have a 316 Stainless steel poppet and seat with an EPDM seat standard. The spring-loaded poppet system shall have an oversized bushing providing stability and quiet and efficient operation regardless of flow rate. Additionally, the design shall allow for direct mounting of a butterfly valve on the discharge side with no poppet/disc interference. Valve can be close coupled with a butterfly valve without a spool piece. The butterfly valve should be operated with the check valve in an “open” or “closed” position without interference.

C. Butterfly Valves. Valves shall be provided in areas as shown on the drawings (P&ID and layouts). Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy. The valve shall be provided with valve indicator and hand wheel operator. The valve shall be manufactured by Flowmatic, AWWA C504, Azure, Model 45 or equal.

D. Pressure and Surge Relief Valve: One valve 4” reduced port Model 650-01 pressure relief manufactured by Cla-val or equal shall be provided. The valves shall be of stainless-steel construction and shall be rated for 125 psig.

E. Gate Valves: Gate valves will be furnished by Mueller Co. or Approved equal for buried application on the bypass line and for interior piping as shown on the drawings (P&ID and layouts). Gate valve type shall be MJ x MJ -8" resilient wedge gate valve with 2" square wrench nut operator furnished and installed for buried application. A FL x FL – 8" resilient wedge gate valve shall be furnished and installed for interior piping as shown in drawings and should be suitable for potable water applications. Gate valve shall be UL Listed, FM Approved: 350 psig (2400 kPa/24 barg). They will be rated for 350 psig maximum working pressure; 700 psig static test pressure. Gate valves will have Non-Rising Stem (NRS) and triple O-ring seal (2 above the thrust collar and 1 below). They shall have iron wedge, symmetrical and fully encapsulated with molded rubber without any exposed iron. Epoxy coating should meet or exceed all applicable requirements of ANSI/AWWA C550 Standard. Gate valve will have iron body with nominal 10 mils Fusion Bonded Epoxy Costed interior and exterior surfaces. Standard mechanical joint ends should comply with ANSI/AWWA C111. Valves should meet or exceed all applicable requirements of ANSI/AWWA C509, UL 262 Listed, FM 1120/1130 Approved, and certified to ANSI/NSF 61 & 372.

F. 2.3.5 Air Release Valves

1. Air release valves up to 3 inches the valves shall have flanged ends and manufactured by DeZURIK/Apco or approved equal. The valves shall have full port liquid capacities and high discharge capacities. The valves shall have excellent corrosion resistance material – body ad cover ductile iron, float – stainless-steel, Seat – bronze-stainless steel or Buna-N, and stainless steel internal parts. The valves shall be rated for the maximum operating and test pressures of the system.

2.4 Miscellaneous Piping Components

A. Expansion Joints

1. Provide all structural work and equipment required to control expansion and contraction of piping. Verify that the anchors, guides, and expansion joints provided, adequately protect the piping systems. Provide rubber expansion joints for piping at connections to equipment as shown on the drawings. The expansion joints shall be flanged with a maximum working pressure range of 150 psi. The joints shall provide an axial movement from 1/2 to 3/4 inches, axial extension of 1/4 inches and transverse deflection of up to 1/2 inch. The materials shall meet requirements of ANSI/ASTM D1418-77 and the Elastomer type shall meet NSF61 requirements. The expansion joints shall be provided with control units. The expansion joints shall be manufactured by Unaflex or approved equal.

2.5 Pipe Supports and Penetrations

A. Provide auxiliary steel where the support of piping systems and equipment is required between building structural elements. Light gauge and structural steel shapes shall conform to the requirements of ASTM A 36/A 36M. The Contractor has the option to use pre-engineered support systems of electrogalvanized steel products from one manufacturer such as Empire, Cooper B-line or approved equal. Where auxiliary steel is indicated as stainless steel, provide TP304 stainless steel conforming to ASTM A 167, No. 1 Finish.

1. Pipe Supports

Adjustable pipe saddle pipe supports such as Model 429 KT manufactured by Empire Industries, Inc. or equal.

Pipe supports shall conform to the requirements of MSS SP-58, MSS SP-69, and MSS SP-89. Where pipe supports contact bare piping or in-line devices, provide supports of compatible material (or dielectric separation) so that neither shall have a deteriorating action on the other. Refer to the Drawings for pipe support details. The absence of pipe supports and details on the drawings does not relieve the Contractor of the responsibility for sizing and providing adequate supports throughout the facility.

B. Wall Penetrations

1. Wall Penetrations

All wall penetrations shall be provided with seals manufactured by Link Seal or approved equal.

PART 3 - EXECUTION

3.1 Examination

A. After becoming familiar with all details of the work, verify all dimensions in the field, and advise Township's Representative of any discrepancy before performing the work.

3.2 Preparation

A. Pipe and equipment openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. Pipe and fittings shall be inspected before piping is installed. Clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.3 Exposed Piping Insulation

A. Exposed piping shall be run as straight as practical along the alignment shown on the PWS Drawings and with a minimum number of joints. Piping and appurtenances shall be installed in conformance with approved shop drawings, manufacturer's instructions and ASME B31.3. Piping shall be installed without springing or forcing the pipe.

