SECTION 40 05 13 - COMMON WORK RESULTS FOR PROCESS PIPING

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

This Section applies to the furnishing and installation of piping inside a building, structure, enclosure piping and miscellaneous yard piping.

A. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section, as well as Sections required to describe complete system or assembly requirements.

1. Section 05 50 00, Metal Fabrications
2. Section 09 90 00, Painting and Coating
3. Section 31 23 17, Trenching
4. Section 33 11 10, Water Utility Distribution and Transmission Piping
5. Section 33 05 64, Precast Concrete Valve Vaults and Meter Boxes.
6. Section 33 13 00, Testing and Disinfection of Water Utility Piping
7. Section 40 05 13.19, Stainless Steel Process Pipe and Tubing

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B1.20.1 Pipe Threads, General Purpose (inch)
2. ASME A13.1 - Scheme for the Identification of Piping Systems.
3. ASME B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
4. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
5. ASME B31.3 - Process Piping.
6. ASME B31.9 - Building Services Piping.

B. ASTM International (ASTM):

1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

2. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile.

3. ASTM A325 - Specification for High-Strength Bolts for Structural Steel Joints.

4. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.

5. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

6. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

7. ASTM D792 - Test Methods for Specific Gravity and Density of Plastics by Displacement.

8. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

9. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

10. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

11. ASTM D2000 - Classification System for Rubber Products in Automotive Applications.

12. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

13. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

14. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

C. American Water Works Association (AWWA):

1. AWWA C200 - Steel Water Pipe - 6 In. (150 mm) and Larger.

2. AWWA C207 - Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.

3. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.

4. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

5. AWWA C510 - Double Check Valve Backflow Prevention Assembly.

6. AWWA C511 - Reduced-Pressure Principal Backflow Prevention Assembly.

7. AWWA C606 - Grooved and Shouldered Joints.

8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

D. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code.

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

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

F. NSF International (NSF):

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

2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

A. Coordinate installation of specified items with installation of valves and equipment.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit Manufacturer catalog information for each product specified.

C. Shop Drawings:

1. Identification:

a. Submit list of wording, symbols, letter size, and color coding for pipe identification.

b. Comply with ASME A13.1.

2. Provide all necessary dimensions and details on pipe joints, restraints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists.

3. Provide detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, couplings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.

D. Manufacturer's Statement: Certifying pipe fabrication and products meet or exceed specified requirements.

E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS and ASME qualification within previous 12 months.

F. Manufacturer Instructions: Submit special procedures and setting dimensions.

G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping appurtenances.

B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Drawings:

1. Piping layouts shown in the Drawings are intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

B. Inspection:

1. All pipe shall be subject to inspection at the place of manufacture.

2. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

C. Welding:

1. All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1.

2. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot, and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

D. Welders:

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding.

2. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local approved testing agency prior to commencing work on the pipeline.

3. Machines and electrodes similar to those used in the Work shall be used in qualification tests.

4. The Contractor shall furnish all material and bear the expense of qualifying welders.

E. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. Welds shall be tested as specified. The Contractor shall perform all tests at no additional cost to the Owner.

1.7 MATERIAL DELIVERY, STORAGE, AND INSPECTION

A. Inspection:

1. Accept materials on Site in Manufacturer's original packaging and inspect for damage.

2. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition.

B. Storage:

1. Store materials according to Manufacturer instructions.

2. Store materials off the ground, to provide protection against oxidation caused by ground contact

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.

3. Provide additional protection according to Manufacturer instructions.

D. All defective or damaged materials shall be replaced with new materials.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

B. Unless specified otherwise or indicated differently in the Drawings, all piping systems and process piping materials shall be as listed in the table below or as shown on the Drawings:

Service	Material
Drainage/Sanitary Sewer	See Division 33.
Exposed ≥ 4”	Class 52 Ductile Iron or Heavy Wall Welded Steel
Buried ≥ 4”	Class 52 Ductile Iron
Submerged/Buried < 4”	Stainless Steel - Type 316 Schedule 40 Threaded - ASTM A 312 Fittings Welded or Threaded
Exposed < 4”	Brass - ASTM B 43, Fittings - Bronze - ASTM B 62 Threaded - ANSI/ASME B 16.15
Buried < 4”	Copper Tubing - ASTM B88 Type K Soft / Fittings - Wrought Copper - ANSI B16.22, Joints-Soldered
Miscellaneous Pipelines	As shown in the Drawings

2.2 DUCTILE IRON PIPE AND FITTINGS

A. See Article 2.1.B, Ductile Iron Pipe of Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 STEEL PIPE AND FITTINGS

Section in development. See Technical Services if Section is needed.

A. General Service Piping:

1. ASTM [**A53**], seamless, Grade B.

2. Schedule: 40, unless indicated otherwise on Drawings [**as indicated on piping schedule**].

B. Water Piping, 6 Inches and Larger: See Section 33 11 10.30, HDPE Water Utility Piping.

2.4 COPPER PIPE AND FITTINGS

A. Description:

1. Seamless; ASTM B88.

2. Type:

a. Type L, hard drawn.

b. For pipe under floor slabs, underground or cast in concrete: Type K, annealed, seamless.

B. Joints:

1. Compression.

2. Manufacturer: Mueller Model 110 or equal

C. Dissimilar Metals: See Dielectric Unions specified herein.

2.5 BRASS PIPE AND FITTINGS

A. Pipe: ASTM B43, chrome plated.

B. Fittings:

1. ASTM B584, brass.

2. ASTM B16.15.

C. Joints:

1. Mechanical compression.

2. Threaded: Tapered and smooth threads, ASME [B1.20.1] and ASTM B43.

D. Dissimilar Metals: See Dielectric Unions specified herein.

2.6 POLYVINYL CHLORIDE (PVC) WATER PIPE AND FITTINGS

A. PVC Pipe and Fittings:

1. Four-inch diameter and smaller:

a. Pipe: ASTM D1785, Schedule 40.

b. Fittings: ASTM D2466, Schedule 40.

c. Joints: Socket, solvent-welded, ASTM D2855.

d. Materials: ASTM D1784, minimum cell classification 12545-C.

2. Six-inch diameter and larger:

a. Pipe: AWWA C900, Class 235.

b. Fittings: AWWA C111, cast iron.

c. Joints: ASTM D3139, compression gasket ring.

d. Materials: ASTM D1784, minimum cell classification 12545-C.

2.7 FLEXIBLE TUBING

A. Polyethylene thermoplastic tubing:

1. Standard weight, conforming to ASTM D1248 Type 1, Class A, Category 4, Grade E5.

2.8 GALVANIZED STEEL PIPE AND FITTINGS

A. Pipe: Seamless, or electric resistance welded, ASTM A53, Schedule 40.

B. Joints: Threaded.

C. Fittings:

1. Threaded, 150-pound malleable iron, galvanized, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3.

2. Unions, 300-pound malleable iron, galvanized with dimensions conforming to ANSI B16.3, brass to iron seat.

3. Thread lubricant shall be Teflon tape or joint compound that is insoluble in water.

D. Buried Service:

1. Galvanized pipes shall be spirally wrapped with polyvinyl chloride or polyethylene pressure sensitive tape, applied with a suitable primer.

2. The wrap shall have a nominal thickness of 20 mils, consisting of either one layer of 20-mil tape or two separate layers of 10-mil tape.

3. Before the primer and wrap is applied, the piping shall be thoroughly cleaned so that all surfaces shall be dry and free of dirt, dust, rust, oil scale, oil, grease, or other foreign matter.

4. Any solvents used shall be totally volatile so as to leave no trace of oil.

5. Weld spatters, burrs, or sharp points and edges shall be removed by chiseling, ball peening or filling.

6. After thorough cleaning, the piping shall be coated with a primer applied in accordance with the Tape Manufacturer's recommendations. Spiral wrappings shall be applied with an overlap of at least 1-inch.

2.9 STAINLESS STEEL TUBING AND FITTINGS

A. Type 316 stainless steel, unless otherwise specified or shown in the Plans.

B. Meet the material standards set forth in ASTM A269.

C. Fittings: ASTM A276 and ASTM A182.

1. Threaded fittings: National pipe thread meeting the requirements of ASME B1.20.1.

2. Compression fittings: Two-ferrule, mechanical grip design.

D. Unions: Provide to facilitate installation and maintenance of tubing.

E. Manufacturer:

1. Swagelock, or equal.

2.10 STAINLESS STEEL PIPE AND FITTINGS

A. Pipe:

1. Size: 4 inches and smaller, schedule 80, type 304, unless otherwise specified.

2. Conforming to ASME B36.19 dimensions.

3. Conforming to ASTM A312 material requirements.

B. Fittings: Conform to ASME B16.11 dimensions and ASTM A182 material requirements.

C. Threads: Conform to ASME B1.20.1.

D. Socket welds: Conform to ASME B16.11.

2.11 FLEXIBLE COUPLINGS

A. Description:

1. Sleeve-type, couplings. Comply with AWWA C219.

2. Minimum design pressure rating: 150 pounds per square inch (psi).

3. Middle Ring: As required for coupling based upon connecting pipe materials, steel, or ASTM A536, ductile iron.

4. Followers: As required for coupling based upon connecting pipe materials, steel, or ASTM A536, ductile iron.

5. Gaskets:

a. Material: Buna-N.

b. Comply with ASTM D2000.

6. Bolts:

a. Buried: Steel.

b. Submerged: Stainless steel.

7. Center Pipe Stop: Required where shown on the Drawings.

B. Finishes:

1. Buried Couplings, Bolts: Factory epoxy coated.

C. Manufacturers:

1. For ductile iron and steel pipe:

a. Dresser, Style 38.

b. Romac, Model 501.

c. Smith-Blair.

2. For PVC pipe:

a. Romac, Model 501 or equal.

3. For flanged steel and ductile pipe:

a. Dresser, Style 128 or equal.

2.12 RESTRAINED FLANGE ADAPTERS FOR DUCTILE IRON PIPE

A. Description:

1. ASTM A536, ductile iron.

2. Flange bolt circles compatible with ANSI/AWWA C115/A21.15.

3. Restraint for the flange adapter shall consist of a plurality of individually actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of the gripping wedges.

4. Capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

5. Safety factor of 2:1 minimum.

6. Manufacturer:

a. EBAA Iron, Series 2100 Megaflange or equal.

2.13 FLANGED INSULATING JOINTS

A. Set shall include a full faced gasket, a full-length insulating sleeve for each flange bolt, and two insulating washers and two steel washers for each bolt.

1. Gaskets:

a. Full-face, comply with ASME 16.21.

b. Non-asbestos and non-phenolic compressed sheet packing with nitrile rubber binder.

c. Manufacturer: Garlock, Style 3505, or equal.

2. Insulating sleeves:

a. G-10 glass epoxy.

b. Extend the full width of both flanges, except where one flange hole is threaded where the sleeve shall extend through one flange and the gasket.

3. Insulating washers:

a. G-10 glass epoxy.

b. One-eighth-inch thickness.

4. Washers:

a. Buried: Cadmium plated steel.

b. Submerged: Stainless steel.

B. The complete assembly shall have an ANSI/AWWA pressure rating equal to or greater than that of the flanges between which is installed.

C. After assembly, the joint shall be tested for continuity. Electrical resistance between flanges and between each bolt and each flange shall be not less than 100,000 ohms.

2.14 INSULATING UNION

A. Description:

1. Material: Galvanized malleable iron with a ground joint.

2. Iron pipe threads: Conform to ANSI B2.1.

3. Insulations: Nylon, bonded, and molded onto the metal body.

4. Union: Rated for the operating and test pressures of the pipe system.

5. Joint connections to copper alloy pipe and tube shall be copper solder or threaded brass ground joints.

6. Isolation Barrier: Impervious to water.

Edit listing of BFP's below to match Project needs. If specifying more than one of the valve types below, designate location of valves for clarity.

For ones not used, replace text with "Not Used".

2.15 BACKFLOW PREVENTERS

A. Manufacturers:

1. Nibco.

2. Watts.

B. Reduced-Pressure Backflow Preventers:

1. Size: 3/4-inch to 2 inches.

2. Comply with AWWA C511.

3. Materials:

a. Body: Bronze.

b. Internal Parts: Bronze.

c. Springs: Stainless steel.

4. Check Valves:

a. Quantity: Two, operating independently.

b. Spring loaded.

c. Third Check Valve: Open under back pressure in case of diaphragm failure.

5. Differential Pressure Relief Valve:

a. Type: Diaphragm.

b. Located between check valves.

6. Ball Valves:

a. Type: Full port, resilient seated.

b. Quantity: Two.

c. Operation: Quarter turn.

d. Material: Bronze.

7. Accessories: Strainer and test cocks.

******** [OR] ********

C. Reduced-Pressure Backflow Preventers with Detector Assembly:

1. Size: 3/4-inch to 2 inches.

2. Comply with AWWA C511.

3. Materials:

a. Body: Bronze.

b. Internal Parts: Bronze.

c. Springs: Stainless steel.

4. Check Valves:

a. Quantity: Two, operating independently.

b. Spring loaded.

c. Third Check Valve: Open under back pressure in case of diaphragm failure.

5. Differential Pressure Relief Valve:

a. Type: Diaphragm.

b. Located between check valves.

6. Ball Valves:

a. Type: Full port, resilient seated.

b. Quantity: Two.

c. Operation: Quarter turn.

d. Material: Bronze.

7. Accessories: Strainer and test cocks.

******** [OR] ********

D. Reduced-Pressure Backflow Preventers:

1. Size: 3 inches to 10 inches.

2. Comply with AWWA C511.

3. Materials:

a. Heavy-duty cast iron.

b. Finish: Fusion epoxy coating inside and outside.

4. Check Valves:

a. Quantity: Two, operating independently operating.

b. Spring loaded.

c. Third Check Valve: Open under back pressure in case of diaphragm failure.

5. Differential Pressure Relief Valve:

a. Type: Diaphragm.

b. Located between check valves.

6. Gate Valves:

a. Type: Resilient seated according to AWWA C509.

b. Quantity: Two.

c. Operation: Non-rising stem.

7. Accessories:

a. Strainer.

b. Four resilient-seated ball valve test cocks.

******** [OR] ********

E. Reduced-Pressure Backflow Preventers with Detector Assembly:

1. Size: 3 inches to 10 inches.

2. Comply with AWWA C511.
3. Materials:
    a. Heavy-duty cast iron.
    b. Finish: Fusion epoxy coating inside and outside.
4. Check Valves:
    a. Quantity: Two, operating independently operating.
    b. Spring loaded.
    c. Third Check Valve: Open under back pressure in case of diaphragm failure.
5. Differential Pressure Relief Valve:
    a. Type: Diaphragm.
    b. Located between check valves.
6. Gate Valves:
    a. Type: Resilient seated according to AWWA C509.
    b. Quantity: Two.
    c. Operation: Non-rising stem.
7. Accessories:
    a. Strainer.
    b. Four resilient-seated ball valve test cocks.

******** [OR] ********

F. Double Check Valve Backflow Preventer Assemblies:
1. Size: 1/2-inch to 3 inches.
2. Comply with AWWA C510.
3. Materials:
    a. Body: Bronze.
    b. Internal Parts: Corrosion resistant.
    c. Springs: Stainless steel.
4. Check Valves:
    a. Quantity: Two, operating independently.

b. Intermediate atmospheric vent.

5. Ball Valves:

a. Type: Full port, resilient seated.

b. Quantity: Two.

c. Operation: Quarter turn.

d. Material: Bronze.

6. Accessories: Strainer and test cocks.

******** [OR] ********

G. Double Check Valve Backflow Preventer with Detector Assembly:

1. Size: 1/2-inch to 3 inches.

2. Comply with AWWA C510.

3. Materials:

a. Body: Bronze.

b. Internal Parts: Corrosion resistant.

c. Springs: Stainless steel.

4. Check Valves:

a. Quantity: Two, operating independently.

b. Intermediate atmospheric vent.

5. Ball Valves:

a. Type: Full port, resilient seated.

b. Quantity: Two.

c. Operation: Quarter turn.

d. Material: Bronze.

6. Accessories: Strainer and test cocks.

******** [OR] ********

H. Double Check Valve Backflow Preventer Assemblies:

1. Size: 2-1/2 inches to 10 inches.

2. Comply with AWWA C510.

3. Materials:
    a. Heavy-duty cast iron.
    b. Finish: Fusion epoxy coating inside and outside.
    c. Springs: Stainless steel.
4. Check Valves:
    a. Quantity: Two, operating independently.
5. Gate Valves:
    a. Type: Resilient seated according to AWWA C509.
    b. Quantity: Two.
    c. Operation: Non-rising stem.
6. Accessories: Strainer.

******** [OR] ********

I. Double Check Valve Backflow Preventer with Detector Assembly:
1. Size: 2-1/2 inches to 10 inches.
2. Comply with AWWA C510.
3. Materials:
    a. Heavy-duty cast iron.
    b. Finish: Fusion epoxy coating inside and outside.
    c. Springs: Stainless steel.
4. Check Valves:
    a. Quantity: Two, operating independently.
5. Gate Valves:
    a. Type: Resilient seated according to AWWA C509.
    b. Quantity: Two.
    c. Operation: Non-rising stem.
6. Accessories: Strainer.

******** [OR] ********

J. Double Check Valve Backflow Preventer Assemblies:

1. Size: 4 inches to 12 inches.
2. Comply with AWWA C510.
3. Materials:
    a. Main Valve Body: Series 300 stainless steel.
    b. Internal Metal Parts: Series 300 stainless steel.
4. Check Valves:
    a. Quantity: Two, operating independently.
    b. Material: Stainless steel.
5. Gate Valves:
    a. Type: Resilient seated according to AWWA C509.
    b. Quantity: Two.
    c. Material: Stainless steel.
    d. End Connections: Flanged.
    e. Operation: Non-rising stem.
6. Accessories: Cast iron strainer.

******** [OR] ********

K. Double Check Valve Backflow Preventer with Detector Assembly:

1. Size: 4 inches to 12 inches.
2. Comply with AWWA C510.
3. Materials:
    a. Main Valve Body: Series 300 stainless steel.
    b. Internal Metal Parts: Series 300 stainless steel.
4. Check Valves:
    a. Quantity: Two, operating independently.
    b. Material: Stainless steel.
5. Gate Valves:
    a. Type: Resilient seated according to AWWA C509.
    b. Quantity: Two.

c. Material: Stainless steel.

d. End Connections: Flanged.

e. Operation: Non-rising stem.

6. Accessories: Cast iron strainer.

2.16 DISMANTLING JOINT

A. Description:

1. Comply with AWWA C219, where applicable.

2. Self-contained flanged restrained joint fitting, including both flanged components and sufficient harness bars to withstand the imposed thrust.

3. Design: No part of the restraint system extends outside the flange diameter. The internal bore shall match that of the pipe system.

4. Dismantling joints will allow for a minimum of 2 inches of longitudinal adjustment.

5. Furnish as a complete assembly consisting of spigot piece, flange adaptor, tie bars, and gasket.

6. The gasket seal and compression stud and nut arrangement shall be independent of the tie rod restraint system. Tie Rod diameter shall be compatible with the corresponding bolt diameter of the mating flange. The Tie Rod restraint system shall be capable of withstanding the full pressure thrust that the pipe system can develop at no more than 50 percent of the yield strength of tie rod material.

7. Pressure Rating:

a. Determined by the flange configuration, and all commonly used flanges shall be available.

b. Design pressure rating shall be equal to or greater than the mating flanges.

c. Dismantling joints will be specially fabricated to accommodate pressure requirements with ANSI B16.5 or ANSI B16.47 300-pound class flanges, depending on size of dismantling joint.

8. Lining and Coating:

a. Shop-applied fusion bonded epoxy coating applied by fluidized bed method, complying with the requirements of NSF 61 and AWWA C550 as applicable.

b. As an alternative, a shop-coat primer suitable for field applied coatings can be supplied.

9. Flanges: Flat-faced, rated to pressure requirements as shown on the Drawings.

a. Where design pressure is greater than 300 psi, flanges shall conform to ASME B16.5 and ASME B16.47 300-pound class.

B. Materials:

1. Spigot piece: Steel, ASTM A283 Grade C.

2. Flange adaptor:

a. Up to 12-inch diameter: Ductile iron, ASTM A536 Grade 65-45-12.

b. Above 12-inch diameter: Steel, ASTM A283 Grade C.

3. Tie bars: ASTM A193 Grade B7 threaded rod with rolled threads.

4. Gasket: EPDM Grade E.

5. Nuts, Bolts, and Washers: Type 304 stainless steel.

C. Manufacturer:

1. Romac or equal.

2.17 PIPE SUPPORTS

A. Floor Support for Pipe:

1. Flanged Pipe Support:

a. Construction:

1) Adjustable vertical pipe support, flange plate, extension pipe from base cup to top collar cup with threaded stud.

2) Bolts directly to flange.

3) Anchorable base plate.

b. Material: Steel, comply with ASTM A36.

c. Finish: Corrosion resistant, electro-galvanized, or prime coated.

d. Manufacturers:

1) Standon - Model S89.

2. Cradle Pipe Support:

a. Construction:

1) Adjustable vertical pipe support with saddle strap, extension pipe from base cup to top collar cup with threaded stud.

2) Anchorable base plate.

b. Material: Steel, comply with ASTM A36.

c. Finish: Corrosion resistant, electro-galvanized, or prime coated.

d. Manufacturers:

1) Standon - Model S92.

2.18 PIPE PENETRATIONS

A. Sleeves for Pipes through Walls and Floors:

1. Material: Galvanized steel.

2. Thickness: Schedule 40.

3. Inside surface of all wall sleeves shall be coated with coal-tar.

4. Annular space between penetrating pipe and wall sleeve shall be filled with an approved permanently flexible sealant.

5. Diameter of wall sleeve shall be as shown in the Drawings.

B. Mechanical Sleeve Seals:

1. Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2. Manufacturer: Link-Seal or equal.

C. Pipes Cast-In Walls and Floors:

1. Material: Ductile iron or steel pipe, as required by the Drawings and the intended service.

2. Diameter: As shown in the Drawings.

3. End Type: As shown in the Drawings.

D. Seep Rings:

1. Material: 3/8-inch-thick steel plate conforming to ASTM A36, unless otherwise noted.

2. Inside diameter: Equal to the outside diameter of the pipe or sleeve to which it is attached plus 1/4-inch.

3. Outside diameter: As shown in the Drawings.

4. Attach to the pipe or sleeve by means of a continuous seal weld located on both sides of the ring.

2.19 PIPE COATINGS

A. See Section 09 90 00, Painting and Coating.

PART 3 EXECUTION

3.1 GENERAL

A. Furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill, and encasement, to provide a functional installation.

B. Pipe shall be installed in accordance with good trade practice. The methods employed in handling and placing of pipe, fittings, and equipment shall be such as to insure that after installation and testing they are in good condition. Should damage occur to the pipe, fitting or equipment, repairs satisfactory to the Engineer shall be made.

3.2 INSTALLATION

A. Buried Piping Systems:

1. Establish elevations of buried piping with not less than 3 feet of cover.

2. Remove scale and dirt from inside of piping before assembly, as may be required.

3. Excavate pipe trench as specified in Section 31 23 17, Trenching.

4. Install pipe to accurate lines, elevations, and grades as shown on the Drawings.

5. Where grades are not shown, pipe shall be laid to grade between control elevations shown on the Drawings.

6. Place bedding material at trench bottom to provide uniform bedding for piping.

7. Level bedding material in one continuous layer not exceeding 6 inches compacted depth.

8. Install pipe on prepared bedding.

9. Route pipe in straight line.

10. Install pipe to allow for expansion and contraction without stressing of pipe or joints.

11. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.

12. Pipe Cover and Backfilling:

    a. Backfill trench as specified in Section 31 23 17, Trenching.

13. All buried non-ferrous piping shall be installed with detectable tracer tape.

a. Tape shall be buried 12 inches above the top of the pipe or as recommended by Manufacturer.

b. Tape shall be continuous and labeled the same as the piping system.

B. Interior Piping Systems:

1. Install non-conducting dielectric connections wherever joining dissimilar metals.

2. Establish elevations of buried piping outside valve vault to obtain not less than 3 feet of cover.

3. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting as specified in Section 09 90 00, Painting and Coating.

4. Install water piping according to ASME B31.9.

5. Install unions downstream of valves and at equipment or apparatus connections.

6. Install brass male adapters each side of valves in copper piped system, solder adapters to pipe.

C. Backflow Preventer Assemblies:

1. Install backflow preventers of type, size, and capacity indicated.

2. Comply with applicable code and authority having jurisdiction.

3. Install airgap fitting on units with atmospheric vent connection.

4. Pipe relief outlet drain to nearest floor drain.

5. Do not install bypasses around backflow preventers.

D. Pipe Supports and Hangers

1. Install pipe supports according to MSS SP-58 and ASME B31.10.

2. All pipe shall be secured in place by use of blocking, hangers, brackets, clamps or other approved methods, and the weight thereof shall be carried independently of pump casings or equipment.

3. Special hangers and supports are shown on the Drawings.

4. The Contractor shall be responsible for determining the location of and providing all additional supports.

5. Hanger supports shall be as noted below with at least one support adjacent to the joint for each length of pipe, at each change in direction and at each branch connection. Sufficient hangers shall be provided to maintain proper slope without sagging. Support spacing shall not exceed Manufacturer's recommendations, nor as listed below.

Pipe	Maximum Support Spacing (Feet)
Steel Pipe	
Under 3 inches	6
3 inches and Over	12
Cast or Ductile Iron	
Under 4 inches	6
4 inches and Over	12
Stainless Steel and Galvanized Iron	
Under 1-1/2 inches	4
1-1/2 inches to 4 inches	6
Over 4 inches	12
Copper Pipe	6
PVC Pipe	
Under 2-1/2 inches	4
2-1/2 inches and Over	6

6. Spacing of clamps for support of vertical piping shall be close enough to keep the pipe in alignment as well as to support the weight of the piping and contents unless other vertical support is shown, but in no case shall be more than 12 feet.

7. Provide adjustable hangers for all pipes, complete with adjusters, swivels, rods, etc. Size hangers to clear insulation and guide where required, as well as support piping. All rigid hangers shall provide a means of vertical adjustment after erection. Hanger rods shall be machine threaded. Continuous threaded rods will not be allowed.

8. Clevis or band-type hangers (B-Line FIG B3100) or equal shall be provided as required. Strap hangers not permitted.

9. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which cannot be properly supported or suspended by the walls or floors. Pipelines near concrete or masonry walls may also be hung by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.

10. Equipment shall be positioned and aligned so that no strain shall be induced within the equipment during or subsequent to the installation of pipework.

11. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.

E. Pipe Penetrations:

1. Exterior Watertight Entries: Seal with mechanical sleeve seals or grout, as shown in the Drawings.

2. Whenever a pipeline of any material terminates at or through a structural wall or floor, install piping or sleeve in advance of pouring of concrete required for the particular installation.

3. Plastic pipe shall not be cast in concrete or masonry walls.

4. Set sleeves in position in forms and provide reinforcing around sleeves.

5. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.

6. Extend sleeves through floors 1-inch above finished floor level and caulk sleeves.

7. Pipe other than concrete, to be cast in water-bearing walls or more than 4 feet below grade shall have seep rings.

8. All buried piping entering structures shall have a flexible connection installed less than 2 feet outside the structure line or as close to the wall as practical.

3.3 CLEANING, TESTING, AND DISINFECTION

A. Testing and Disinfection: Piping shall be hydrostatically tested, flushed, and disinfected as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

END OF SECTION

SECTION 40 05 13.33 - COPPER PROCESS PIPE AND TUBING

This Section specifies copper pipe and tube materials normally encountered in plant process piping systems and includes common fittings. Specialized fittings, joints, accessories, and other appurtenances are specified in detail in the appropriate piping Section based on service.

For water and wastewater treatment projects, individual piping systems (such as sanitary, raw water, and drainage) are typically defined on Drawings using a piping schedule, which describes piping components required for that system and may provide other relevant data such as pressure testing requirements and applicable valve types.

Piping for Site utilities is specified in applicable site utilities Sections in Division 33.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive specifications. Edit to avoid conflicting requirements.

This Section may include term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Checklist and Evaluations for information needed to coordinate this Specification Section with Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper pipe and fittings.
2. Copper tube and fittings.
3. Accessories.

B. Related Requirements:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

1. Section 33 13 00 – Testing and Disinfection of Water Utility Piping: Disinfection requirements for potable water systems.
2. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping: Piping appurtenances.

3. Section 40 05 51 - Common Requirements for Process Valves: Common product requirements for valves for placement by this Section.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

A. American Welding Society:

1. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding.

B. ASME International:

1. ASME B1.1 - Unified Inch Screw Threads, UN and UNR Thread Form.
2. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.
3. ASME B1.20.2M - Pipe Threads, 60 deg. General Purpose (Metric).
4. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
5. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
6. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
7. ASME B16.20 - Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed.
8. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
9. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
10. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV.
11. ASME B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500.
12. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
13. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
14. ASME B31.3 - Process Piping.

C. ASTM International:

1. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
2. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
3. ASTM B32 - Standard Specification for Solder Metal.
4. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.

5. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings.

6. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

7. ASTM B75/B75M - Standard Specification for Seamless Copper Tube.

8. ASTM B98/B98M - Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.

9. ASTM B124/B124M - Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.

10. ASTM B150/B150M - Standard Specification for Aluminum Bronze Rod, Bar, and Shapes.

11. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.

12. ASTM B251M - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube (Metric).

13. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.

14. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).

D. Manufacturers Standardization Society:

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

E. NSF International:

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

2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer information regarding pipe, tube, and fittings.

C. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials list.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

Include separate Paragraphs for additional certifications.

Include following Paragraph when Contractor is responsible for designing products or assemblies. List affected products when Section specifies more than one product.

E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with piping layout and with design calculations and assumptions for pipe sizing methods.

F. Source Quality-Control Submittals: Indicate results of [shop] [factory] tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer, installer, and licensed professional.

2. Submit Manufacturer's approval of installer.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and [invert] [centerline] elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

A. Permanently mark each length of pipe with Manufacturer's name or trademark and indicate conformance to standards.

B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

C. Perform Work according to <_____> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

D. Maintain <_____> [copy] [copies] of each standard affecting Work of this Section on Site.

1.6 QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [three] <_____> years' [documented] experience.

B. Installer: Company specializing in performing Work of this Section with minimum [three] <_____> years' [documented] experience [and approved by Manufacturer].

C. Licensed Professional: [Professional engineer] <_____> experienced in design of specified Work and licensed [at Project location] [in State of _____].

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect piping and appurtenances by storing off ground.

3. Provide additional protection according to Manufacturer instructions.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 COPPER PIPE, TUBE, AND FITTINGS

Copper is generally corrosion resistant, although it is rapidly corroded by oxidizing acids such as chromic and nitric acids. Copper pipe with soldered joints is not recommended for transporting fuel oil or other flammable or toxic liquids. Copper tubing is not allowed for natural gas distribution according to U.S. code. Consult with Piping Manufacturer and select materials based on specific application.

Piping is available in various lengths depending on specific material. Copper tube comes in rigid, hard-tempered "joints" or soft-tempered (annealed) rolls.

Copper tubing "type" designations apply only to tubing furnished under ASTM B88 (B88M). "Type" indicates wall thickness; Type K has the greatest wall thickness, and Type M the least wall thickness. Some plumbing codes may require use of ASTM B88 (B88M) Type K or Type L pipe for water service applications and water distribution systems, but may not allow use of Type M.

Select from following options required for Project conditions based on service requirements.

A. Pipe:

1. Material: Seamless copper.

2. Comply with ASTM [B42] [B302] [B306].

3. Temper: [**Annealed**] [**Hard drawn**].

4. Type: [**K**] [**L**] [**M**].

B. Tube:

1. Material: Seamless copper alloy.

2. Comply with ASTM B88 (B88M).

3. Type: [**K**] [**L**] [**M**].

4. Temper: [**Drawn**] [**Annealed**].

******** [OR] ********

C. Tube:

1. Material: Seamless copper alloy.

2. Comply with ASTM [**B75/B75M**] [**B251 (B251M)**].

3. Temper: [**Soft**] annealed.

D. Fittings:

1. Material: Copper alloy.

2. Temper: Comply with ASTM [**B61**] [**B62**].

3. Solder-Joint Fittings: Comply with ASME [**B16.18**] [**B16.22**] [**B16.23**] [**B16.29**].

4. Flared Fittings: Comply with ASME B16.26.

5. Threaded Fittings:

   a. Material: Cast bronze.

   b. Comply with ASME B16.15.

   c. Threads: Comply with ASME B1.20.1 (B1.20.2M).

6. Flanges and Flanged Fittings:

   a. Comply with ASME B16.24.

   b. Class [**150**] [**300**] <_____>.

   c. Gaskets:

      1) Material: [**Neoprene**] <_____>.

      2) Comply with ASME B16.5 and ASME [**B16.20**] [**B16.21**].

      3) Thickness: 1/16 inch (1.6 mm).

7. Seals:

a. Material: [EPDM] <_____>.

b. [Factory installed.]

8. Tubing Compression Fittings:

a. Material: Forged brass alloy.

b. Comply with ASTM [B124/B124M] <_____>.

c. Threads: Comply with ASME B1.1.

d. Press Fittings:

1) Material: [Copper] [Bronze].

2) Comply with ASME [B16.18] [B16.22].

E. Pipe Joints:

1. Type:

a. [Threaded] [Soldered] [Brazed].

b. Connections to Equipment: [Flanged] <_____>.

F. Tube Joints:

1. Type: [Soldered] [Flared] [Press compression] [Compression].

2.2 ACCESSORIES

A. Bolting: Comply with ASTM [B98/B98M] [B150/B150M] <_____>.

Consider operating temperature and exposure to corrosivity when selecting a solder type.

B. Solder:

1. Comply with ASTM B32 [and AWS A5.8/A5.8M].

Due to risk of galvanic corrosion, direct contact with steel and galvanized steel hangers should not be allowed.

C. Piping Supports:

1. Material: [Copper] [Brass] [Padded steel].

2. Comply with MSS SP-58.

2.3 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

Include one or both of following Paragraphs to require Owner's inspection or witnessing of test at factory.

C. Owner Inspection:

1. Make completed [piping] [and] [tubing] components available for inspection at Manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least [seven] <_____> days before inspection is allowed.

D. Owner Witnessing:

1. Allow witnessing of factory inspections and test at Manufacturer's test facility.

2. Notify Owner at least [seven] <_____> days before inspections and tests are scheduled.

Include following Paragraph if reliance on Manufacturer's approved quality-control program is sufficient for Project requirements.

E. Certificate of Compliance:

1. If Manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at Manufacturer's facility conforms to Contract Documents.

2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that field dimensions are as indicated on [Shop] Drawings.

C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Thoroughly clean pipe and fittings before installation.

3.3 INSTALLATION

A. Comply with [ASME B31.3] <_____>.

B. Run piping straight along alignment as indicated on [Shop] Drawings, with minimum number of joints.

C. Fittings:

1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.

2. Install fittings according to Manufacturer instructions.

3. Bolts:

a. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.

b. Use torque wrench to tighten bolts to Manufacturer instructions.

D. Provide required upstream and downstream clearances from devices as indicated on [Shop] Drawings.

E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

F. Provide expansion joints as specified in Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping to compensate for pipe expansion due to temperature differences.

G. [Disinfection: Disinfect potable water piping as specified in Section 33 13 00 – Testing and Disinfection of Water Utility Piping.]

H. Dielectric Fittings: Provide between dissimilar metals.

I. Field Cuts: According to Pipe Manufacturer instructions.

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

J. Installation Standards: Install Work according to <_____> standards.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Laying Tolerance: [5/8] <_____> inch ([20] <_____> mm).

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

******** [OR] ********

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Inspection:

1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Architect/Engineer.

2. Repair damaged piping or provide new, undamaged pipe.

3. After installation, inspect for proper supports and interferences.

D. Pressure Testing: As indicated on piping schedule.

******** [OR] ********

E. Pressure Testing:

1. Test Pressure: Not less than 200 psig (1 380 kPa) or 50 psi (345 kPa) in excess of maximum static pressure, whichever is greater.

2. Conduct hydrostatic test for minimum [**two**] <_____> hours.

3. Filling:

   a. Fill section to be tested with water slowly and expel air from piping at high points.

   b. Install corporation cocks at high points.

   c. Close air vents and corporation cocks after air is expelled.

   d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.

5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.

6. Leakage:

   a. Correct visible deficiencies and continue testing at same test pressure for additional [**two**] <_____> hours to determine leakage rate.

   b. Maintain pressure within plus or minus 5 psi (34.4 kPa) of test pressure.

   c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.

   d. Compute maximum allowable leakage by following formula:

      1) L = SD x sqrt(P)/C.

      2) L = testing allowance in gph (L/h).

      3) S = length of pipe tested in feet (m).

      4) D = nominal diameter of pipe in inches (mm).

      5) P = average test pressure during hydrostatic test in psig (kPa).

6) C = 148,000 (794 797).

7) If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.

f. Correct visible leaks regardless of quantity of leakage.

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

F. Pressure Testing: According to <_____> standards.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Keep pipe interior clean as installation progresses.

C. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION

SECTION 40 05 13.07 - HANGERS AND SUPPORTS FOR PROCESS PIPING

This Section specifies supports, hangers, anchors, and guides applicable to plant process piping systems, and equipment bases and supports.

This Section is intended to be used as a standalone Section to specify hangers and supports for entire Division. If this Section is used, consider deleting requirements in individual piping system specification Sections and instead reference this Section.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive specifications. Edit to avoid conflicting requirements.

This Section may include term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Checklist and Evaluations for information needed to coordinate this Specification Section with Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Structural attachments.
4. Pipe guides.
5. Formed-steel channel.
6. <_____>.

B. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section, as well as Sections required to describe complete system or assembly requirements.

1. Section 03 10 00 - Concrete Forming and Accessories: Execution requirements for placement of [inserts] [sleeves] in concrete forms specified by this Section.
2. Section 03 30 00 - Cast-in-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this Section.

3. Section [09 90 00 - Painting and Coating] [09 96 35 - Chemical-Resistant Coatings]: Product and execution requirements for painting specified by this Section.

4. Section 40 05 13.30 - Brass Process Pipe: Execution requirements for placement of hangers and supports as specified by this Section.

5. Section 40 05 13.33 - Copper Process Pipe and Tubing: Execution requirements for placement of hangers and supports as specified by this Section.

6. Section 40 05 13.53 - Ductile Iron Process Piping: Execution requirements for placement of hangers and supports as specified by this Section.

7. Section 40 05 13.19 - Stainless Steel Process Piping: Execution requirements for placement of hangers and supports as specified by this Section.

8. Section 40 05 13.13 - Steel Process Pipe: Execution requirements for placement of hangers and supports as specified by this Section.

9. Section 40 05 13.73 - Thermoplastic Process Piping: Execution requirements for placement of hangers and supports as specified by this Section.

10. Section 40 05 13.76 - Fiberglass-Reinforced Plastic Process Pipe: Execution requirements for placement of hangers and supports as specified by this Section.

11. Section 40 05 51 - Common Requirements Results for Process Valves: Common product requirements for valves for placement by this Section.

12. Section 40 42 13 - Process Piping Insulation: Insulation requirements for pipe, fittings, and appurtenances.

Commented [JW1]: We do not have this in our spec list. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

LEED requires compliance with specific editions of referenced standards. Section 01 40 00 requires compliance with the latest reference standard edition, except when a specific date is required by code. Consider including publication dates for referenced standards in this Section to ensure the correct standard is used for LEED compliance.

A. American Welding Society:

1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

B. ASME International:

1. ASME B31.1 - Power Piping.

2. ASME B31.9 - Building Services Piping.

C. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

2. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

3. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

4. ASTM A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacturer, Selection, Application, and Installation.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with piping and equipment connections specified in other Sections [**and as indicated on Drawings**].

1.4 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum [**one week**] <_____> [**weeks**] prior to commencing Work of this Section.

1.5 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer information, including load capacity.

C. Shop Drawings: Indicate system layout with location, including critical dimensions, sizes, hanger and support locations, and details of trapeze hangers, anchors, and guides.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

Include separate Paragraphs for additional certifications.

Include following Paragraph when Contractor is responsible for designing products or assemblies. List affected products when Section specifies more than one product.

F. Delegated Design Submittals:

1. Submit signed and sealed Shop Drawings with design calculations and assumptions for load carrying capacity of trapeze, multiple pipe, and riser support hangers.

2. Indicate [**sizing methods**] [**calculations**] used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

G. Manufacturer Instructions: Submit special procedures and assembly of components.

H. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer, fabricator, installer, and licensed professional.

2. Submit Manufacturer's approval of installer.

1.6 QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

Some codes permit compliance with more than one reference standard. Coordinate references with applicable codes.

A. Perform Work according to [applicable authority] [AWS D1.1/D1.1M] for welding hanger and support attachments to building structure.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

B. Perform Work according to <_____> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

C. Maintain <_____> [copy] [copies] of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum [three] <_____> years' [documented] experience.

B. Fabricator: Company specializing in fabricating products specified in this Section with minimum [three] <_____> years' [documented] experience.

C. Installer: Company specializing in performing Work of this Section with minimum [three] <_____> years' [documented] experience [and approved by Manufacturer].

D. Licensed Professional: [Professional engineer] <_____> experienced in design of specified Work and licensed [at Project location] [in State of] <_____>.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Provide additional protection according to Manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

This Article extends warranty period beyond one year. Extended warranties may increase construction costs and Owner enforcement responsibilities. Specify warranties with caution.

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish [five] <_____>-year Manufacturer's warranty for pipe hangers and supports.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description:

ASME B31.9 concerns piping in industrial, institutional, commercial, and public buildings, and multiunit residences, which do not require the range of sizes, pressures, and temperatures as covered in ASME B31.1.

MSS SP-58 combines the content of other MSS pipe hanger and support standards into a single document.

1. Comply with [ASME B31.1] [ASME B31.9] [MSS SP-58].
2. Provide means of vertical adjustment after erection.
3. Pipe Sizes 1/2 to 1-1/2 Inches (13 to 38 mm):
   a. Material: [Malleable iron; ASTM A47A47M] [Steel; ASTM A36/A36M] <_____>.
   b. Configuration: Split ring.
   c. Swivel: Adjustable.
4. Pipe Sizes 2 Inches (50 mm) and Larger:
   a. Material: [Steel; ASTM A36/A36M] <_____>.
   b. Configuration: Clevis.
   c. Swivel: Adjustable.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes 3 Inches (76 mm) and Smaller: Cast-iron J-hook.
7. Wall Support for Pipe Sizes 4 Inches (100 mm) and Larger: [Welded steel bracket] <_____>.
8. Vertical Support: Riser clamp.
9. Floor Supports: Cast-iron adjustable pipe saddle, lock nut, nipple, floor flange, and [concrete pier] [steel support].