1. FIELD Piping Flexibility Provisions

a. Thrust protection shall be provided as required. Additional pipe anchors and flexible couplings beyond those shown on the PWS Drawings shall be provided to facilitate piping installation, in accordance with approved shop drawings.

2. Couplings, Adapters and Service Saddles

a. Pipes shall be thoroughly cleaned of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Gaskets shall be wiped clean prior to installation. Flexible couplings and flanged coupling adapter gaskets shall be lubricated with the manufacturer's standard lubricant before installation on the pipe ends. Couplings, service saddles, and anchor studs shall be installed in accordance with manufacturer's instructions. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used to tighten bolts.

3. Piping Equipment/Component Installation

a. Piping components and instrumentation shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances, isolation valves, and miscellaneous devices shall be provided for an operable and serviceable installation. The upstream and downstream lengths of undisturbed piping shall be in accordance with the flow element manufacturer's recommendations and at a minimum shall be at least 5 pipe diameters of straight run pipe upstream and at least 2 pipe diameters of straight run pipe downstream of the edge of the flow tube.

b. Local Instrumentation: All direct-reading instrumentation and pressure gauges shall be installed so that they can be easily read from floor level and are readily accessible for maintenance and service. Pressure gauges shall be installed where indicated on the PWS Drawings. Differential pressure gauges shall be installed across the process equipment indicated on the PWS Drawings, in accordance with the manufacturer's recommendations, and arranged for easy observation at eye level.

4. Pipe Flanges

a. Pipe flanges shall be set level, plumb, and aligned. Flanged fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall be concentric to the centerline of the pipe and shall straddle the vertical centerline of the pipe.

5. Valve Locations

a. Valves shall be located in accordance with the PWS Drawings where actuators are shown. Where actuators are not shown, valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences. Valves shall be installed so that they can be fully opened and closed without interferences.

6. PVC Pipe Installation

a. All PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Solvent-cemented joints shall be constructed in accordance with ASTM D 2855. Pipe shall not be laid in the rain and when the air temperature is below 40 deg F. All PVC piping installed above grade shall be ultraviolet (UV) resistant. The pipe ends that are to be joined shall be shielded from direct sunlight prior to and during installation. Adequate ventilation shall be provided when working with pipe joint solvent cement and the handling of solvent cement. Provide and install supports and hangers in accordance with the manufacturer's recommendations. All non-gravity lines shall be hydrostatically tested to at least 1.5 times the upstream pump dead head pressure.

3.4 Connecting Dissimilar Pipe

A. Flexible transition couplings, dielectric fittings and isolation joints shall be installed in accordance with the manufacturer's instructions.

3.5 Valve Installation

A. Flanged valve bolt holes shall be installed so as to straddle the vertical centerline of pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts, and then the nuts shall be tightened progressively and uniformly. Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation.

1. Valve Orientation

a. The operating stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations 4.5 feet or less above finished floor, unless otherwise shown on PWS Drawings. The operating stem of a manual valve shall be installed in a horizontal position in horizontal runs of pipe having centerline elevations between 4.5 feet and 6.75 feet above finish floor, unless otherwise shown on the PWS Drawings. Automatic valves shall be installed in accordance with the manufacturer's instructions. Chain wheels and chains shall be provided if valves are located five feet above the floor.

3.6 Pipping Support Systems Installation

A. The absence of pipe supports and details on the PWS Drawings shall not relieve the Contractor of the responsibility for sizing and providing adequate supports throughout the plant.

1. General Support Requirements

a. Large or heavy valves, fittings, and/or equipment shall be supported independently of associated piping. Pipes shall not be supported off other pipes or equipment. Pipes shall be supported by engineered supports independent of equipment. Supports shall be provided at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the Drawings. Pipe supports and hangers shall not be installed in equipment access areas. Pedestal type pipe supports shall be provided under base flanges adjacent to rotating equipment and where required to isolate vibration.

2. Piping support and spacing shall be provided as specified and as shown in the drawings, in addition to supplemental support as needed in the field. Horizontal pedestal mounted piping shall have saddle type supports. Horizontal wall mounted piping shall have wall brackets. Vertical piping shall be supported by wall brackets, base elbows, or riser clamps on floor penetrations. All metal supports shall be stainless steel and all nuts, bolts and fasteners shall be 316 SS. Refer to the Drawings for pipe support details.

3. Pipe support locations shown on the drawings are the minimum requirements and does not relieve the Contractor from providing adequate support and meeting the intent of this specification.

3.7 Final Cleaning

A. Following assembly and testing, and prior to final acceptance, liquid piping systems shall be flushed with water to remove accumulated construction debris and other foreign matter. The piping shall be flushed until all foreign matter is removed from the pipeline. Provide all hoses, temporary pipes, ditches, and other items as required to properly dispose of flushing water. The minimum flushing velocity shall be 2.5 fps. Accumulated debris shall be removed through drains, or by removing spools or valves. Provide potable water for pipe flushing and cleaning.

B. See additional details specification section 43 21 10 Water Main Installation and 43 21 20 Water Main Tech Specifications.

END OF SECTION