C. Performance and Design Criteria:

Insert performance requirements and criteria below when design is assigned to Contractor.

1. Pipe Hangers:
   a. Design for pipe movement without disengagement of supported pipe.
   b. Allow for expansion and contraction of piping while eliminating undue stress on piping appurtenances and equipment.
   c. Provide linkage to permit lateral or axial movement where anticipated.

d. If horizontal pipe movement is greater than 1/2 inch (12 mm), or if hanger rod deflection from the vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger rod and structural attachment to maintain rod vertical in hot position.

2. Heat Transmission: Design supports, hangers, anchors, and guides to prevent excessive heat from being transmitted to building structure, equipment, or piping appurtenances.

3. Riser Supports: Support risers on each floor with riser clamps and lugs, independent of connected horizontal piping.

4. Point Loads:

a. Support plastic piping containing meters, valves, appurtenances, and other point loads on both sides.

b. Avoid point loads on plastic piping by providing extra-wide pipe saddles or galvanized-steel shields.

5. Noise Reduction: Wrap copper tubes located within buildings in a 2-inch- (50-mm-) wide strip of [**rubber**] <_____> at each pipe support, bracket, clip, and hanger.

2.2 HANGER RODS

A. Material: [**Steel; ASTM A576**] <_____>.

B. End Connections: [**Threaded both ends**] [**Threaded one end**] [**All thread**].

C. Size: [**Comply with ASME B31.1**] [**and**] [**as indicated on Drawings**].

2.3 STRUCTURAL ATTACHMENTS

A. Concrete Inserts:

1. Manufacturers:

a. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

b. Substitutions: [**As specified in Section 01 60 00 - Product Requirements**] [**Not permitted**].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

c. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

2. Case: Malleable iron with [**galvanized-**]steel shell and expander plug.

3. Connection: Threaded, with lateral adjustment.

4. Size: To suit threaded hanger rods.

B. Mounting Brackets: Welded steel; ASTM A36/A36M.

C. Beam Clamps:

1. Manufacturers:

a. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

b. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

c. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

2. Comply with MSS SP-58.

3. Material: [Steel; ASTM A36 (/A36M)] [Forged steel; ASTM A181/ (181M)] <_____>.

4. Size: Suitable for load to be supported.

5. Anchoring: Locknuts and [cup-point] set screws.

6. Furnish reversible [top] [or] [bottom] flange.

D. Riser Clamps:

1. Manufacturers:

a. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

b. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

c. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

2. Material: [Steel; ASTM A36/A36M] <_____>.

Consider including following Subparagraph if copper tubing is to be supported.

3. Support of Copper Tubing: Furnish copper-plated clamp.

E. Offset Clamps:

1. Manufacturers:

a. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

b. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ******

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

c. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

2. Configuration: Double leg, two pieces.

2.4 PIPE GUIDES

A. Intermediate Guides:

1. Pipes 6 Inches (150 mm) and Smaller: Pipe clamp with oversize pipe sleeve.

2. Pipes 8 Inches (200 mm) and Larger: U-bolts with double nuts.

B. Alignment Guides:

1. Pipes 8 Inches (200 mm) and Smaller:

a. Material: [Galvanized steel] <_____>.

b. Type: [Spider] [Sleeve] <_____>.

2. Pipes 10 Inches (250 mm) and Larger:

a. Material: [Galvanized steel] <_____>.

b. Type: [Roller] <_____>.

2.5 FORMED-STEEL CHANNEL

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description:

1. Material: [Galvanized steel] <_____>.

2. Thickness: 12 gauge (2.8 mm).

3. Mounting Holes: 1-1/2 inches (38 mm) o.c.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that field dimensions as indicated on [Shop] Drawings.

3.2 INSTALLATION

A. Obtain permission from [Architect/Engineer] <_____> before using powder-actuated anchors.

B. Obtain permission from [Architect/Engineer] <_____> before drilling or cutting structural members.

******** [OR] ********

C. Do not drill or cut structural members.

D. Inserts:

1. Placement:

a. Concrete forms.

b. Reinforced concrete slabs and sides of reinforced concrete beams.

2. Piping 4 Inches (100 mm) and Larger: Provide hooked rod to concrete reinforcement section.

3. Concrete Slabs Forming Finished Ceiling: Locate inserts flush with slab surface.

E. Pipe Hangers and Supports:

1. Comply with [**ASME B31.1**] [**ASME 31.9**] [**MSS SP-58**].

2. Support horizontal piping as indicated [**in schedule following END OF SECTION**] [**on Drawings**] [**on Shop Drawings**].

3. Install hangers with minimum 1/2-inch (13-mm) space between finished covering and adjacent Work.

4. Place hangers within 12 inches (300 mm) of each horizontal elbow.

5. Minimum Vertical Adjustment: 1-1/2 inches (38 mm).

6. Supports:

a. Independently of equipment.

b. Horizontal Cast-Iron Piping: Adjacent to each hub, with maximum 5-foot (1.5-m) spacing between hangers.

c. Vertical Piping:

1) Cast-Iron Piping: At each floor at hub.

2) Other Piping: At every [**other**] floor.

d. Riser Piping: Independent of connected horizontal piping.

7. Piping in Parallel at Same Elevation: Provide multiple pipe or trapeze hangers.

8. [**Provide sheet-lead packing between hanger or support and piping**].

9. Clamps and Brackets:

a. Provide welded steel brackets if piping is to be run adjacent to building walls or columns.

b. Use beam clamps if piping is to be suspended from building steel.

c. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.

d. Use offset clamps if pipes are indicated as offset from wall surfaces.

F. Insulation:

1. Provide clearance in hangers and from structure and other equipment for installation of insulation.

2. As specified in Section [**40 42 13 - Process Piping Insulation**] <_____-_____>.

Manufactured hangers are typically supplied in black steel.

G. Equipment Bases and Supports:

1. Housekeeping Pads:

a. Material: Concrete, as specified in Section 03 33 00 - Cast-in-Place Concrete.

b. Minimum Thickness: [**3-1/2 inches (87 mm)**] [**As indicated on Drawings**] [**As indicated on Shop Drawings**].

c. Plan Area: Extend 6 inches (150 mm) beyond supported [**equipment**] <_____>.

******** [OR] ********

2. Housekeeping Pads: As indicated on [**Drawings**] [**Shop Drawings**].

3. Supports:

a. Material: [**Steel members**] [**Formed-steel channel**] [**Steel pipe and fittings**] <_____>.

b. Brace and fasten with flanges bolted to structure.

c. Anchor Bolts and Accessories: Use templates furnished with equipment.

H. Finishes:

1. Prime coat exposed steel hangers and supports as specified in Section [**09 90 00 - Painting and Coating**] [**09 96 35 - Chemical-Resistant Coatings**].

Commented [JW2]: We do not have this in our spec list. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

2. Hangers and supports located in crawlspaces, pipe shafts, and suspended ceiling spaces are not considered as exposed.

3.3 ATTACHMENTS

When relying on separate schedules, tables, illustrations, or forms to specify product requirements, include list of each attachment. Include identical list of attachments in Project Manual table of contents.

Consider including schedule if pipe hanger spacing and size is not defined by code.

Insert attachments following END OF SECTION. Consider following examples when developing Project schedule.

A. Pipe Hanger Spacing:

1. Pipe Material: ABS.

a. Maximum Hanger Spacing: 4 feet (1.2 m).

b. Hanger Rod Diameter:3/8 inch (9 mm).

2. Pipe Material: Aluminum.

   a. Maximum Hanger Spacing: 10 feet (3.0 m).

   b. Hanger Rod Diameter:1/2 inch (13 mm).

3. Pipe Material: Cast iron.

   a. Maximum Hanger Spacing: 5 feet (1.5 m).

   b. Hanger Rod Diameter:5/8 inch (15 mm).

4. Pipe Material: Cast iron, with 10-foot (3-m) length of pipe.

   a. Maximum Hanger Spacing: 10 feet (3.0 m).

   b. Hanger Rod Diameter:5/8 inch (15 mm).

5. Pipe Material: CPVC.

   a. Size: 1 inch (25 mm) and smaller.

   b. Maximum Hanger Spacing: 3 feet (0.9 m).

   c. Hanger Rod Diameter:1/2 inch (13 mm).

6. Pipe Material: CPVC.

   a. Size: 1-1/4 inches (32 mm) and larger.

   b. Maximum Hanger Spacing: 4 feet (1.2 m).

   c. Hanger Rod Diameter:1/2 inch (13 mm).

7. Pipe Material: Copper tube.

   a. Size: 1-1/4 inches (32 mm) and smaller.

   b. Maximum Hanger Spacing: 6 feet (1.8 m).

   c. Hanger Rod Diameter:1/2 inch (13 mm).

8. Pipe Material: Copper tube.

   a. Size: 1-1/2 inches (39 mm) and larger.

   b. Maximum Hanger Spacing: 10 feet (3.0 m).

   c. Hanger Rod Diameter:1/2 inch (13 mm).

9. Pipe Material: Fiberglass:

   a. Maximum Hanger Spacing: 4 feet (1.2 m).

b. Hanger Rod Diameter:1/2 inch (13 mm).

10. Pipe Material: Glass.

    a. Maximum Hanger Spacing: 8 feet (2.4 m).

    b. Hanger Rod Diameter:1/2 inch (13 mm).

11. Pipe Material: Polybutylene.

    a. Maximum Hanger Spacing: 2.7 feet (0.8 m).

    b. Hanger Rod Diameter:3/8 inch (9 mm).

12. Pipe Material: Polypropylene.

    a. Maximum Hanger Spacing: 4 feet (1.2 m).

    b. Hanger Rod Diameter:3/8 inch (9 mm).

13. Pipe Material: PVC.

    a. Maximum Hanger Spacing: 4 feet (1.2 m).

    b. Hanger Rod Diameter:3/8 inch (9 mm).

14. Pipe Material: Steel.

    a. Size: 3 inches (75 mm) and smaller.

    b. Maximum Hanger Spacing: 12 feet (3.7 m).

    c. Hanger Rod Diameter:1/2 inch (13 mm).

15. Pipe Material: Steel.

    a. Size: 4 inches (100 mm) and larger.

    b. Maximum Hanger Spacing: 12 feet (3.7 m).

    c. Hanger Rod Diameter:5/8 inch (15 mm).

END OF SECTION

SECTION 40 05 13.13 - STEEL PROCESS PIPE

This Section specifies steel pipe materials normally encountered in plant process piping systems and common to multiple Sections in this Division, and it includes common fittings and joints. Common piping components, including penetrations, restrained joints, flexible connections, and expansion joints and loops, are specified in Section 40 05 06. Specialized fittings, joints, accessories, and other appurtenances are specified in detail in the appropriate piping Section based on service.

For water and wastewater treatment projects, individual piping systems (such as sanitary, raw water, and drainage) are typically defined on Drawings via a piping schedule, which describes piping components required for that system and may provide other relevant data such as pressure testing requirements and applicable valve types.

Piping for Site utilities is specified in applicable site utilities Sections in Division 33.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive specifications. Edit to avoid conflicting requirements.

This Section may include term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Checklist and Evaluations for information needed to coordinate this Specification Section with Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe.
2. Steel tube.
3. Cement-mortar-lined steel pipe.
4. Plastic-lined steel pipe.
5. Glass-lined steel pipe.
6. Rubber-lined steel pipe.
7. Internally coated steel pipe.
8. Fittings.
9. Accessories.

B. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

1. Section 09 90 00 - Painting and Coating: Finishes as specified by this Section.
2. Section 09 96 35 - Chemical-Resistant Coatings: Finishes as specified by this Section.
3. Section 33 13 00 – Testing and Disinfection of Water Utility Piping: Disinfection requirements for potable-water systems.
4. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping: Pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
5. Section 40 05 51 - Common Requirements Results for Process Valves: Common product requirements for valves for placement by this Section.
6. Section 40 46 42 - Cathodic Process Corrosion Protection: Passive cathodic protection for buried ferrous piping.

Commented [JW1]: We do not have this in our spec list. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

A. American Water Works Association:

1. AWWA C200 - Steel Water Pipe, 6 In. (150 mm) and Larger.
2. AWWA C203 - Coal-Tar Protective Coatings and Linings for Steel Water Pipe.
3. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied.
4. AWWA C206 - Field Welding of Steel Water Pipe.
5. AWWA C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
6. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
7. AWWA C210 - Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
8. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
9. AWWA C222 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.
10. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.

11. AWWA C606 - Grooved and Shouldered Joints.

12. AWWA M11 - Steel Water Pipe - A Guide for Design and Installation.

B. American Welding Society:

1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

C. ASME International:

1. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.

2. ASME B1.20.2M - Pipe Threads, 60 deg. General Purpose (Metric).

3. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

4. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

5. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

6. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.

7. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.

8. ASME B16.20 - Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed.

9. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.

10. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

11. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.

12. ASME Boiler and Pressure Vessel Code (BPVC) Section IX - Welding, Brazing, and Fusing Qualifications.

D. ASTM International:

1. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

3. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications.

4. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

5. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

6. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

7. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

8. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

9. ASTM A334/A334M - Standard Specification for Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service.

10. ASTM A423/A423M - Standard Specification for Seamless and Electric-Welded Low-Alloy Steel Tubes.

11. ASTM A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

12. ASTM A727/A727M -Standard Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness.

13. ASTM A858/A858M - Standard Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service.

14. ASTM A865/A865M - Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints.

15. ASTM C33/C33M - Standard Specification for Concrete Aggregates.

16. ASTM C150/C150M - Standard Specification for Portland Cement.

17. ASTM C600 - Standard Test Method of Thermal Shock Test on Glass Pipe.

18. ASTM D1418 - Standard Practice for Rubber and Rubber Latices - Nomenclature.

19. ASTM D3308 - Standard Specification for PTFE Resin Skived Tape.

20. ASTM E438 - Standard Specification for Glasses in Laboratory Apparatus.

21. ASTM F336 - Standard Practice for Design and Construction of Nonmetallic Enveloped Gaskets for Corrosive Service.

22. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

23. ASTM F1545 - Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges.

E. NSF International:

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

2. NSF 372 - Drinking Water System Components - Lead Content.

F. SSPC - The Society for Protective Coatings:

1. SSPC-SP 6 - Commercial Blast Cleaning.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with piping and equipment connections specified in other Sections [**and indicated on Drawings**].

1.4 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum [**one week**] <_____> [**weeks**] prior to commencing Work of this Section.

1.5 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer information regarding pipe and fittings.

C. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and material lists.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Welder Certificates: Submit welders' certification of compliance with [**ASME BPVC Section IX**] [**AWS D1.1/D1.1M**] <_____>, verifying qualification within previous 12 months.

Include separate Paragraphs for additional certifications.

Include following Paragraph when Contractor is responsible for designing products or assemblies. List affected products when Section specifies more than one product.

F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with piping layout and with design calculations and assumptions for pipe sizing methods.

G. Source Quality-Control Submittals: Indicate results of [**shop**] [**factory**] tests and inspections.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

I. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer, installer, and licensed professional.

2. Submit Manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and [invert] [centerline] elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

A. Permanently mark each length of pipe with Manufacturer's name or trademark and indicate conformance to standards.

B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

C. Perform Work according to <_____> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

D. Maintain <_____> [copy] [copies] of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [three] <_____> years' [documented] experience.

B. Installer: Company specializing in performing Work of this Section with minimum [three] <_____> years' [documented] experience [and approved by Manufacturer].

C. Welders: [AWS] [ASME] qualified within previous 12 months for employed weld types.

D. Licensed Professional: [Professional engineer] <_____> experienced in design of specified Work and licensed [at Project location] [in State of _____].

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect piping and appurtenances by storing off ground.

3. Provide additional protection according to Manufacturer instructions.

1.10 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Minimum Conditions: Do not store or handle uninstalled lined pipes or fittings at temperatures below zero degrees F (minus 18 degrees C).

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. General Service Piping:

1. Comply with ASTM A53/A53M; Grade [**A**] [**B**].

2. Type: [**Welded**] [**Seamless**] [**Butt welded**] [**Electric welded**].

3. Schedule: [**40**] [**80**] [**As indicated on Drawings**] [**As indicated in piping schedule**].

4. Finish: Hot-dip galvanized.

B. High-Temperature Service Piping:

1. Comply with ASTM A106/A106M; Grade [**A**] [**B**] [**C**].

2. Type: [**Hot finished**] [**Cold drawn**].

3. Schedule: [**40**] [**80**] [**As indicated on Drawings**] [**As indicated in piping schedule**].

4. Dimensions: [**Comply with ASME B36.10M**] [**As indicated in piping schedule**].

C. Water Piping:

1. Comply with AWWA C200.

2. Type: [**Fabricated**] [**Mill**] pipe.

3. Minimum Wall Thickness:

a. Pipe Diameter 8 Inches (200 mm) and Smaller: 0.375 inch (9 mm).

b. Pipe Diameter Greater Than 8 Inches (200 mm): 0.500 inch (13 mm).

4. Fittings and Special Sections: Comply with AWWA C208.

5. Flanges:

a. Comply with AWWA C207[; **Class D**].

b. Type: Slip on.

6. Field Welding Materials: Comply with AWWA C206.

D. Joints:

1. Description: [**Screwed ends; NPT**] [**Straight threaded**] [**Taper threaded**] [**Butt welded**] [**Socket welded**] [**Flanged**] [**Mechanical coupling**] [**Push on; harnessed for high-pressure service**].

E. Fittings:

1. Type:

a. Piping 2 Inches (50 mm) and Smaller: Threaded.

b. Piping 2-1/2 Inches (65 mm) and Larger: Welded or flanged.

2. Dimensions: [**Comply with ASME B36.10M**] [**As indicated in piping schedule**].

3. Flanged Connections: [**As required to connect steel piping to fittings and equipment**] [**As indicated on Drawings**] [**As indicated in piping schedule**].

4. Threaded Fittings:

a. Class: [**150**] [**300**].

b. Malleable Iron:

1) Comply with [**ASTM A47/A47M**] [**and**] [**ASME B16.3**].

2) Type: Black; banded.

******** [OR] ********

c. Cast Iron:

1) Comply with ASME B16.3.

2) Pattern: Drainage.

******** [OR] ********

d. Forged Steel:

1) Comply with [ASTM A105/A105M] [ASTM A858/A858M] [and] [ASME B16.11].

2) Threads: Comply with ASME B1.20.1 (B1.20.2M).

5. Rigid Steel Couplings: Comply with [ASTM A865/A865M] <_____>.

6. Butt-Welding Fittings:

a. Comply with [ASTM A105/A105M] [ASTM A858/A858M] [and] [ASME B16.9].

b. Class: [150] [300] <_____>.

7. Socket-Welding Fittings:

a. Comply with [ASTM A105/A105M] [ASTM A858/A858M] [and] [ASME B16.11].

b. Class: [150] [300] <_____>.

8. Flanged Fittings:

a. Forged Steel: Comply with [ASTM A105/A105M] [ASTM A727/A727M] <_____> [, AWWA C207] [, and] [ASME B16.5].

******** [OR] ********

b. Cast Iron: Comply with ASME B16.1.

c. Class: [125] [150] [300] <_____>.

d. Type: [Welding neck] [Slip on] [Socket welded] [Lapped] [Threaded].

e. Facing and Drilling:

1) Comply with ASME B16.5.

2) Type: [<_____>-inch (<_____>-mm) raised face] [Flat face] <_____>.

f. Backing Flanges:

1) Material: Cast steel.

2) Comply with ASTM A216/A216M; Grade [WCA] [WCB] [WCC].

3) Class: [150] <_____>.

4) Type: Van stone.

5) Drilling: Comply with ASME [B16.1] [B16.5].

g. Fasteners:

1) Bolts: Comply with ASTM A193/A193M; Grade [B5] [B7] <_____>, hex head.

2) Nuts: Comply with ASTM A194/A194M; Grade <_____>; hex head.

3) Cast-Iron Mating Flange on Valves or Equipment:

a) Bolts: Comply with ASTM A193/A193M, Grade <_____>; hex head.

b) Nuts: Comply with ASTM A194/A194M; Grade <_____>; hex head.

4) Washers: Constructed of same material as bolts.

9. Mechanical Couplings: Comply with [**AWWA C606**] [**ASTM F1476**].

10. Unions:

a. Piping 2 Inches (50 mm) and Smaller: Threaded.

b. Piping 2-1/2 Inches (65 mm) and Larger: Threaded or flanged.

2.2 STEEL TUBE AND FITTINGS

A. Tube:

1. Material: Carbon steel.

2. Comply with ASTM A334/A334M; Grade <_____>.

3. Type: [**Seamless**] [**Welded**].

******** [OR] ********

4. Material: Low-alloy carbon steel.

5. Comply with ASTM A423/A423M; Grade <_____>.

6. Type: [**Seamless**] [**Electric welded**].

7. Size: As indicated [**on Drawings**] [**in piping schedule**].

B. Fittings:

1. Material: Steel.

2. Comply with ASTM [**A108**] [**A576**].

3. Type: Compression.

4. Pressure Rating: As indicated [**on Drawings**] [**in piping schedule**].

5. Threads:

a. Comply with ASME B1.1.

b. Type: Straight.

2.3 BURIED STEEL PIPE EXTERIOR LINING

A. Description: Shop-applied prime coat and coal-tar enamel protective coating.

B. Comply with AWWA C203.

******** [OR] ********

2.4 BURIED STEEL PIPE EXTERIOR LINING

A. Fusion-bonded epoxy coating.

B. Comply with AWWA C213.

2.5 CEMENT-MORTAR-LINED STTEL PIPE AND FITTINGS

A. Comply with AWWA C205.

B. Shop-apply lining after fabrication and before installation.

C. Cement: Comply with ASTM C150/C150M.

D. Aggregate:

1. Material: [**Silica sand**] <_____>.

2. Comply with ASTM C33/C33M.

E. Water: Clean with no organic matter or strong alkalis.

F. Liner Thickness: Comply with [**AWWA C205**] <_____>.

2.6 PLASTIC-LINED STEEL PIPE AND FITTINGS

Polypropylene (PP)-lined pipe is relatively economical and offers good resistance to various acids and alkalis, although it is not recommended for solvents and is brittle at low temperatures. Potential applications are hydrochloric acid (less than 30 percent concentration), sulfuric acid (less than 90 percent concentration), sea water or brine, sodium hydroxide, and ultrapure water. Consult with Piping Manufacturer and select materials based on specific application.

Operating temperature limitations may be encountered depending upon specific chemical environments.

A. Polypropylene (PP)-Lined Steel Pipe and Fittings:

1. Liner:

a. Comply with ASTM F1545.

b. As indicated [**on Drawings**] [**in piping schedule**].

2. Maximum Design Pressure: <_____> psig (<_____> MPa) at <_____> degrees F (<_____> degrees C).

3. Maximum Operating Temperature: [**225**] <_____> degrees F ([**110**] <_____> degrees C).

4. Minimum Liner Thickness: <_____> mils (<_____> mm).

5. Lock liner to shell.

6. Gaskets: [Rubber] [As indicated in piping schedule] <_____>.

Polyvinylidene fluoride (PVDF)-lined pipe is abrasion resistant and also offers excellent resistance to halogens and high-strength acids and alkalis. This liner material has a relatively high thermal expansion coefficient. Potential applications are hydrochloric acid (less than 35 percent concentration), sulfuric acid (less than 98 percent concentration), chlorine, and bromine. Consult with Piping Manufacturer and select materials based on specific application.

Operating temperature limitations may be encountered depending upon specific chemical environments.

B. Polyvinylidene Fluoride (PVDF)-Lined Steel Pipe and Fittings:

1. Liner:

   a. Comply with ASTM F1545.

   b. As indicated [on Drawings] [in piping schedule].

2. Maximum Design Pressure: <_____> psig (<_____> MPa) at <_____> degrees F (<_____> degrees C).

3. Maximum Operating Temperature: [275] <_____> degrees F ([135] <_____> degrees C).

4. Minimum Liner Thickness: <_____> mils (<_____> mm).

5. Lock liner to shell.

6. Gaskets: [Rubber] [As indicated in piping schedule] <_____>.

PTFE-lined pipe offers a relatively high maximum operating temperature. This liner material is virtually inert. Potential applications are nitric acid and other chemical processing materials. Consult with Piping Manufacturer and select materials based on specific application.

Operating temperature limitations may be encountered depending upon specific chemical environments.

C. PTFE-Lined Steel Pipe and Fittings:

1. As indicated [on Drawings] [in piping schedule].

2. Maximum Design Pressure: <_____> psig (<_____> MPa) at <_____> degrees F (<_____> degrees C).

3. Maximum Operating Temperature: [450] <_____> degrees F ([230] <_____> degrees C).

4. Minimum Liner Thickness: <_____> mils (<_____> mm).

5. Lock liner to shell.

6. Gaskets: [**Rubber**] [**As indicated in piping schedule**] <_____>.

D. Flanges:

1. Pipes 1 Inch (25 mm) through 8 Inches (200 mm):

a. Material: Forged steel.

b. Comply with ASTM A105/A105M and ASME [**B16.1**] [**B16.5**] [**B16.42**].

c. Class: [**150**] [**300**].

2. Pipes 10 Inches (25 mm) through 12 Inches (200 mm):

a. Type: Flared steel, lap jointed.

b. Comply with ASTM A105/A105M and ASME [**B16.1**] [**B16.5**] [**B16.42**].

c. Class: [**150**] <_____>.

******** [OR] ********

E. Flanges:

1. Pipes 4 Inches (100 mm) and Larger:

a. Type: Flat face.

b. Comply with AWWA C207.

c. Class: D.

2.7 GLASS-LINED STEEL PIPE AND FITTINGS

A. Liner:

1. Material: [**Chemically resistant, low-expansion, borosilicate glass**] [**Porcelain enamel**] <_____>.

2. Comply with ASTM E438.

B. Operating Temperature Range: [**Minus 20**] <_____> degrees F ([**Minus 29**] <_____> degrees C) to [**plus 200**] <_____> degrees F ([**plus 93**] <_____> degrees C).

C. Working Pressure: 150 psig (1.03 MPa) [**and full vacuum**].

D. Minimum Liner Thickness: <_____> mils (<_____> mm).

E. Lock liner to shell.

F. Gaskets:

1. Material: [**PTFE**] <_____>.

2. Comply with ASTM F336.

2.8 RUBBER-LINED STEEL PIPE AND FITTINGS

A. Liner:

1. Material: Elastomeric.

2. Comply with ASTM D1418.

3. Class: <_____>.

4. Hardness: Brinell <_____>.

B. Terminate lining inside bolt holes and fill remaining space to flange edge with <_____>-inch (<_____>-mm) [PTFE] [PVDF] [PP] <_____>.

C. Lock liner to shell.

D. Gaskets:

1. Material: [Polyethylene] <_____>.

2. Maximum Thickness: [1/8] <_____> inch ([3] <_____> mm).

2.9 INTERNALLY COATED STEEL PIPE AND FITTINGS

A. Polyurethane Liner:

1. Description: Self-priming, plural component, 100 percent solids, and non-extended polyurethane.

2. Comply with AWWA C222.

3. As indicated [on Drawings] [in piping schedule].

4. Dry Film Thickness: 30 mils (0.76 mm).

B. Spray-Applied Liquid Epoxy Liner:

1. Description: Thermosetting, fusion-bonded, 100 percent solids, and dry powder epoxy resin.

2. Comply with AWWA C210 and AWWA C550.

3. As indicated [on Drawings] [in piping schedule].

2.10 FINISHES

A. Coat machined faces of flanges with temporary rust-inhibitive coating.

B. Prepare piping for field finishes as specified in Section [09 90 00 - Painting and Coating] [09 96 35 - Chemical-Resistant Coatings].

Commented [JW2]: We do not have this in our spec list. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

2.11 ACCESSORIES

A. Pipe-Thread Tape:

1. Material: PTFE.

2. Comply with ASTM D3308.

B. Flange Gaskets:

1. Comply with [**ASME B16.5**] [**AWWA C207**].

2. Nonmetallic Gaskets:

a. Material: [**Chloroprene rubber**] <_____>.

b. Comply with ASME B16.21.

3. Metallic Ring Joint Gaskets:

a. Material: <_____>.

b. Comply with ASME B16.20.

4. Type:

a. Raised Face: Flat ring.

b. Flat Face: Full face.

2.12 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing:

1. Provide shop inspection and testing of completed pipe sections.

2. Conduct 15,000-V minimum electrostatic spark test on each plastic-lined pipe to ensure integrity of plastic liner.

3. Test thermal shock resistance of glass-lined pipe according to ASTM C600.

Include one or both of following Paragraphs to require Owner's inspection or witnessing of test at factory.

C. Owner Inspection:

1. Make completed pipe sections available for inspection at Manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least [**seven**] <_____> days before inspection is allowed.

D. Owner Witnessing:

1. Allow witnessing of factory inspections and test at Manufacturer's test facility.

2. Notify Owner at least [seven] <_____> days before inspections and tests are scheduled.

Include following Paragraph if reliance on Manufacturer's approved quality-control program is sufficient for Project requirements.

E. Certificate of Compliance:

1. If Manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at Manufacturer's facility conforms to Contract Documents.

2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that field dimensions are as indicated on [Shop] Drawings.

C. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Ream ends of threaded pipes and file smooth.

C. Thoroughly clean pipe and fittings before installation.

D. Surface Preparation:

1. Touch up shop-primed surfaces with primer as specified in Section [09 90 00 - Painting and Coating] [09 96 35 - Chemical-Resistant Coatings].

2. Solvent-clean surfaces that are not shop primed.

3. Clean surfaces to remove loose rust, mill scale, and other foreign substances by [power wire brushing] [commercial sand blasting; SSPC-SP 6].

4. Prime surfaces as specified in Section [09 90 00 - Painting and Coating] [09 96 35 - Chemical-Resistant Coatings].

3.3 INSTALLATION

A. According to [ASME B31.3] [AWWA M11] <_____>.

Commented [JW3]: We do not have this in our spec list. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

Commented [JW4]: We do not have this in our spec list. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

B. Run piping straight along alignment as indicated on [**Shop**] Drawings, with minimum number of joints.

C. Fittings:

1. Clean gasket seats thoroughly and wipe gaskets clean prior to installation.

2. Install fittings according to Manufacturer instructions.

3. Bolts:

a. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.

b. Use torque wrench to tighten bolts to Manufacturer instructions.

D. Install cement-lined fabricated fittings with flexible pipe couplings.

E. Welding of Cement-Lined Steel Pipe: Permitted only with approval of Architect/Engineer.

F. Provide required upstream and downstream clearances from devices as indicated on [**Shop**] Drawings.

G. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

H. Provide expansion joints as specified in Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping to compensate for pipe expansion due to temperature differences.

I. [**Disinfection: Disinfect potable-water piping as specified in Section 33 13 00 – Testing and Disinfection of Water Utility Piping.**]

J. Dielectric Fittings: Provide between dissimilar metals.

K. Field Cuts: According to Manufacturer instructions.

L. Finish primed surfaces as specified in Section [**09 90 00 - Painting and Coating**] [**09 96 35 - Chemical-Resistant Coatings**].

Commented [JW5]: We do not have this in our spec list. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

M. Provide cathodic protection [**as indicated on Drawings**] for buried ferrous piping systems as specified in Section [**40 46 42 - Cathodic Process Corrosion Protection**] <_____>.

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

N. Installation Standards: Install Work according to <_____> standards.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Install pipe within tolerance of [5/8] <_____> inch ([20] <_____> mm).

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

******** [OR] ********

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Inspection:

1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Architect/Engineer.

2. Repair damaged piping or provide new, undamaged pipe.

3. After installation, inspect for proper supports and interferences.

D. Pressure Testing:

1. As indicated in piping schedule.

******** [OR] ********

E. Pressure Testing:

1. Test Pressure: Not less than 200 psig (1 380 kPa) or 50 psi (345 kPa) in excess of maximum static pressure, whichever is greater.

2. Conduct hydrostatic test for minimum [two] <_____> hours.

3. Filling:

a. Slowly fill with water section to be tested and expel air from piping at high points.

b. Install corporation cocks at high points.

c. Close air vents and corporation cocks after air is expelled.

d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.

5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.

6. Leakage:

a. Correct visible deficiencies and continue testing at same test pressure for additional [two] <_____> hours to determine leakage rate.

b. Maintain pressure within plus or minus 5 psi (34.4 kPa) of test pressure.

c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.

d. Compute maximum allowable leakage by following formula:

1) L = SD x sqrt(P)/C.

2) L = testing allowance in gph (L/h).

3) S = length of pipe tested in feet (m).

4) D = nominal diameter of pipe in inches (mm).

5) P = average test pressure during hydrostatic test in psig (kPa).

6) C = 148,000 (794 797).

7) When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.

f. Correct visible leaks regardless of quantity of leakage.

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

F. Pressure Testing: According to <_____> standards.

G. [Repair] [Replace] pipe or fittings with mortar cracks wider than 1/16 inch (1.6 mm).

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Keep pipe interior clean as installation progresses.

C. After installation, clean pipe interior of soil, grit, loose mortar, and other debris.

END OF SECTION

SECTION 40 05 13.19 - STAINLESS STEEL PROCESS PIPING

This Section specifies steel pipe materials normally encountered in plant process piping systems and common to more than one Section in this Division and includes common fittings and joints. Common piping components, including penetrations, restrained joints, flexible connections, expansion joints, and loops, are specified in Section 40 05 06. Specialized fittings, joints, accessories, and other appurtenances are specified and detailed in the appropriate piping Section based on service.

For water and wastewater treatment projects, individual piping systems (for example, sanitary, raw water, and drainage) are typically defined on Drawings by providing a piping schedule, which describes the piping components required for that system and may provide other relevant data such as pressure testing requirements and applicable valve types.

Piping for site utilities are specified in applicable site utilities Sections in Division 33.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive specifications. Edit to avoid conflicting requirements.

This Section may include term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Checklist and Evaluations for information needed to coordinate this Specification Section with Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-steel pipe and fittings.
2. Stainless-steel tube and fittings.
3. Accessories.

B. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

1. Section 33 13 00 – Testing and Disinfection of Water Utility Piping: Disinfection requirements for potable-water systems.

2. Section 40 05 06 - Couplings, Adaptors, and Specials for Process Piping: Pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.

3. Section 40 05 51 - Common Requirements Results for Process Valves: Common product requirements for valves for placement by this Section.

4. Section 40 46 42 - Cathodic Process Corrosion Protection: Passive cathodic protection for buried metallic piping.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

A. American Welding Society:

1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

B. ASME International:

1. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.

2. ASME B1.20.2.M - Pipe Threads, 60 deg. General Purpose (Metric).

3. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, 250 and 800.

4. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

5. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.

6. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.

7. ASME B16.20 - Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed.

8. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.

9. ASME B31.3 - Process Piping.

10. ASME Boiler and Pressure Vessel Code (BPVC), Section IX - Welding and Brazing Qualifications.

C. ASTM International:

1. ASTM A182/A182M - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.

2. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

3. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

4. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

5. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

6. ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

7. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.

8. ASTM A479/A479M - Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.

9. ASTM A632 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small Diameter) for General Service.

10. ASTM A789/A789M - Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service.

11. ASTM A813/A813M - Standard Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe.

12. ASTM A814/A814M - Standard Specification for Cold-Worked Welded Austenitic Stainless Steel Pipe.

13. ASTM D3308 - Standard Specification for PTFE Resin Skived Tape.

D. NSF International:

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

2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with piping and equipment connections as specified in other Sections [**and as indicated on Drawings**].

1.4 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum [**one week**] <_____> [**weeks**] prior to commencing Work of this Section.

1.5 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer information on pipe materials, tube materials, and fittings.

C. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Welder Certificates: Submit welders' certification of compliance with [ASME BPVC, Section IX] [AWS D1.1/D1.1M] <_____>, verifying qualification within previous 12 months.

Include separate Paragraphs for additional certifications.

Include following Paragraph when Contractor is responsible for designing products or assemblies. List affected products when Section specifies more than one product.

F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with piping layout, with design calculations and assumptions for pipe sizing methods.

G. Source Quality-Control Submittals: Indicate results of [shop] [factory] tests and inspections.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

I. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer, installer, and licensed professional.

2. Submit Manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of valves, fittings, and appurtenances.

1.7 QUALTIY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

A. Permanently mark each length of pipe with Manufacturer's name or trademark, and compliance with standards.

B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

C. Perform Work according to <_____> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

D. Maintain <_____> [copy] [copies] of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [three] <_____> years' [documented] experience.

B. Installer: Company specializing in performing Work of this Section with minimum [three] <_____> years' [documented] experience [and approved by Manufacturer].

C. Welders: [AWS] [ASME] qualified within previous 12 months for employed weld types.

D. Licensed Professional: [Professional engineer] <_____> experienced in design of specified Work and licensed [at Project location] [in State of _____].

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect piping and appurtenances by storing off ground.

3. Provide additional protection according to Manufacturer instructions.

1.10 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Minimum Conditions: Do not store or handle uninstalled lined pipes or fittings at temperatures below zero degrees F (minus 18 degrees C).

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 STAINLESS-STEEL PIPE AND FITTINGS

A. General Service Piping:

1. Type:

a. [Welded] [Seamless]; comply with ASTM A813/A813M.

b. Class: [SW] [DW]; comply with [ASTM A814/A814M] <_____>.

2. Schedule: [40S] [80S] <_____>.

******** [OR] ********

3. Schedule: As indicated [on Drawings] [in piping schedule].

Select grade based on service requirements. Generally, Type 316 stainless steel offers greater corrosion resistance and higher yield strength than Type 304. Types 304L and 316L (low-carbon grades) may be preferred when welding is to be performed, as welding heat may cause chromium carbide precipitation. Consult Pipe Manufacturer to ensure correct application for required service and installation conditions.

4. Grade: Type [304] [304L] [316] [316L] <_____>.

5. Dimensions: [Comply with ASTM A312/A312M] [As indicated in piping schedule].

B. Fittings:

1. Type:

a. Piping 2 Inches (50 mm) and Smaller: Socket welding.

b. Piping 2-1/2 Inches (65 mm) and Larger: Butt welding.

2. Dimensions: [Comply with ASTM A312/A312M] [As indicated in piping schedule].

3. Threaded Fittings:

a. Comply with ASME B16.11 and ASTM A182/ (A182M).

b. Grade: Type [304] [304L] [316] [316L] <_____>.

c. Threads: Comply with ASME B1.20.1 (B1.20.2M).

4. Butt-Welding Fittings:

a. Comply with ASTM A403/A403M.

b. Grade: Type [304] [304L] [316] [316L] <_____>.

c. Class: [CR] <_____>; comply with ASME B16.9.

5. Socket-Welding Fittings:

a. Comply with ASTM A403/A403M.

b. Grade: Type [304] [304L] [316] [316L] <_____>.

c. Class: [WP-S] [WP-W] [WP-WX] [WP-WU]; comply with ASME B16.11.

6. Flanged Fittings:

a. Type: [Welding neck] [Slip on] [Socket welding] [Lapped] [Threaded].

b. Class: [150] [300] <_____>.

c. Comply with ASTM A182/A182M.

d. Grade: Type [304] [304L] [316] [316L] <_____>.

e. Facing and Drilling: Comply with ASME B16.5, with [<_____>-inch (<_____>-mm) raised face] [flat face] <_____>.

f. Backing Flanges:

1) Material: Stainless steel.

2) Class: [150] <_____>.

3) Comply with ASTM A351/A351M.

4) Grade: Type <_____>.

5) Type: Van stone.

6) Drilling: Comply with ASME [B16.1] [B16.5].

7. Flanged Connections: As [required to connect stainless-steel piping to fittings and equipment] [indicated on Drawings] [indicated in piping schedule].

2.2 STAINLESS-STEEL TUBE AND FITTINGS

A. Tube:

1. Type: [Seamless] [Welded].

2. Comply with ASTM [A269/A269M] [A632] [A789/A789M].

Select grade based on service requirements. Generally, Type 316 stainless steel offers greater corrosion resistance and higher yield strength than Type 304. Types 304L and 316L (low-carbon grades) may be preferred when welding is to be performed, as welding heat may cause chromium carbide precipitation. Consult Pipe Manufacturer to ensure correct application for required service and installation conditions.

3. Grade: Type [304] [304L] [316] [316L] <_____>.

B. Fittings:

1. Threaded:

    a. Comply with ASTM A182 (/A182M) and ASME B16.11.

    b. Grade: Type [304] [304L] [316] [316L] <_____>.

    c. Threads: Comply with ASME B1.20.1 (B1.20.2M).

2. Butt-Welding Fittings:

    a. Comply with ASTM A403/ (A403M and ASME B16.9).

    b. Grade: Type [304] [304L] [316] [316L] <_____>.

    c. Class: [CR] <_____>.

3. Socket-Welding Fittings:

    a. Comply with ASTM A403 (/A403M and ASME B16.11).

    b. Grade: Type [304] [304L] [316] [316L] <_____>.

    c. Class: [WP-S] [WP-W] [WP-WX] [WP-WU].

4. Flanged Fittings:

    a. Type: [Welding neck] [Slip on] [Socket welding] [Lapped] [Threaded].

    b. Class: [150] [300] <_____>.

    c. Comply with ASTM A182 (/A182M).

    d. Grade: Type [304] [304L] [316] [316L] <_____>.

    e. Facing and Drilling: Comply with ASME B16.5, with [<_____>-inch (<_____>-mm) raised face] [flat face] <_____>.

    f. Backing Flanges:

        1) Material: Stainless steel.

        2) Class: [150] <_____>.

        3) Comply with ASTM A351/A351M.

        4) Grade: Type <_____>.

        5) Type: Van stone.

        6) Drilling: Comply with ASME [B16.1] [B16.5].

    g. Bolting:

        1) Bolts: Comply with ASTM A193/A193M, Grade [B5] [B7] <_____>; hex head.

2) Nuts: ASTM A194 (/A194M), Grade <_____>; hex head.

h. Cast-Iron Mating Flange on Valves or Equipment:

1) Bolts: Comply with ASTM A193/A193M, Grade <_____>; hex head.

******** [OR] ********

2) Bolts: Comply with ASTM A194/A194M, Grade <_____>; heavy hex head nuts.

3) Washers: Same material as bolts.

5. Crimp Fittings:

a. Material: Cold-drawn stainless steel.

b. Grade: Type [**304**] [**304L**] [**316**] [**316L**] <_____>.

6. Compression Fittings:

a. Material: Stainless steel.

b. Comply with ASTM A479/A479M.

c. Grade: Type 316.

d. Pressure Rating: As indicated [**on Drawings**] [**in piping schedule**].

2.3 ACCESSORIES

A. Pipe-Thread Tape:

1. Material: PTFE.

2. Comply with ASTM D3308.

B. O-Ring Seals: [**Rubber**] [**EPDM**] [**Fluoro-elastomeric**] <_____>.

C. Flange Gaskets:

1. Comply with ASME B16.5.

2. Nonmetallic Gaskets:

a. Material: [**Chloroprene rubber**] <_____>.

b. Comply with ASME B16.21.

3. Metallic Ring Joint Gaskets:

a. Material: <_____>.

b. Comply with ASME B16.20.

4. Type:

a. Raised-Face Flanges: Flat ring.

b. Flat-Face Flanges: Full face.

2.4 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

Include one or both of following Paragraphs to require Owner's inspection or witnessing of test at factory.

C. Owner Inspection:

1. Make completed [piping] [and] [tubing] components available for inspection at Manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least [seven] <_____> days before inspection is allowed.

D. Owner Witnessing:

1. Allow witnessing of factory inspections and test at Manufacturer's test facility.

2. Notify Owner at least [seven] <_____> days before inspections and tests are scheduled.

Include following Paragraph if reliance on Manufacturer's approved quality-control program is sufficient for Project requirements.

E. Certificate of Compliance:

1. If Manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at Manufacturer's facility conforms to Contract Documents.

2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that field dimensions are as indicated on [Shop] Drawings.

C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Ream [**pipe**] [**and**] [**tube**] ends and remove burrs.

C. [**Bevel plain-end pipe.**]

D. Thoroughly clean pipe and fittings before installation.

3.3 INSTALLATION

A. Comply with ASME B31.3.

B. Run piping straight along alignment as indicated on [**Shop**] Drawings, with minimum number of joints.

C. Fittings:

1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.

2. Install according to Manufacturer instructions.

3. Bolting:

a. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.

b. Use torque wrench to tighten bolts to Manufacturer instructions.

D. Provide required upstream and downstream clearances from devices as indicated on [**Shop**] Drawings.

E. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.

F. Provide expansion joints as specified in Section 40 05 06 - Couplings, Adaptors, and Specials for Process Piping to compensate for pipe expansion due to temperature differences.

G. [**Disinfection: Disinfect potable-water piping as specified in Section 33 13 00 – Testing and Disinfection of Water Utility Piping.**]

H. Dielectric Fittings: Provide between dissimilar metals.

I. Field Cuts: According to pipe Manufacturer instructions.

J. Field welding of stainless steel is [**not**] permitted.

K. Provide cathodic protection [**where indicated on Drawings**] for buried ferrous piping systems, as specified in Section [**40 46 42 - Cathodic Process Corrosion Protection**] <_____>.

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

L. Installation Standards: Install Work according to <_____> standards.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Piping Laying Tolerance: [5/8] <_____> inch ([16] <_____> mm).

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

******** [OR] ********

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Inspection:

1. Inspect for damage to piping or tubing that may be detrimental as determined by the Architect/Engineer.

2. Repair damaged piping, or provide new, undamaged pipe.

3. After installation, inspect for required supports and anchoring, interferences, and damage to pipe, tube, or fittings.

D. Pressure Testing: As indicated on piping schedule.

******** [OR] ********

E. Pressure Testing:

1. Test Pressure: Not less than 200 psig (1 380 kPa) or 50 psi (345 kPa) in excess of maximum static pressure, whichever is greater.

2. Conduct hydrostatic test for minimum [two] <_____> hours.

3. Filling:

a. Fill section to be tested with water slowly and expel air from piping at high points.

b. Install corporation cocks at high points.

c. Close air vents and corporation cocks after air is expelled.

d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.

5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.

6. Leakage:

   a. Correct visible deficiencies and continue testing at same test pressure for additional [two] <_____> hours to determine leakage rate.

   b. Maintain pressure within plus or minus 5 psi (34.4 kPa) of test pressure.

   c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.

   d. Compute maximum allowable leakage by following formula:

      1) L = SD x sqrt(P)/C.

      2) L = testing allowance, in gallons per hour (liters per hour).

      3) S = length of pipe tested, in feet (meters).

      4) D = nominal diameter of pipe, in inches (mm).

      5) P = average test pressure during hydrostatic test, in psig (kPa).

      6) C = 148,000 (794 797).

      7) When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

   e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.

   f. Correct visible leaks regardless of quantity of leakage.

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

F. Pressure Testing: According to <_____> standards.

G. [Repair] [Replace] pipe or fittings with mortar cracks wider than 1/16 inch (1.6 mm).

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Keep pipe interior clean as installation progresses.

C. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION

SECTION 40 05 13.53 - DUCTILE IRON PROCESS PIPING

This Section specifies ductile-iron piping materials, and ductile-iron, malleable-iron, and cast-iron fitting materials, normally encountered in plant process piping systems and common to more than one Section in this Division. Common piping components, including penetrations, restrained joints, flexible connections, expansion joints, and loops, are specified in Section 40 05 06. Specialized fittings, joints, accessories, and other appurtenances are specified in detail in appropriate piping Sections based on service requirements.

In process industries such as water and wastewater treatment, piping is typically specified by pipe material. Individual piping systems (such as sanitary, raw water, drainage) may be defined on the Drawings using a piping schedule, which describes the piping components required for that system and may provide other relevant data such as pressure-testing requirements and applicable valve types.

Piping for site utilities is specified in applicable site utilities Sections in Division 33.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive specifications. Edit to avoid conflicting requirements.

This Section may include term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Checklist and Evaluations for information needed to coordinate this Specification Section with Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ductile-iron pipe.
2. Ductile-iron, malleable-iron, and cast-iron fittings.
3. Accessories.

B. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

1. Section [09 90 00 - Painting and Coating] [09 96 35 - Chemical-Resistant Coatings]: Product and execution requirements for painting specified by this Section.

Commented [JW1]: We do not have this in our specifications library. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

2. Section 33 11 16 - Site Water Utility Distribution Piping: Installation requirements for buried piping.

3. Section 33 13 00 – Testing and Disinfection of Water Utility Piping: Disinfection requirements for potable water systems.

4. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping: Piping appurtenances.

5. Section 40 05 51 - Common Requirements Results for Process Valves: Common product requirements for valves for placement by this Section.

6. Section 40 46 42 - Cathodic Process Corrosion Protection: Passive cathodic protection for buried ferrous piping.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

A. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

6. AWWA C150 - Thickness Design of Ductile-Iron Pipe.

7. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.

8. AWWA C153 - Ductile-Iron Compact Fittings.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

2. ASME B31.3 - Process Piping.

C. ASTM International:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.

D. NSF International:

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

2. NSF 372 - Drinking Water System Components - Lead Content.

E. Society for Protective Coatings:

1. SSPC SP 6 - Commercial Blast Cleaning.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with piping and equipment connections specified in other Sections [and indicated on Drawings].

1.4 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum [one] <_____> week prior to commencing Work of this Section.

1.5 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer information regarding pipe and fittings.

C. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

Include separate Paragraphs for additional certifications.

Include following Paragraph when Contractor is responsible for designing products or assemblies. List affected products when Section specifies more than one product.

E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizing methods and calculations used.

F. Source Quality-Control Submittals: Indicate results of [shop] [factory] tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer, installer, and licensed professional.

2. Submit Manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and [invert] [centerline] elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

A. Permanently mark each length of pipe with Manufacturer's name or trademark and indicate conformance to standards.

B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

C. Perform Work according to <_____> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

D. Maintain <_____> [copy] [copies] of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [three] <_____> years' [documented] experience.

B. Installer: Company specializing in performing Work of this Section with minimum [three] <_____> years' [documented] experience [and approved by Manufacturer].

C. Licensed Professional: [Professional engineer] <_____> experienced in design of specified Work and licensed [at Project location] [in State of _____].

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect piping and appurtenances by storing off ground.

3. Provide additional protection according to Manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Piping:

1. Comply with AWWA [**C115**] [**C150**] [**C151**].

2. [**Class**] [**Pressure Rating**]: As indicated on [**Drawings**] [**piping schedule**].

B. Fittings:

1. Material: [**ASTM A48/A48M, gray iron**] [**AWWA C110, ductile iron**] [**AWWA C153, ductile iron**].

2. [**Class**] [**Pressure Rating**]: [**Same as that of connected piping**] [**As indicated on Drawings**] [**As indicated on piping schedule**].

3. Mechanical Joints:

a. Comply with AWWA C110 and AWWA C111.

b. Glands: [**Ductile**] [**Gray**] iron with [**asphaltic**] <_____> coating.

c. Push-on Joints: Comply with AWWA C111.

4. Restrained Joints: Comply with AWWA C111.

5. Flanged Fittings: Comply with [**AWWA C110**] [**ASME B16.1**].

C. Cement-Mortar Lining:

1. Comply with AWWA C104.

2. Thickness: [**Standard**] [**Double**].

D. Outside Coating:

1. Buried Service:

a. Type: Asphaltic.

b. Thickness: [0.04] <_____> inch ([1.0] <_____> mm).

2. Exposed Service: As specified in Section [09 90 00 - Painting and Coating] [09 96 35 - Chemical-Resistant Coatings].

Commented [JW2]: We do not have this in our specifications library. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

2.2 ACCESSORIES

A. Jackets:

1. Description:

a. Material: Polyethylene.

b. Comply with AWWA C105.

******** [OR] ********

2. Description:

a. Double-layer, half-lapped polyethylene tape.

b. Thickness: [10] <_____> mils ([0.25] <_____> mm).

B. Gaskets: [Rubber] <_____>.

2.3 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

Include one or both of following Paragraphs to require Owner's inspection or witnessing of test at factory.

C. Owner Inspection:

1. Make completed piping components available for inspection at Manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least [seven] <_____> days before inspection is allowed.

D. Owner Witnessing:

1. Allow witnessing of factory inspections and test at Manufacturer's test facility.

2. Notify Owner at least [seven] <_____> days before inspections and tests are scheduled.

Include following Paragraph if reliance on Manufacturer's approved quality-control program is sufficient for Project requirements.

E. Certificate of Compliance:

1. If Manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at Manufacturer's facility conforms to Contract Documents.

2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that field dimensions are as indicated on [**Shop**] Drawings.

C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Thoroughly clean pipe and fittings before installation.

C. Surface Preparation:

1. Clean surfaces to remove loose rust, mill scale, and other foreign substances by [**power wire brushing**] [**commercial sand blasting; SSPC SP 6**].

2. Touch up shop-primed surfaces with primer as specified in Section [**09 90 00 - Painting and Coating**] [**09 96 35 - Chemical-Resistant Coatings**].

3. Solvent-clean surfaces that are not shop primed.

Commented [JW3]: We do not have this in our specifications library. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

3.3 INSTALLATION

A. Buried Service Piping: As specified in Section 33 11 16 - Site Water Utility Distribution Piping.

B. Exposed Service Piping:

1. According to ASME B31.3.

2. Run piping straight along alignment as indicated on [**Shop**] Drawings, with minimum number of joints.

C. Fittings:

1. According to Manufacturer instructions.

2. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.

3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to Manufacturer instructions.

4. Provide required upstream and downstream clearances from devices as indicated on Drawings.

D. Make taps to ductile iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.

E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

F. Provide expansion joints as specified in Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping to compensate for pipe expansion due to temperature differences.

G. [**Disinfection: Disinfect potable water piping as specified in Section 33 13 00 – Testing and Disinfection of Water Utility Piping.**]

H. Dielectric Fittings: Provide between dissimilar metals.

I. Field Cuts: According to Pipe Manufacturer instructions.

J. Finish primed surfaces according to Section [**09 90 00 - Painting and Coating**] [**09 96 35 - Chemical-Resistant Coatings**].

Commented [JW4]: This is not in our specifications library. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

K. Provide cathodic protection [**where indicated on Drawings**] for buried ferrous piping systems, as specified in Section [**40 46 42 - Cathodic Process Corrosion Protection**] <_____-_____>.

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

L. Installation Standards: Install Work according to <_____> standards.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Laying Tolerance: As specified in Section 33 11 16 - Site Water Utility Distribution Piping.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

******** [OR] ********

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Inspection:

1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Architect/Engineer.

2. Repair damaged piping or provide new, undamaged pipe.

3. After installation, inspect for proper supports and interferences.

D. Pressure Testing: As indicated on piping schedule.

******** [OR] ********

E. Pressure Testing:

1. Test Pressure: Not less than 200 psig (1 380 kPa) or 50 psi (345 kPa) in excess of maximum static pressure, whichever is greater.
2. Conduct hydrostatic test for minimum [**two**] <_____> hours.
3. Filling:
   a. Fill section to be tested with water slowly and expel air from piping at high points.
   b. Install corporation cocks at high points.
   c. Close air vents and corporation cocks after air is expelled.
   d. Raise pressure to specified test pressure.
4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
6. Leakage:
   a. Correct visible deficiencies and continue testing at same test pressure for additional [**two**] <_____> hours to determine leakage rate.
   b. Maintain pressure within plus or minus 5 psi (34.4 kPa) of test pressure.
   c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
   d. Compute maximum allowable leakage by following formula:
      1) L = SD x sqrt(P)/C.
      2) L = testing allowance in gph (L/h).
      3) S = length of pipe tested in feet (m).
      4) D = nominal diameter of pipe in inches (mm).
      5) P = average test pressure during hydrostatic test in psig (kPa).
      6) C = 148,000 (794 797).
      7) If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.

f. Correct visible leaks regardless of quantity of leakage.

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

F. Pressure Testing: According to <_____> standards.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for cleaning.

B. Keep pipe interior clean as installation progresses.

C. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION

SECTION 40 05 13.73 - THERMOPLASTIC PROCESS PIPING

This Section specifies plastic pipe materials normally encountered in plant process piping systems and common to more than one Section in this Division and includes common fittings and joints. Common piping components, including penetrations, restrained joints, flexible connections, expansion joints and loops, are specified in Section 40 05 06. Specialized fittings, joints, accessories, and other appurtenances are specified in detail in the appropriate piping Section based on service.

In process industries such as water and wastewater treatment, piping is typically specified by pipe material. Individual piping systems (for example, sanitary, raw water, and drainage) may be defined on the Drawings by way of a piping schedule, which describes the piping components required for that system as well as provides other relevant data such as pressure-testing requirements and applicable valving requirements.

Piping for site utilities are specified in applicable site utilities Sections in Division 33 - Utilities.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive specifications. Edit to avoid conflicting requirements.

This Section may include term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Checklist and Evaluations for information needed to coordinate this Specification Section with Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC pipe.
2. PVC tube.
3. CPVC pipe.
4. Polyvinylidene fluoride (PVDF) pipe and tube.
5. Acrylonitrile-butadiene-styrene (ABS) pipe.
6. Polyethylene (PE) pipe and tube.
7. Fittings.

8. Accessories for plastic piping.

B. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

1. Section 33 11 16 - Site Water Utility Distribution Piping: Pipe laying requirements and tolerances, excavation, backfill, and thrust restraints.

2. Section 33 13 00 – Testing and Disinfection of Water Utility Storage Tanks: Disinfection requirements for potable-water systems.

3. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping: Pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.

4. Section 40 05 51 - Common Requirements for Process Valves: Common product requirements for valves for placement by this Section.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

LEED requires compliance with specific editions of referenced standards. Section 01 40 00 requires compliance with the latest reference standard edition, except when a specific date is required by code. Consider including publication dates for referenced standards in this Section to ensure the correct standard is used for LEED compliance.

A. American Water Works Association:

1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

2. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 12 In. (100 mm through 300 mm), for Water Transmission and Distribution.

3. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) through 3 In. (76 mm), for Water Service.

4. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In. (1,600 mm), for Water Distribution and Transmission.

B. ASME International:

1. ASME B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).

2. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

3. ASME B1.20.2M - Pipe Threads, 60 deg., General Purpose.

4. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, 250 and 800.

5. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

6. ASME B16.20 - Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed.

7. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.

8. ASME B31.3 - Process Piping.

C. ASTM International:

1. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

2. ASTM A194/A194M -Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

3. ASTM D1527 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80.

4. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

5. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

6. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

7. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

8. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.

9. ASTM D2464 - Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

10. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

11. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

12. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.

13. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.

14. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.

15. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.

16. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

17. ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing.

18. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.

19. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

20. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

21. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

22. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.

23. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

24. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

25. ASTM D3892 - Standard Practice for Packaging/Packing of Plastics.

26. ASTM D3965 - Standard Classification System and Basis for Specifications for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings.

27. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.

28. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

29. ASTMF438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

30. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

31. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

32. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).

33. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

34. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

35. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

36. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.

37. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

38. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing.

39. ASTM F1056 - Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings.

40. ASTM F1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings.

D. NSF International:

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

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with piping and equipment connections specified in other Sections [**and indicated on Drawings**].

1.4 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum [**one week**] [**<_____> weeks**] prior to commencing Work of this Section.

1.5 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer's catalog information regarding pipe and fittings.

C. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

Include separate Paragraphs for additional certifications.

Include following Paragraph when Contractor is responsible for designing products or assemblies. List affected products when Section specifies more than one product.

E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizes and sizing methods.

F. Source Quality-Control Submittals: Indicate results of [shop] [factory] tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer, installer, and licensed professional.

2. Submit Manufacturer's approval of installer.

1.6 SUSTAINABLE DESIGN SUBMITTALS

A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.

B. Manufacturer's Certificate:

1. Certify that products meet or exceed specified sustainable design requirements.

Insert material certifications list below to suit products specified in this Section and Project sustainable design requirements. Specific certificate submittal and supporting data requirements are specified in Section 01 81 13.

2. Materials Resources Certificates:

a. Certify source and origin for [salvaged] [and] [reused] products.

b. Certify recycled material content for recycled content products.

c. Certify source for regional materials and distance from Project Site.

C. Product Cost Data:

1. Submit cost of products to verify compliance with Project sustainable design requirements.

2. Exclude cost of labor and equipment to install products.

3. Provide cost data for following products:

Edit list of material cost data below to suit products specified in this Section and Project sustainable design requirements. Specific cost data requirements are specified in Section 01 81 13.

a. Salvaged, refurbished, and reused products.

b. Products with recycled material content.

c. Regional products.

d. <_____>.

1.7 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and [invert] [centerline] elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

A. Permanently mark each length of pipe with Manufacturer's name or trademark and indicate conformance to standards.

B. Materials in Contact with Potable Water: Certified according to NSF 61.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

C. Perform Work according to <_____> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

D. Maintain <_____> [copy] [copies] of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [three] <_____> years' [documented] experience.

******** [OR] ********

B. Manufacturer: Company listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the Resin Manufacturer for the resin used to manufacture each of the respective thermoplastic pipe systems.

C. Installer: Company specializing in performing Work of this Section with minimum [three] <_____> years' [documented] experience [and approved by Manufacturer].

D. Licensed Professional: [Professional engineer] <_____> experienced in design of specified Work and licensed [at Project location] [in State of <_____>].

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection:

1. Accept materials on Site in Manufacturer's original packaging and inspect for damage.

2. Manufacturer's Packaging: Comply with ASTM D3892.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from puncture, abrasion, moisture, dust, and UV by storing in clean, dry location remote from construction operations areas.

2. Protect piping and appurtenances by storing off ground.

3. Provide additional protection according to Manufacturer instructions.

1.11 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Minimum and Maximum Temperatures: Do not install pipe when temperature is below 40 degrees F (4.4 degrees C) or above 90 degrees F (32.2 degrees C) if pipe is exposed to direct sunlight.

C. UV Protection: Provide pipe installed above ground or outside with UV protection.

1.12 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 PVC PIPE, TUBE, AND FITTINGS

Select one or more of following Paragraphs based on Project requirements.

A. PVC Pipe and Fittings:

1. Pipe:

a. Comply with [**ASTM D1785**] <_____>.

b. Schedule: [**40**] [**80**] <_____>.

****** [OR] ******

2. Pipe:

   a. Comply with [ASTM D2241] <_____>.

   b. [SDR-26 for 160-psig pressure rating, calculated according to ASTM D2837] [SDR-41 for 100-psig rating, calculated according to ASTM D2837] [SDR-21 for 200-psig rating, calculated according to ASTM D2837].

****** [OR] ******

3. Pipe: As indicated in piping schedule.

4. Fittings: ASTM [D2466, Schedule 40] [D2467, Schedule 80] [; ASTM D2464, threaded].

Consider specifying threaded or flanged end connections if later removal is required.

5. Joints: [ASTM D2855, socket, solvent welded] [Flanged] [Threaded]<_____>.

6. Materials:

   a. Comply with ASTM D1784.

   b. [Minimum] Cell Classification: [12545-C] <_____>.

****** [OR] ******

B. PVC Pipe and Fittings:

1. Pipe:

   a. Comply with AWWA C900.

   b. Class: [165] [235] <_____>.

2. Fittings:

   a. Material: Cast iron.

   b. Comply with AWWA C111.

3. Joints:

   a. Type: Compression gasket ring.

   b. Comply with ASTM D3139.

4. Materials:

   a. Comply with ASTM D1784.

   b. [Minimum] Cell Classification: [12545-C] <_____>.

C. PVC Tube and Fittings:

1. Tube:
    a. Type: [**Clear**] <_____>.
    b. Size and Wall Thickness: [**As indicated in piping schedule**] <_____>.
    c. Pressure Rating: As indicated [**on Drawings**] [**in piping schedule**].
2. Fittings:
    a. Type: Compression.
    b. Materials: Suitable for application.
3. Threads:
    a. Type: Straight.
    b. Comply with ASME B1.1.

2.2 CPVC PIPE AND FITTINGS

CPVC is considered to be stronger, more ductile, and more flexible than PVC. CPVC is also considered nontoxic, in that it does not leach toxins at elevated temperatures as PVC might do. CPVC is resistant to many chemicals (consult pipe supplier for listing) and resists scale buildup; for mixed waste systems, chemical analyses, and corrosion, testing may be necessary to properly select the piping system.

A. Description:
1. Pipe:
    a. Comply with ASTM F441/F441M.
    b. Schedule: [**40**] [**80**].

******** [OR] ********

2. Pipe:
    a. Comply with ASTM F442/F442M.
    b. SDR: <_____> [**As indicated**].
3. Fittings:
    a. Flanged: Comply with ASME [**B16.1**] [**B16.5**]; Class [**125**] <_____>.
    b. Socket Welded: Comply with ASTM [**F438, Schedule 40**] [**F439, Schedule 80**].
    c. Threaded: Comply with ASTM F437 and ASME B1.20.1 (B1.20.2M).
    d. Schedule: 80.

Consider specifying threaded or flanged end connections if later removal is required.

4. Joints: [Socket welded] [Flanged] [Push on] [Threaded].

5. Materials:

   a. Comply with ASTM D1784.

   b. [Minimum] Cell Classification: [23447] <_____>.

2.3 PVDF PIPE, TUBE, AND FITTINGS

PVDF is considered to provide superior chemical resistance to many solvents, acids, bases, and halogens. It is designed for extra tough applications where plastic may not have been considered. PVDF is able to maintain much of its strength and chemical resistance within a broad temperature range. Single- and double-wall configurations are available, as are molded drainage pattern fittings.

A. Description:

1. Pipe:

   a. Comply with ASTM D3222.

   b. Schedule [40] [80].

******** [OR] ********

   c. SDR: <_____> [As indicated].

Butt and socket welding are the preferred methods for joining PVDF pipe. Threading is available for Schedule 80 piping only. A common recommendation for PVDF fittings is that butt welding be used for sizes 1/2 to 12 inches (20 to 315 mm), and socket welding be used for sizes 3/8 to 4 inches (16 to 110 mm).

2. Fittings:

   a. Comply with ASTM D3222.

   b. Type: Molded.

Consider specifying threaded or flanged end connections if later removal is required.

   c. End Connections:

      1) [Butt] [Socket] welded.

******** [OR] ********

      2) Flanged: Comply with ASME [B16.1] [B16.5]; Class [125] <_____>.

******** [OR] ********

      3) Threaded: Comply with ASME B1.1.

B. PVDF Tube and Fittings:

1. Tube:
    a. Size and Wall Thickness: [**As indicated in piping schedule.**]
    b. Pressure Rating: As indicated [**on Drawings**] [**in piping schedule**].
2. Fittings:
    a. Type: Compression.
    b. Materials: Suitable for application.

2.4 ABS PIPE AND FITTINGS

A. Pipe:
1. Comply with ASTM D1527.
2. Schedule: [**40**] [**80**].

******** [OR] ********

3. SDR: <_____> [**As indicated in piping schedule**] [**As calculated according to ASTM D2837**].

B. Fittings:
1. Comply with ASTM D2661.
2. Type: Molded.

Consider specifying threaded or flanged end connections if later removal is required.

3. End Connections:
    a. Solvent welded.

******** [OR] ********

    b. Flanged: Comply with ASME [**B16.1**] [**B16.5**]; Class [**125**] <_____>.

******** [OR] ********

    c. Threaded: Comply with ASME B1.1.

C. Materials:
1. Comply with ASTM D3965.
2. [**Minimum**] Cell Classification: [**42222**] <_____>.

2.5 PE PIPE, TUBE, AND FITTINGS

Select one or more of following Paragraphs based on Project requirements.

A. PE Pipe and Fittings:

1. Pipe:

   a. Comply with ASTM D2447.

   b. Schedule: [40] [80].

   c. SDR: <_____> [As indicated in piping schedule] [As calculated according to ASTM D3035] [As calculated according to ASTM F714].

2. Fittings:

   a. Type: Molded.

   b. [ASTM D3261, butt welded] [ASTM D2683, socket welded] [ASTM F1056, socket welded].

   Consider specifying threaded or flanged end connections if later removal is required.

3. Joints: [Socket heat fusion] [Butt fusion] [Flanged] [Threaded].

4. Materials:

   a. Comply with ASTM D3350.

   b. [Minimum] Cell Classification: [324433-C] <_____>.

   ******** [OR] ********

   ASTM D3035 piping is available in different wall thicknesses ranging from DR 32.5, thinnest, to DR 7, thickest, with pressure ratings from 160 to 840 psig (1.10 to 5.79 MPa). Coordinate wall thickness and pressure rating with intended service conditions.

B. PE Pipe and Fittings:

1. Pipe: [AWWA C901] [AWWA C906] [ASTM D3035, DR <_____> for <_____>-psig (<_____>)-MPa) pressure rating].

2. Fittings:

   a. Comply with AWWA [C901] [C906].

   b. Type: Molded [or fabricated].

   Consider specifying threaded or flanged end connections if later removal is required.

3. Joints: [Compression] [Butt fusion] [Flanged] [Threaded].

4. Materials:

   a. Comply with ASTM D3350.

   b. [Minimum] Cell Classification: [324433-C] <_____>.

C. PE Tube and Fittings:

1. Tube:
    a. Comply with AWWA C901.
    b. Size and Wall Thickness:
        1) [**As indicated in piping schedule.**]
        2) Comply with ASTM [**D2737**] [**F876**].
    c. Pressure Rating: As indicated [**on Drawings**] [**in piping schedule**].
2. Fittings:
    a. Type: Compression.
    b. Materials: Suitable for application.
3. Threads:
    a. Type: Straight.
    b. Comply with ASME B1.1.

2.6 SUSTAINABILITY CHARACTERISTICS

Insert sustainable design characteristics in this Article to suit content of this Section and Project sustainable design requirements as specified in Section 01 81 13.

A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Material and Resource Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content [**including:**] [**.**]

Insert list of materials specified in this Section required to have recycled content.

a. <_____>.

2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles (800 km) of Project Site [**including:**] [**.**]

Insert list of materials specified in this Section required to be regional materials.

a. <_____>.

2.7 FINISHES

A. Coat machined faces of metallic flanges with temporary rust-inhibitive coating.

2.8 ACCESSORIES

A. PVC Piping:

1. Flange Bolting:
    a. Hex-Head Bolts: Stainless steel; ASTM A193/A193M; Grade <_____>.
    b. Hex-Head Nuts: Stainless steel; ASTM A194/A194M; Grade <_____>.
2. Flange Gaskets:
    a. Type: Full faced.
    b. Material: [**EPDM**] <_____>.
    c. Comply with ASME B16.21.
3. Solvent Cement:
    a. Comply with ASTM D2564.
    b. [**Primers: Comply with ASTM F656.**]

B. CPVC Piping:
1. Flange Bolting:
    a. Hex-Head Bolts: Stainless steel; ASTM A193/A193M; Grade <_____>.
    b. Hex-Head Nuts: Stainless steel; ASTM A194/A194M; Grade <_____>.
2. Flange Gaskets:
    a. Type: Full faced.
    b. Material: [**EPDM**] <_____>.
    c. Comply with ASME B16.21.
3. Push-On Joint Seals:
    a. Material: [**EPDM**] <_____>.
    b. Comply with ASTM F477.
4. Solvent Cement: Comply with ASTM F493.

C. PVDF Piping:
1. Nonmetallic Gaskets:
    a. Material: [**Chloroprene rubber**] <_____>.
    b. Comply with ASME B16.21.
2. Metallic Ring Joint Gaskets:
    a. Material: <_____>.

b. Comply with ASME B16.20.

3. Flange Bolting:

a. Hex-Head Bolts: Stainless steel; ASTM A193/A193M; Grade <_____>.

b. Hex-Head Nuts: Stainless steel; ASTM A194/A194M; Grade <_____>.

4. Flange Gaskets:

a. Type: Full faced.

b. Material: [**EPDM**] <_____>.

c. Comply with ASME B16.21.

D. ABS Piping:

1. Flange Bolting:

a. Hex-Head Bolts: Stainless steel; ASTM A193/A193M; Grade <_____>.

b. Hex-Head Nuts: Stainless steel; ASTM A194/A194M; Grade <_____>.

2. Flange Gaskets:

a. Type: Full faced.

b. Material: [**EPDM**] <_____>.

c. Comply with ASME B16.21.

3. Solvent Cement: Comply with ASTM D2235.

E. PE Piping:

1. Insert Fittings: Comply with ASTM D2609.

2. Couplings: Comply with ASTM F1055.

3. Flange Bolting:

a. Hex-Head Bolts: Stainless steel; ASTM A193/A193M; Grade <_____>.

b. Hex-Head Nuts: Stainless steel; ASTM A194/A194M; Grade <_____>.

4. Flange Gaskets:

a. Type: Full faced.

b. Material: [**EPDM**] <_____>.

c. Comply with ASME B16.21.

2.9 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed [**pipe sections**] [**tubes**].

Include one or both of following Paragraphs to require Owner's inspection or witnessing of test at factory.

C. Owner Inspection:

1. Make completed [**pipe sections**] [**tubes**] available for inspection at Manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least [**seven**] <_____> days before inspection is allowed.

D. Owner Witnessing:

1. Allow witnessing of factory inspections and test at Manufacturer's test facility.

2. Notify Owner at least [**seven**] <_____> days before inspections and tests are scheduled.

Include following Paragraph if reliance on Manufacturer's approved quality-control program is sufficient for Project requirements.

E. Certificate of Compliance:

1. If Manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at Manufacturer's facility conforms to Contract Documents.

2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that field dimensions are as indicated on [**Shop**] Drawings.

C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Ream [**pipe**] [**and**] [**tube**] ends, remove burrs [**, and**] [**bevel plain-end pipe**].

C. Thoroughly clean pipe and fittings before installation.

D. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. Comply with ASME B31.3.

B. Run piping straight along alignment as indicated on [**Shop**] Drawings, with minimum number of joints.

C. Fittings:

1. According to Manufacturer instructions.

2. Gaskets:

a. Clean seats thoroughly.

b. Wipe gaskets clean prior to installation.

3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to Manufacturer instructions.

D. Provide required upstream and downstream clearances from devices as indicated.

E. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.

F. Provide expansion joints as specified in Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping to compensate for pipe expansion due to temperature differences.

G. [**Disinfection: Disinfect potable-water piping as specified in Section 33 13 00 – Testing and Disinfection of Water Utility Piping.**]

H. Field Cuts: According to Pipe Manufacturer instructions.

I. Joining:

1. Heat Joining: Comply with ASTM D2657.

2. Electrofusion: Comply with ASTM F1290.

3. Primers and Cleaners: Comply with ASTM F402.

4. PVC Solvent-Cemented Joints: Comply with ASTM D2855.

J. Insulation: As indicated [**on Shop Drawings**] [**on Drawings**] [**in piping schedule**].

K. Underground Piping: As specified in Section 31 11 16 - Site Water Utility Distribution Piping.

Commented [JW1]: We do not have this in our specifications library

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

L. Installation Standards: Install Work according to <_____> standards.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Laying Tolerances: As specified in Section 31 11 16 - Site Water Utility Distribution Piping.

Commented [JW2]: We do not have this in our specifications library

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

******** [OR] ********

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Inspection:

1. Inspect for piping defects that may be detrimental as determined by the Architect/Engineer.
2. Repair damaged piping, or provide new, undamaged pipe.
3. After installation, inspect for proper supports and interferences.

D. Pressure Testing:

1. As indicated in piping schedule.

******** [OR] ********

E. Pressure Testing:

1. Test Pressure: Not less than 200 psig (1 380 kPa) or 50 psi (345 kPa) in excess of maximum static pressure, whichever is greater.
2. Conduct hydrostatic test for minimum [two] <_____> hours.
3. Filling:
   a. Fill section to be tested with water slowly and expel air from piping at high points.
   b. Install corporation cocks at high points.
   c. Close air vents and corporation cocks after air is expelled.
   d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.

5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.

6. Leakage:

   a. Correct visible deficiencies and continue testing at same test pressure for additional [two] <_____> hours to determine leakage rate.

   b. Maintain pressure within plus or minus 5 psi (34.4 kPa) of test pressure.

   c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.

   d. Compute maximum allowable leakage by following formula:

      1) L = SD x sqrt(P)/C.

      2) L = testing allowance in gph (L/h).

      3) S = length of pipe tested in feet (m).

      4) D = nominal diameter of pipe in inches (mm).

      5) P = average test pressure during hydrostatic test in psig (kPa).

      6) C = 148,000 (794 797).

      7) When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

   e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.

   f. Correct visible leaks regardless of quantity of leakage.

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

7. Perform pressure test on piping according to <_____> standards.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Keep pipe interior clean as installation progresses.

C. Clean pipe interior of soil, grit, shavings, and other debris after pipe installation.

END OF SECTION

SECTION 40 05 51 – COMMON REQUIREMENTS RESULTS FOR PROCESS VALVES

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

List other Valve Sections required for the Project.

For example, Section 40 05 XX.XX, SP Name

A. This Section includes basic materials and methods related to valves commonly used for process systems, including pump stations, utility vaults, and water and wastewater treatment. This Section is to be used in conjunction with 40 05 51.15, Gate Valves, Section 40 05 51.18, Butterfly Valves <_____>.

B. Section Includes:

1. Valves.

2. Valve actuators.

C. Related Sections

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section, as well as Sections required to describe complete system or assembly requirements.

Delete sections not needed and renumber.

1. Section 03 30 00, Cast-in-Place Concrete

2. Section 05 50 00, Metal Fabrications

3. Section 09 90 00, Painting and Coating

4. Section 33 11 10, Water Utility Distribution and Transmission Piping

5. Section 40 05 13, Common Work Results for Process Piping

6. Section 40 05 51.15, Gate Valves

7. Section 40 05 51.18, Butterfly Valves

8. Section 40 05 51.24, Check Valves

9. Section 40 05 78, Miscellaneous Valves

1.2 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.

2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

3. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.

4. [AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.]

5. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

B. ASTM International (ASTM):

1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

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

1. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.

D. [National Electrical Manufacturers Association (NEMA):]

1. [NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).]

E. [National Fire Protection Association (NFPA):]

1. [NFPA 70 - National Electrical Code (NEC).]

F. NSF International (NSF):

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

2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

2. Submit valve cavitation limits.

3. [Submit Manufacturer data for actuator with model number and size indicated.]

Use Shop Drawings only when installing electrically actuated valves. Otherwise, delete text and add "Not Used".

C. Shop Drawings:

1. Submit description of proposed installation, including associated wiring diagrams and electrical data as may be specified elsewhere in the contract documents.

2. Provide assembly drawings indicating parts list, materials, sizes, position indicators, limit switches, [control system,] actuator mounting, wiring diagrams, control system schematics [, and] <_____>.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.

F. Lining and coating data.

G. Valve Labeling Schedule: Indicate valve locations and nametag text.

H. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

I. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and actuators.

B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of Manufacturer's recommended spare parts.

B. Tools:

1. Furnish special wrenches and other devices required for Owner to maintain equipment.

2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.7 QUALITY ASSURANCE

A. Cast Manufacturer's name, pressure rating, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Maintain clearances as indicated on Drawings [**and Shop Drawings**].

E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

B. Store materials according to Manufacturer instructions.

1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.

3. Provide additional protection according to Manufacturer instructions.

D. Handle products carefully to prevent damage to interior or exterior surfaces.

E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 VALVES

A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required and shown in the Drawings.

B. Operation:

1. Open by turning counterclockwise; close by turning clockwise.

2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

C. Valve Construction:

1. Bodies: Rated for maximum temperature and pressure to which valve will be subjected as specified in valve Sections.

D. Connecting Nuts and Bolts: Stainless steel.

2.3 RESILIANT-SEATED GATE VALVES

A. As specified in Section 40 05 51.15, Gate Valves.

If Project requires double disc gate valves or solid wedge metal-seated gate valves, refer to them in a similar fashion as above.

2.4 RUBBER-SEATED BUTTERFLY VALVES

A. As specified in Section 40 05 51.18, Butterfly Valves.

2.5 VALVE ACTUATORS

A. All valves shall be furnished with manual actuators, unless otherwise indicated in the Drawings.

B. Valves in sizes up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the Manufacturer's best standard design.

C. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.

D. Provide actuators with position indicators for shutoff valves 6 inches and larger.

E. Comply with AWWA C541 and C542, where applicable.

F. Furnish gear operators for valves 8 inches and larger, and chainwheel operators for valves mounted over 7 feet above floor.

G. Provide gear and power actuators with position indicators.

H. Gear-Assisted Manual Actuators:

1. Provide totally enclosed gears.

2. Maximum Operating Force: 60-pound-force (lbf).

3. Bearings: Permanently lubricated bronze.

4. Packing: Accessible for adjustment without requiring removal of actuator from valve.

I. Handwheel:

1. Furnish permanently attached handwheel for emergency manual operation.

2. Rotation: None during powered operation.

3. Permanently affix directional arrow and cast OPEN or CLOSE on handwheel to indicate appropriate direction to turn handwheel.

4. Maximum Operating Force: 60 lbf.

Include following paragraph when included in Project. Otherwise, delete text and add "Not Used".

J. Chain Actuator:

1. Description: Chain guides and hot-dip-galvanized operating chain extending to 5-1/2 feet above operating floor level.

2. Chain Wheels: Sprocket-rim type.

3. Furnish chain storage if chains may interfere with pedestrian traffic.

Include following paragraph only when electrically actuated valves are included in Project. Otherwise, delete text and add "Not Used".

K. Valve Actuators in NEC Class I, Group D, Division 1 or 2 Hazardous Locations: UL approved.

Include following paragraph when included in Project. Otherwise, delete text and add "Not Used".

L. Pneumatic Actuators:

1. Furnish [oil lubricators,] isolating valves, filter regulators, pressure gauges, and condensate drains.

2. [Provide local control to override automatic operation.]

Include following paragraph only when electrically actuated valves are included in Project. Otherwise, delete.

Section of Electric Motor Actuators is still in development. See Technical Services.

Input required from electrical/control subconsultant.

M. Electric Motor Actuators:

1. As specified in Section 26 05 03 - Equipment Wiring Connections and following:

   a. <_____> hp (<_____> kW), <_____> V, [single] [three] phase.

2. Motors: As specified in Section 40 05 13 - Common Work Results for Process Piping.

3. Control Panel:

   a. Factory mounted.

   b. NEMA 250, Type [1] [4] <_____>.

   c. Single-point power connection and grounding lug.

4. Controls: <_____>.

5. Disconnect Switch: Factory mounted in control panel.

6. Operation Sequences: <_____>.

7. Gearing:

   a. Single- or double-reduction unit.

   b. Spur or helical gears and worm gearing.

   c. Lubrication: [Grease] [or] [oil] in sealed housing.

2.6 SOURCE QUALITY CONTROL

A. Testing: Test valves according to Manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping system is ready for valve installation.

3.2 PREPARATION

A. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.

B. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.3 INSTALLATION

A. Install valves, actuators, extensions, and accessories according to Manufacturer instructions.

B. Firmly support valves to avoid undue stresses on piping.

C. Coat studs, bolts, and nuts with anti-seizing lubricant.

D. Clean field welds of slag and splatter to provide a smooth surface.

E. Install valves with stems upright or horizontal, not inverted.

F. Install valves with clearance for installation of insulation and allowing access.

G. Provide access where valves and fittings are not accessible.

H. Comply with Division 40 - Process Interconnections for piping materials applying to various system types.

I. Valve Applications:

1. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.

2. Install shutoff and isolation valves.

3. Isolate equipment, part of systems, or vertical risers as indicated on Drawings.

4. Install valves for throttling, bypass, or manual flow control services as indicated on Drawings.

J. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.4 FIELD QUALITY CONTROL

A. Valve Field Testing:

1. Test for proper alignment.

2. If specified by valve Section, field test equipment to demonstrate operation without undue leakage, noise, vibration, or overheating.

3. Engineer will witness field testing.

If Project is large and/or complex, with a variety of valve sizes and types and types of accessories, it is recommended to include a Schedule of Process Valves following this Section. Provide as follows by example.

3.5 ATTACHMENTS

A. The attachments listed below, following "END OF SECTION", are part of this Section.

1. Attachment 1 – Schedule for Process Valves.

END OF SECTION

Consider following example when developing Process Valve Schedule.

SCHEDULE FOR PROCESS VALVES							
VALVE NUMBER	LOCATION	DESCRIPTION	VALVE TYPE	MEDIA	SIZE	OPERATOR	REMARKS
V-221	Pump Room	Pump P-110 Discharge	Check	RW	16-inch	-----	-----
V-222	Pump Room	Pump P-110 Discharge - Low-Pressure Shutoff	B/F	RW	16-inch	Electric Motor	OPEN-CLOSE
V-214	Western Pipeline - Sta. 35+05	Entrance to RWS Vault	Gate	RW	12-inch	Manual	OPEN-CLOSE

SECTION 40 05 51.12 - BALL VALVES

This Section specifies ball valves for use in water and wastewater treatment plants.

Refer to Section 40 05 51 for common work results for process valves, and to Section 22 05 23 for general purpose valves for plumbing piping.

In the water and wastewater treatment industry, valving is typically specified by valve type. Valves may be detailed via a valve schedule, which describes valve type and characteristics required for that system. A sample valve schedule is provided in Section 40 05 51.

When selecting valve materials for corrosive fluids, consult with Valve Manufacturer and select materials based on specific application.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive specifications. Edit to avoid conflicting requirements.

This Section may include term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Checklist and Evaluations for information needed to coordinate this Specification Section with Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubber-seated ball valves.
2. Plastic ball valves.

B. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

1. Section 22 05 23 - General-Duty Valves for Plumbing Piping: Miscellaneous plumbing valves as required by Project.
2. Section 40 05 51 - Common Requirements Results for Process Valves: Basic materials and methods related to valves commonly used for process systems.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

A. American Water Works Association:

1. AWWA C507 - Ball Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm).

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

3. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.

4. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

5. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.

6. ASME B1.20.2 - Pipe Threads, 60 deg. General Purpose (Metric).

C. ASTM International:

1. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

2. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.

3. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

Coordinate remainder of PART 1 requirements with Section 40 05 51. Reference Section 40 05 51 only, or include items not covered in Section 40 05 51.

1.3 <_____>

A. Section <_____-_____>: <_____>.

B. As specified in Section 40 05 51 - Common Requirements Results for Process Valves: Submittal requirements for compliance with this Section.

******** [OR] ********

C. <_____>.

PART 2 PRODUCTS

A ball valve is an adaptation of a plug valve. Instead of a plug, it contains a ball with a hole through one axis that lines up with inlet and outlet ports of valve body. The ball rotates between two seats: flow is straight through in open position, and when valve is rotated 90 degrees (in closed position), flow is completely blocked.

Ball valves are generally recommended for following service conditions:

- OPEN-CLOSE, non-throttling.

- Minimum resistance to flow.

- Quick opening.

- Low maintenance cost.

- Moderate temperature conditions.

2.1 RUBBER SEATED BALL VALVES

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. 4 Inches (100 mm) through 48 Inches (1 200 mm):

1. AWWA C507, Class [150] [300].

2. [Minimum] Working Pressure: [<_____> psig (<_____> MPa) at <_____> deg. F (<_____> deg. C)] [As indicated on valve schedule].

3. Maximum Process Fluid Temperature: [<_____> deg. F (<_____> deg. C)] [As indicated on valve schedule].

4. Body:

a. Material: [Cast iron, ASTM A126] [Ductile iron, ASTM A536] [Cast steel] [Bronze] <_____>.

b. Seats: [Rubber] <_____>.

5. Ball:

   a. Material: [**Cast iron, ASTM A126**] [**Ductile iron, ASTM A536**] [**Cast steel**] <_____>.

   b. Surfacing: [**Stainless steel**] [**Nickel-chrome**] <_____>.

6. Bearing Seal, O-Rings, and Packing: [**Buna-N**] <_____>.

7. Shaft and Attachment Pins: [**Type 316**] stainless steel.

8. Bearings: PTFE-lined with fiberglass backing.

9. Shaft Seals: Self-lubricating and self-adjusting.

10. Connecting Hardware: [**Type 316**] stainless steel.

11. End Connections:

    a. Socket Welded: Comply with [**ASME B16.11**] [**and**] [**MSS SP-110**].

    ******** [OR] ********

    b. Threaded: Comply with ASTM B1.20.1 (B1.20.2M).

    ******** [OR] ********

    c. Flanged: Comply with ASME [**B16.1**] [**B16.5**] [**B16.42**].

    ******** [OR] ********

    d. Soldered.

12. Operator: [**Hand lever**] [**T-handle**] [**Handwheel**] [**Pneumatically actuated**] [**Electrically actuated**] <_____>.

C. Smaller Than 4 Inches (100 mm):

1. Comply with MSS SP 110.

2. [**Minimum**] Working Pressure: [<_____> psig (<_____> MPa) at <_____> deg. F (<_____> deg. C)] [**As indicated on valve schedule**].

3. Maximum Process Fluid Temperature: [<_____> deg. F (<_____> deg. C)] [**As indicated on valve schedule**].

4. Body:

   a. Type: [**One**] [**Two**] piece.

   b. Material: [**Bronze**] [**Carbon steel**].

5. Ball: [**Stainless steel**] <_____>.

6. Port: [**Regular**] [**Full**].

7. Seats: [PTFE] [Buna-N] [Neoprene] <_____>.

8. Stem: Blowout proof.

9. End Connections: [Soldered] [Threaded] [, with union].

10. Operator: [Hand lever] [Pneumatically actuated] [Electrically actuated] <_____>.

11. Finishes: As specified in Section 40 05 51 - Common Requirements Results for Process Valves.

2.2 PLASTIC BALL VALVES

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

When selecting valve materials for corrosive fluids, consult with Valve Manufacturer and select materials based on specific application.

B. Description:

1. [Minimum] Working Pressure: [<_____> psig (<_____> MPa) at <_____> deg. F (<_____> deg. C)] [As indicated on valve schedule].

2. Maximum Process Fluid Temperature: [<_____> deg. F (<_____> deg. C)] [As indicated on valve schedule].

3. Ports: Full size.

4. End Connections:

a. Flanged: Comply with ASME [B16.1] [B16.5] [B16.42].

******** [OR] ********

b. Union.

C. Operator: [Hand lever] [Pneumatically actuated] [Electrically actuated] <_____>.

D. Materials:

1. Body and Ball: [PVC, ASTM D1784] [CPVC, ASTM D1784] [Polypropylene, ASTM D4101] [PVDF, ASTM D3222] <_____>.

2. Seats: PTFE.

2.3 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. As specified in Section 40 05 51 - Common Requirements Results for Process Valves.

C. Testing: Test ball valves according to AWWA C507.

PART 3 EXECUTION

Coordinate remainder of PART 3 requirements with Section 40 05 51. Reference Section 40 05 51 only, or include items not covered in Section 40 05 51.

3.1 <_____>

A. Section <_____-_____>: <_____>.

B. As specified in Section 40 05 51 - Common Requirements Results for Process Valves: Submittal requirements for compliance with this Section.

******** [OR] ********

C. <_____>.

3.2 INSTALLATION

A. According to AWWA C507.

END OF SECTION

SECTION 40 05 51.15 - GATE VALVES

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

Edit listing of installation locations for valves and coordination with specs to suit Project.

A. This Section includes gate valves for use in [buried service, pump stations,] [utility vaults,] [and] [water and wastewater treatment plants.] Coordinate with Section 33 12 16, Water Utility Distribution and Transmission Valves and Section 40 05 13.19, Stainless Steel Process Piping.

B. Section Includes:

Double disc and solid wedge, metal-seated gate valves are not a standard. Included only in the instance it is a client preference; otherwise, delete. Renumber if needed.

1. Resilient-seated gate valves.

2. [Double disc gate valves.]

3. [Solid wedge, metal-seated gate valves.]

Delete if small valves not required for Project.

4. General duty gate valves smaller than [3] <___> inches.

Edit Sections below to fit Project. Renumber if needed.

C. Related Sections:

1. Section 33 12 16, Water Utility Distribution and Transmission Valves

2. Section 33 11 10, Water Utility Distribution and Transmission Piping

3. Section 40 05 13, Common Work Results for Process Piping

4. Section 40 05 51, Common Requirements Results for Process Valves.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.

3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

4. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

3. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. American Water Works Association (AWWA):

1. [**AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.**]

2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

3. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.

Delete if this Paragraph D if no valves smaller than 3 inches. Renumber if needed.

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

1. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends.

2. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.

E. NSF International (NSF):

1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects

2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. As required by [**Section 33 12 16 - Water Utility Distribution and Transmission Valves and/or Section 40 05 51, Common Requirements Results for Process Valves.**]

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT-SEATED GATE VALVES

A. Description:

1. Comply with AWWA C509.

Standard pressure ratings provided below. If Project has higher pressure requirements, discuss with PM.

2. Minimum Pressure Rating:

a. Twelve-inch Diameter and Smaller: 200 pounds per square inch (gauge) (psig).

b. Sixteen-inch Diameter and Larger: 150 psig.

c. [As indicated on Valve Schedule at the end of this Section.]

3. End Connections: As shown in the Drawings.

a. Standard mechanical joint ends comply with ANSI/AWWA C111.

b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125. Comply with AWWA C115 & ASME 16.5.

1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.

4. Gear Actuators: Conforming to AWWA C509 for manual valves.

5. Linings and Coatings:

a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.

b. All internal and external ferrous surfaces.

c. Do not coat flange faces of valves.

6. Bi-directional flow.

B. Operation:

1. Non-rising stem.

2. Open counterclockwise when viewing the valve from above, unless otherwise indicated in the Drawings.

3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.

4. In-Plant Service Valves: Valves for in-plant or exposed service shall be furnished with handwheel operators, unless otherwise specified in Section 40 05 51, Common Requirements Results for Process Valves.

C. Materials:

1. Wedge:

    a. ASTM A126, cast iron or ASTM A536, ductile iron.

    b. Fully encapsulated with [molded rubber ***standard*] [Buna-N ***if soil contamination is suspected*].

2. Body and Bonnet:

    a. ASTM A126, cast iron or ASTM A536, ductile iron.

3. Stem, Stem Nuts, Glands, and Bushings: ASTM B584, bronze.

4. Valve Body Bolting: Stainless steel.

Edit to fit Project.

Below is a list of acceptable manufacturers typically listed. Check with client preferences when specifying.

Delete as needed.

D. Manufacturers:

1. Clow Valve Company.

2. M&H Valve.

3. U.S. Pipe.

4. American Flow Control.

5. Mueller Company.

Double-disc gate valves are not standard specification. Only use where required by Owner; otherwise replace text with "Not Used".

2.3 DOUBLE-DISC GATE VALVES

A. Description:

1. Comply with AWWA C500 and NSF 61 and 372.

Standard pressure ratings provided below. If Project has higher pressure requirements, discuss with PM.

2. Minimum Pressure Rating:

    a. Twelve-inch Diameter and Smaller: 200 psig.

    b. Sixteen-inch Diameter and Larger: 150 psig.

    c. [As indicated on Valve Schedule at the end of this Section.]

3. End Connections: As shown in the Drawings.

a. Standard mechanical joint ends comply with ANSI/AWWA C111.

b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125. Comply with AWWA C115 & ASME 16.5.

1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.

4. Gear actuators: Conforming to AWWA C509 for manual valves.

5. Linings and Coatings:

a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.

b. All internal and external ferrous surfaces.

c. Do not coat flange faces of valves.

6. Bi-directional flow.

B. Operation:

1. Non-rising stem.

2. Open counterclockwise when viewing the valve from above, unless otherwise indicated in the Drawings.

3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.

4. In-Plant Service Valves: Valves for in-plant or exposed service shall be furnished with handwheel operators, unless otherwise specified in Section 40 05 51, Common Requirements Results for Process Valves.

C. Materials:

1. Body: Iron.

2. Trim: Bronze.

3. Gate: Double-disc parallel seat.

4. Stem Seals: O-ring.

Below is a list of acceptable manufacturers typically listed. Check with client preferences when specifying.

D. Manufacturers:

1. Clow Valve Company.

2. Mueller

Solid wedge, metal-seated gate valves are not standard specification. Only use where required by Owner; otherwise replace text with "Not Used".

2.4 SOLID WEDGE, METAL-SEATED GATE VALVES

A. Description:

1. Comply with AWWA C500 and NSF 61 and 372.

Standard pressure ratings provided below. If Project has higher pressure requirements, discuss with PM.

2. Minimum Pressure Rating:

a. Twelve-inch Diameter and Smaller: 200 psig.

b. Sixteen-inch Diameter and Larger: 150 psig.

c. [As indicated on Valve Schedule at the end of this Section.]

3. End Connections: As shown in the Drawings.

a. Standard mechanical joint ends comply with ANSI/AWWA C111.

b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125. Comply with AWWA C115 and ASME 16.5.

1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.

4. Gear actuators: Conforming to AWWA C509 for manual valves.

5. Linings and Coatings:

a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.

b. All internal and external ferrous surfaces.

c. Do not coat flange faces of valves.

6. Bi-directional flow.

B. Operation:

1. Buried Service:

a. Non-rising stem (NRS).

b. Two-inch square operating nut.

2. Interior and Exposed Service:

a. Outside screw and yoke (OS&Y).

b. Provide NRS valves with position indicators.

3. Open counterclockwise when viewing the valve from above, unless otherwise indicated in the Drawings.

C. Materials: AWWA C500.

1. Body, Bonnet, Wedge, and Gland: ASTM A536, ductile iron.

2. [**Handwheel**] [**Nut**]: [**Ductile iron**] <_____>.

3. Stem: Stainless steel.

4. Trim: Bronze.

5. Packing: Non-asbestos graphite.

6. Rollers and Tracks: Bronze.

7. Rubber Components: Buna-N.

Include only if small valves required for Project; otherwise replace text with "Not Used".

2.5 GENERAL-DUTY GATE VALVES – SMALLER THAN 3 INCHES

A. Two inches and Smaller:

1. MSS SP 80, Class 125.

2. Body and Trim: ASTM B584, bronze.

3. Bonnet: Union.

4. Operation: Handwheel.

5. Inside screw [**with back-seating stem**].

6. Wedge Disc: Solid; ASTM B584, bronze.

7. End Connections: Threaded.

B. Two and one-half inches to 3 inches:

1. MSS SP 70, Class 125.

2. Stem: Non-rising.

3. Body: ASTM A126, cast iron.

4. Trim: Bronze.

5. Bonnet: Bolted bonnet.

6. Handwheel, outside screw and yoke.

7. Wedge Disc: Solid, with bronze seat rings.

8. End Connections: ASME B16.1, ASME B16.5, ASME B16.42, flanged.

2.6 SOURCE QUALITY CONTROL

A. Testing: Test gate valves according to AWWA C509.

PART 3 EXECUTION

3.1 INSTALLATION

A. As required by [**Section 33 12 16, Water Utility Distribution and Transmission Valves and/or Section 40 05 51 - Common Requirements Results for Process Valves.**]

B. Install according to Manufacturer's instructions.

C. Support valves in plastic piping to prevent undue stresses on piping.

END OF SECTION

SECTION 40 05 51.18 - BUTTERFLY VALVES

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

Edit listing of installation locations for valves and coordination with specs to suit Project.

A. This Section includes butterfly valves for use in [buried service,] [pump stations,] [utility vaults,] [and water and wastewater treatment plants]. Coordinate with Section 33 12 16, Water Utility Distribution and Transmission Valves and Section 40 05 51, Common Requirements Results for Process Valves.

B. Section Includes:

1. Rubber-seated butterfly valves.

C. Related Sections:

1. Section 33 12 16, Water Utility Distribution and Transmission Valves
2. Section 33 11 10, Water Utility Distribution and Transmission Piping.
3. Section 40 05 13, Common Work Results for Process Piping.
4. Section 40 05 51, Common Requirements Results for Process Valves.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

4. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. American Water Works Association (AWWA):

1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).

2. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.

D. NSF International (NSF):

1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects

2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. As required by [**Section 33 12 16 - Water Utility Distribution and Transmission Valves and/or Section 40 05 51, Common Requirements Results for Process Valves.]**

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RUBBER-SEATED BUTTERFLY VALVES

A. Description:

If Project has Class 250 BFV's, make sure to indicate such for the individual valves in the Drawings or the Valve Schedule at the end of this Section. Edit Item 1 below accordingly.

1. Comply with AWWA C504, Class 150B and 250B as indicated in the Drawings [**or on Valve Schedule at the end of this Section.]**

2. Minimum Pressure Rating:

a. Twelve-inch (300-millimeter) Diameter and Smaller: 200 pounds per square inch (gauge) (psig).

b. Sixteen-inch (400-millimeter) Diameter and Larger: 150 psig.

c. [As indicated on Valve Schedule at the end of this Section.]

3. End Connections: As shown in the Drawings.

   a. Standard mechanical joint ends comply with ANSI/AWWA C111.

   b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125, unless shown otherwise. [**NTS: Class 125 drilling is typically desired for Class 250 valves.**] Comply with AWWA C115 & ASME 16.5.

      1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.

4. Gear Actuators: Conforming to AWWA C504 for manual valves.

5. Linings and Coatings:

   a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.

   b. All internal and external ferrous surfaces.

   c. Do not coat flange faces of valves.

6. Bubble-tight at the rated pressure for bi-directional flow.

7. Style: Wafer.

8. Shaft: Self-lubricating, sleeve-type bearings. One-piece, through-shaft construction.

   a. Valve shafts shall be full size for that portion of the shaft extending through the valve bearings, valve disc, and shaft seal.

   b. Any portion of the shaft turned down for any reason shall have fillets with radii equal to the offset to minimize stress concentrations at the junction of the different shaft diameters. The turned down portion of the shaft shall be capable of transmitting the maximum operator torque without exceeding a torsional steel stress of 11,500 pounds per square inch (psi).

9. Seats: Mounted on body for valves 24 inches and smaller; field replaceable (mechanically retained in a machined groove) for valves larger than 24 inches.

10. Packing: Replaceable without dismantling valve.

B. Operation:

   1. Open counterclockwise, unless otherwise indicated in the Drawings.

   2. Operators shall be of the traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between full open and fully closed without creeping or fluttering.

   3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.

Edit paragraph below to Project needs. Typical in-plant and in-vault service valves are specified with only a handwheel. Other options provided as reference only and may be deleted if not desired.

4. In-Plant Service Valves: Valves for in-plant or exposed service shall be furnished with handwheel operators, unless otherwise specified in Section 40 05 51, Common Requirements Results for Process Valves.

C. Materials:

1. Body: ASTM A126, cast iron or ASTM A536, ductile iron. Integrally cast flanged or mechanical end joints.

2. Shaft: Stainless steel.

3. Disc: ASTM A126, cast iron or ASTM A536, ductile iron.

4. Seats: Resilient, replaceable, Buna-N.

5. Seating Surfaces: Type 316 stainless steel.

6. Bearings:

a. Sleeve: Corrosion-resistant and self-lubricating.

D. Manufacturers:

Below is a list of acceptable manufacturers typically listed. Check with client preferences when specifying.

1. M&H Valve.

2. Henry Pratt Company.

3. Mueller Company.

4. Kennedy Valve Company.

5. Dezurik.

6. Val-Matic Valve & Manufacturing Corporation.

2.3 SOURCE QUALITY CONTROL

A. Testing: Test butterfly valves according to AWWA C504.

PART 3 EXECUTION

3.1 INSTALLATION

A. As required by [Section 33 12 16, Water Utility Distribution and Transmission Valves and/or Section 40 05 51 - Common Requirements Results for Process Valves].

B. Install according to Manufacturer's instructions.

END OF SECTION

SECTION 40 05 51.24 - CHECK VALVES

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

If tilting disc valves used add to summary.

A. Work in this Section includes check valves for use in water and wastewater facilities. Work includes the furnish and install of all swing and silent check valves, complete, as shown on the Drawings and specified herein, including coating and lining, appurtenances, operators, and accessories.

Edit to fit Project. Renumber if needed.

B. Section includes:

1. Swing check valves, 1-inch through 4-inch diameter.
2. Swing check valves, 4-inch diameter and larger
3. Tilting disc check valves.
4. Silent check valves.
5. Plastic check valves.

C. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section, as well as Sections required to describe complete system or assembly requirements.

If not needed replace text with "Not Used".

1. Section 22 05 23 - General-Duty Valves for Plumbing Piping
2. Section 40 05 51 - Common Requirements Results for Process Valves

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings.

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. ASTM A536 - Standard Specification for Ductile Iron Castings.

3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

4. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings.

5. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

6. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

7. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.

8. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

C. American Water Works Association (AWWA):

1. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.

D. NSF International (NSF):

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

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. As required by Section 40 05 51, Common Requirements Results for Process Valves.

Check valves are designed to prevent the reversal of flow in a piping system and are activated by the pressure of the flowing fluid. Reversal of flow will close the valve, with closure accomplished by the weight of the check mechanism, backpressure, a spring, or a combination of these factors.

PART 2 PRODUCTS

Edit to fit Project. If not needed replace text with "Not Used".

2.1 SWING CHECK VALVES, 1-INCH THROUGH 4-INCH DIAMETER

A. Description:

1. Horizontal T-pattern style.

2. 200# WOG.

3. Capable of functioning in the vertical position.

4. Connections shall be standard threaded or threaded for fire hose connections where shown on plans

B. Materials:

1. Body Cap and Disc: Brass conforming to ASTM B584 C85400.

C. Manufacturer:

1. Figure 246 as manufactured by Red White Valve.

Edit to fit Project. If not needed replace text with "Not Used".

2.2 SWING CHECK VALVES, 4-INCH DIAMETER AND LARGER

A. Description:

1. Meeting requirements of AWWA C508.

2. Type: Swing, resilient seated, with outside lever and adjustable [weight] [spring].

3. Flow Area: Full open.

4. Mounting: Horizontal or vertical.

5. Shall close tightly when the pressure downstream of the valve disc exceeds the upstream pressure.

6. Working Pressure: [150 psi] <OR> [250 psi] <OR HIGHER AS NEEDED FOR SPECIAL APPLICATIONS>

7. Tight sealing, shockless in operation and absolutely prevent the return of water back through the valve.

8. The disc shall be attached to the sic arm by means of a center pin, disc nut, and washer providing 360-degree angular articulation but not rotation.

9. Pin Shaft:

a. Discs shall be suspended from a non-corrosive hinge pin shaft that shall rotate freely without the need for external lubrication.

b. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing.

10. End Connections: As shown on Drawings <OR SPECIFY> [ASME B16.1, flanged] [ASME B16.42, flanged]. End connections shall be rated to the working pressure requirements specified above.

B. Materials:

1. Body and Disc: Constructed of heavy cast iron conforming to ASTM A126 class B, or ductile iron conforming to ASTM A536.

2. Cover: Steel conforming to ASTM A36 or Ductile iron conforming to ASTM A536.

3. Disc Arm: Ductile iron conforming to ASTM A536.

4. Body Seat: Type 316 stainless steel or Bronze ASTM B62.

5. Disc Seat: Field-replaceable, NBR or Buna-N.

6. Hinge Pin and Key: Stainless steel.

7. Rubber Components: NBR or Buna-N.

8. Connecting Hardware: Stainless steel.

C. Finishes:

1. Epoxy lining and coating conforming to AWWA C210.

2. [For potable water service, epoxy lining and coating shall meet be provided with NSF 61 certification.]

D. Manufacturer:

1. GA Industries, Figure No. 220-D.

2. Cla-Val, 585 Series.

3. Approved equal.

Edit to fit Project. If not needed replace text with "Not Used".

<SEE FULTON PUMP STATION SPECS, 10-1173 IF YOU NEED TO SPECIFY A TILTING DISC CHECK VALVE>

2.3 TILTING DISC CHECK VALVE

Edit to fit Project. If not needed replace text with "Not Used".

2.4 SILENT CHECK VALVES

A. Description:

1. Type: Globe-style, silent operating type that begins to close as the forward velocity diminishes and be fully closed at zero velocity, preventing flow reversal and resultant water hammer or shock.

2. Valve design shall incorporate a center-guided, spring-loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe.

3. Valve Interior: Contoured and unrestricted to achieve maximum flow capacity along with minimum pressure drop.

4. Installation: Operation of the valve shall not be affected by the position of installation. It shall be capable of operating in the horizontal or vertical position with the flow op or down.

5. Valve Disc: Concave to the flow direction providing for disc stabilization, maximum strength, and minimal flow velocity to fully open the valve.

6. All component parts shall be field replaceable without the need of special tools.

7. A replaceable guide bushing shall be provided and held in position by the valve's spring.

8. Spring: Designed to withstand 100,000 cycles without failure and exert a force which allows the valve to start opening at a differential pressure of .5 pounds per square inch (psi) (.04 kilograms per square centimeter (kg/cm2)) and to fully open at a flow velocity of 4 feet per second (1.22 meters per second).

9. The valve disc and seat shall be field replaceable and have a seating surface finish of 32 micro-inch or better to insure positive seating at all pressures.

10. Valve shall be hydrostatically tested at 1.5 times the rated working pressure.

11. Working Pressure: **[150 psi] <OR> [250 psi] <OR HIGHER AS NEEDED FOR SPECIAL APPLICATIONS>**

12. End Connections: As shown on Drawings **<OR SPECIFY> [ASME B16.1, flanged] [ASME B16.42, flanged].** End connections shall be rated to the working pressure requirements specified above.

B. Materials:

1. Body: ASTM A536, ductile iron.

2. Trim: Stainless steel.

3. Spring: Stainless steel.

4. Resilient Seat: Buna-N

C. Finishes:

1. Epoxy lining and coating conforming to AWWA C210.

2. **[For potable water service, epoxy lining and coating shall meet be provided with NSF 61 certification.]**

D. Manufacturer:

1. Val-Matic, 1800 series.

2. Cla-Val, 581 series.

3. Approved equal.

2.5 SOURCE QUALITY CONTROL

A. Testing:

1. Hydrostatically test check valves at twice rated pressure, in conformance with requirements of AWWA C508.

2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install check valves according to AWWA C508, Section 40 05 51 Common Requirements Results for Process Valve, and as recommended by Manufacturer.

3.2 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVE

A. Provide the services of the Valve Manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 40 05 51.76 - ALTITUDE CONTROL VALVE

PART 1 GENERAL

1.1 DESCRIPTION

The Contractor shall furnish and install combination solenoid control, altitude shutoff, and pressure sustaining valve complete, as shown on the drawings and/or specified herein, including coating and lining, appurtenances, operators, and accessories.

1.2 CONTRACTOR SUBMITTALS

As required by Section 15100.

PART 2 PRODUCTS

2.1 COMBINATION SOLENOID CONTROL AND ALTITUDE SHUTOFF VALVE

A. Construction: Valve shall be single seated, globe style, hydraulically operated and diaphragm actuated. Diaphragm assembly shall be guided top and bottom by a precision machined stem. Resilient valve disc, retained on three sides by disc retainers, shall form a drip-tight seal with a renewable seat when pressure is applied above the diaphragm. Control of valve operation shall be by means of an externally mounted, hydraulic pilot system.

Main valve body and cover shall be ASTM A48 cast iron or ASTM A536 ductile iron, with flanged ends. Main valve trim shall be bronze. Pilot control components shall be ASTM B61 bronze or ASTM B283 brass with Type 303 stainless steel trim, and pilot tubing shall be copper. Rubber parts shall be BUNA N synthetic rubber.

B. Protective Coating: Valve body and cover shall be lined and coated with an FDA approved fusion bonded epoxy coating system suitable for use with cast iron or ductile iron. The epoxy coating thickness and application shall be in accordance with AWWA C550.

C. Pressure Rating: Valve shall be suitable for a working water pressure of 200 psig.

D. Operating Conditions: Valve shall function properly with water supply to the pilot system of approximately 10 to 40 psig pressure head. Flow through the valve shall be one-way.

E. Operating Requirements

1. Primary Control: Valve shall open fully by de-energizing an electrically powered solenoid valve located in the pilot system, and shall close drip-tight upon energizing of the solenoid valve. Solenoid valve shall be designed to operate at 120 volts AC, and coil shall be contained in a NEMA Type 4 enclosure.

2. Secondary Control: An altitude control, located in the pilot system, shall sense the water level in the reservoir through a connection to the reservoir sensing line, and shall close the valve drip-tight when a desired high water level in the reservoir is reached, over-riding the primary solenoid control. The desired water level shall be set by adjusting the spring force in the altitude control. The altitude control shall allow the valve to re-open and return

primary control to the solenoid when the water level in the reservoir drops to its normal operating range.

F. Accessories: The following accessories shall be furnished with the valve:

1. Self-cleaning strainer for pilot system.
2. Pilot system isolation valves on inlet, outlet, cover and sensing lines.
3. Opening speed control.
4. Closing speed control.
5. Valve position indicator.

G. Manufacturer: Valve shall be manufactured by Cla-Val Co., Newport Beach, CA, without exception. The valve model shall be 210G-17BY combination altitude and solenoid shutoff valve.

PART 3 EXECUTION

3.1 GENERAL

Valve installation shall be in accordance with Section 15100 and manufacturer's requirements. The valve model shall be 210 combination altitude control and solenoid shut-off valve.

3.2 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVES

The Contractor shall provide the services of the valve manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 40 05 78 - MISCELLANEOUS VALVES

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes miscellaneous valves not included in other Sections for use in [buried service,] [pump stations,] [utility vaults,] [and water and wastewater treatment plants].

B. Section Includes:

Edit listing below for items relevant to Project.

Delete ones not used and renumber if needed.

1. Mud valves.
2. Solenoid valves.
3. Air release valves.
4. Combination air/vacuum valves.
5. Blow-off hydrant assemblies.
6. Flap valves.
7. Shear gates.
8. Ball valves, 2 inches and under.

C. Related Sections:

1. Section 05 50 00, Metal Fabrications
2. Section 09 90 00, Painting and Coating
3. Section 33 11 10, Water Utility Distribution and Transmission Piping.
4. Section 40 05 13, Common Work Results for Process Piping.
5. Section 40 05 51, Common Requirements Results for Process Valves.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.

3. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.

4. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

5. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. ASTM A536 - Standard Specification for Ductile Iron Castings.

3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

1.3 COORDINATION

A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

2. Submit valve cavitation limits.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.

E. Lining and coating data.

F. Valve Labeling Schedule: Indicate valve locations and nametag text.

G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and actuators.

B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of Manufacturer's recommended spare parts.

B. Tools:

1. Furnish special wrenches and other devices required for Owner to maintain equipment.

2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.7 QUALITY ASSURANCE

A. Cast Manufacturer's name, pressure rating, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Maintain clearances as indicated on Drawings.

E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

B. Store materials according to Manufacturer instructions.

1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.

3. Provide additional protection according to Manufacturer instructions.

D. Handle products carefully to prevent damage to interior or exterior surfaces.

E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

Edit Paragraphs below for items relevant to Project.

If not needed replace text with "Not Used".

Cast-iron mud valves are used as drain valves in the bottom of some reservoirs, water treatment basins and tanks. They may also be used in applications such as spill or overflow containment basins.

2.2 MUD VALVES

A. Description:

1. Type: Non-rising, threaded stem.

2. Furnish coupling nut, extension stem, stem guides, and operating stand as indicated on Drawings.

3. Operation: [Wheel] [Nut with wrench].

4. End Connections: ASME B16.1, ASME B16.5, ASME B16.42, flanged.

B. Materials:

1. Body: ASTM A126, cast iron or ASTM A536, ductile iron.

2. Stem, Seat Ring, and Gate Ring: ASTM B62, bronze.

3. Connecting Hardware: Type 316 stainless steel.

4. Linings and Coatings:

a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.

b. All internal and external ferrous surfaces.

c. Do not coat flange faces of valves.

If not needed replace text with "Not Used".

A solenoid valve combines two functional units: an electromagnet or solenoid, with its plunger or core, and a valve. The valve is OPENED or CLOSED by the plunger being drawn into the solenoid when the coil is energized.

Solenoid valves are typically used for fully OPEN, fully CLOSED service.

2.3 SOLENOID VALVES

Edit below to fit Project requirements. Consult with Owner and Electrical EOR.

A. Description:

1. Type: As indicated [on Drawings] [on valve schedule].

2. [Minimum] Working Pressure: [<_____> pounds per square inch (gauge) (psig) (<_____> megapascal (MPa)) at <_____> degrees Fahrenheit (F) (<_____> degrees Celsius (C))] [As indicated on valve schedule].

3. Coil: Continuous duty.

4. Operation: [Fail open, energize to close] [Fail closed, energize to open].

5. Enclosures: National Electrical Manufacturers' Association (NEMA) psig rated according to area designation as indicated on Drawings.

6. Electrical Characteristics: As indicated [on Drawings] [on valve schedule].

7. End Connections: [Screwed] <_____>.

8. Conduit Connection: [Threaded] <_____>.

B. Materials:

1. Body: [Brass] [ASTM B62, bronze] <_____>.

2. Trim and Spring: Stainless steel.

3. Seals: Resilient, [polytetrafluoroethylene (PTFE)] <_____>.

If not needed replace text with "Not Used".

2.4 AIR RELEASE VALVES

A. Description:

1. Inlet Size: 2-inch diameter and smaller.

2. Cast-iron body and cover. Comply with ASTM A126, Class B.

3. Stainless steel orifice and float. Comply with ASTM A240.

4. Design test pressure: 450 psig.

B. Manufacturers:

1. DeZurik - APCO Series 200A or equal.

If not needed replace text with "Not Used".

2.5 COMBINATION AIR/VACUUM VALVES

A. Description:

1. Construction: Two independent valves: one air/vacuum valve, one air release valve.
2. Inlet Size: Greater than 2-inch diameter.
3. Cast iron body and cover. Comply with ASTM A126, Class B.
4. Stainless steel orifice and float. Comply with ASTM A240.
5. Valves seats: Buna-N.

B. Manufacturers:

1. DeZurik - APCO Series 1700 or equal.

If not needed replace text with "Not Used".

2.6 BLOW-OFF HYDRANT ASSEMBLIES

A. Description:

1. Material: 100 percent low-lead brass.
2. Inlet: 2-inch diameter female iron pipe (FIP) vertical straight inlet.
3. Outlet: 2-inch diameter male iron pipe (MIP).
4. Operation:
   a. By turning a top-mounted square operating nut.
   b. Operation must seal drain outlet in all positions from 1/4-open to fully open.
5. Hydrant shall be non-freezing, self-draining.
6. Accessories: Provide Owner with one operating wrench.

B. Manufacturers:

1. Kupferle – Truflo #TF500 or equal.

If not needed replace text with "Not Used".

2.7 FLAP VALVES

A. Description:

1. Material: ASTM A126, cast iron.
2. Seat and hinge pin: Bronze.
3. End connection: 125-pound flange, unless otherwise noted on the Drawings.
4. Two pivot points.
5. Valves 14-inches and smaller shall have the hinge pin secured with cotter pins.
6. Valves 16-inches and larger shall have the hinge pin secured with nuts.

B. Manufacturers:

1. M & H, Style 47 or equal.

If not needed replace text with "Not Used".

2.8 SHEAR GATES

A. Description:

1. Frame: ASTM A126, cast iron.
2. Seat: Bronze to bronze.
3. Latch and hinge pin: Bronze.
4. Double wedge and latch.
5. Wedge: ASTM A126, cast iron with bronze facing. Field replaceable.
6. The valve shall be equipped with a pull rod made of galvanized steel that is long enough to facilitate valve operation without entering manhole.
7. Pull rods shall be equipped with an adjustable cast iron hook for positioning the valve.
8. Flanged shear gates shall have 125-pound flanged ends, unless otherwise noted on the drawings.

B. Manufacturer:

1. M & H, Style 44 or equal.

If not needed replace text with "Not Used".

2.9 BALL VALVES, 2 INCHES AND UNDER

A. Description:

1. Four hundred-pound. Water, oil, and gas rating (WOG) with bronze body and trim, unless otherwise shown on the Drawings.
2. Seat ring: Tetrafluoroethylene (TFE).

3. O-ring seals: Fluorocarbon.

4. Three-piece construction so that maintenance can be performed without distributing the valve body after installation.

B. Manufacturer:

1. Nibco T-590-Y or equal.

2.10 SOURCE QUALITY CONTROL

A. Testing Pressure-Reducing and Pressure-Sustaining Valves:

1. Leakage Testing:

a. Test each assembled valve hydrostatically at 1-1/2 times rated working pressure for minimum five minutes.

b. Test each valve for leakage at rated working pressure against closed valve.

c. Permitted Leakage: None.

2. Functional Testing:

a. Test each valve to verify specified performance.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install valves per Manufacturer requirements and recommendations.

B. Install all valves with valve seats level.

C. Install protective strainers upstream of solenoid valves, pressure-reducing valves, and pressure-sustaining valves.

If Project is large and/or complex, with a variety of valve sizes and types and types of accessories, it is recommended to include a Schedule of Miscellaneous Valves following this Section. Provide as follows by example.

3.2 ATTACHMENTS

A. The attachments listed below, following "END OF SECTION", are part of this Section.

1. Attachment 1 – Schedule for Miscellaneous Valves.

END OF SECTION

Consider following example when developing Schedule.

SCHEDULE FOR MISCELLANEOUS VALVES							
VALVE NUMBER	LOCATION	DESCRIPTION	VALVE TYPE	MEDIA	SIZE	OPERATOR	REMARKS
PRV-221	Vault, STA 36+00	Entrance to PZ 2	PRV		16-inch	-----	-----
V-222	Pump Room	Pump P-110 Discharge - Low-Pressure Shutoff	Flap		8-inch	---	-----

SECTION 40 05 53 - IDENTIFICATION FOR PROCESS PIPING

This Section includes nameplates, labeling, and identification methods for process piping, valves, and accessories.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting the requirements of this Specification.

This Section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

This Section includes the term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See the Drawing Coordination Considerations for information needed to coordinate this Specification Section with the Drawings.

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Sections

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this Section.
2. Section 40 05 13 - Common Work Results for Process Piping: Basic materials and methods for process piping systems.
3. Section 40 05 23 - Common Work Results for Process Valves: Basic materials and methods or valves.

Commented [JW1]: We do not have this in our specifications library. Verify with Technical Lead.

1.2 REFERENCE STANDARDS

List reference standards included within text of this section. Edit the following for Project conditions.

LEED requires compliance with specific editions of referenced standards. Section 01 40 00 requires compliance with the latest reference standard edition, except when a specific date is required by code. Consider including publication dates for referenced standards in this Section to ensure the correct standard is used for LEED compliance.

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum [one] <_____> week prior to commencing Work of this Section.

1.4 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer's catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color-coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and Valve Manufacturer's name and model number.

Include the following Paragraph for submission of physical samples for selection of finish, color, texture, and other properties.

D. Samples: Submit [two] <_____> [tags] [labels] [pipe markers] [and] <_____> for each size used on Project.

E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

F. Manufacturer's Certificate: Certify that [products] <_____> meet or exceed [specified requirements] <_____>.

Include separate Paragraphs for additional certifications.

G. Qualifications Statement:

Coordinate following Subparagraph with the requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer.

1.5 SUSTAINABLE DESIGN SUBMITTALS

A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.

B. Manufacturer's Certificate: Certify that the following products meet or exceed specified sustainable design requirements.

Insert material certifications list below to suit products specified in this Section and Project sustainable design requirements. Specific certificate submittal and supporting data requirements are specified in Section 01 81 13.

1. <_____>.

C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1. Provide cost data for the following products:

Edit list of material cost data below to suit products specified in this Section and Project sustainable design requirements. Specific cost data requirements are specified in Section 01 81 13.

a. Salvaged, refurbished, and reused products.

b. Products with recycled material content.

c. Regional products.

d. <_____>.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Extra Stock Materials: Furnish [two] <_____> [containers of spray-on adhesive] <_____>.

C. Tools: Furnish special [crimpers] <_____> and other devices required for Owner to reinstall tags.

1.8 QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

B. Perform Work according to <_____> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

C. Maintain <_____> [copy] [copies] of each standard affecting the Work of this Section on-Site.

1.9 QUALIFICATIONS

Coordinate following Paragraph with the requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [three] <_____> years' [documented] experience.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [Specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

B. Description: Laminated three-layer plastic with engraved [black] <_____> letters on light, contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

b. Substitutions: [**Specified in Section 01 60 00 - Product Requirements**] [**Not permitted**].

2. Description:

a. Laminated three-layer plastic with engraved [**black**] <_____> letters on light, contrasting background color.

b. Minimum Tag Size and Configuration: 1-1/2 inches (38 mm); [**diameter**] [**square**] <_____>.

B. Metal Tags:

1. Manufacturers:

a. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

b. Substitutions: [**Specified in Section 01 60 00 - Product Requirements**] [**Not permitted**].

2. Description:

a. [**Brass**] [**Aluminum**] [**Stainless-steel**] <_____> construction; stamped letters.

b. Minimum Tag Size and Configuration: 1-1/2 inches (38 mm); [**diameter**] [**square**] <_____> with finished edges.

C. Information Tags:

1. Manufacturers:

a. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

b. Substitutions: [**Specified in Section 01 60 00 - Product Requirements**] [**Not permitted**].

2. Description:

a. Clear plastic with printed [**DANGER**] [**CAUTION**] [**WARNING**] <_____> and message.

b. Minimum Tag Size: 3-1/4 by 5-5/8 inch (83 by 143 mm).

c. Furnish grommet and self-locking nylon ties.

3. Tag Chart: Typewritten, letter-size list of applied tags and location, [**in anodized aluminum frame**] [**plastic laminated**].

2.3 STENCILS

A. Manufacturers:

1. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

2. Substitutions: [**Specified in Section 01 60 00 - Product Requirements**] [**Not permitted**].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

B. Description:

1. Clean-cut symbols.

2. Letters:

a. Up to 2-inch (51-mm) Outside Diameter of Insulation or Pipe: 1/2-inch (13-mm)-high letters.

b. 2-1/2- to 6-inch (64- to 150-mm) Outside Diameter of Insulation or Pipe: 1-inch (25-mm)-high letters.

c. Over 6-inch (150-mm) Outside Diameter of Insulation or Pipe: [**1-3/4-inch (44-mm)**] [**<_____>-inch (<_____>-mm)**]-high letters.

C. Stencil Paint: As specified in Section 09 90 00 - Painting and Coating; semigloss enamel.

D. Color-Coding and Lettering Size: Conform to ASME A13.1.

2.4 PIPE MARKERS

A. Color-Coding and Lettering Size: Conform to ASME A13.1.

B. Plastic Pipe Markers:

1. Manufacturers:

a. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

b. Substitutions: [**Specified in Section 01 60 00 - Product Requirements**] [**Not permitted**].

2. Description:

a. Factory-fabricated, flexible, semirigid plastic.

b. Preformed to fit around pipe or pipe covering.

c. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:

1. Manufacturers:

a. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

b. Substitutions: [Specified in Section 01 60 00 - Product Requirements] [Not permitted].

2. Description: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Plastic Underground Pipe Markers:

1. Manufacturers:

a. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

b. Substitutions: [Specified in Section 01 60 00 - Product Requirements] [Not permitted].

2. Description:

a. Brightly colored, continuously printed plastic ribbon tape.

b. Minimum 6 inches (150 mm) wide by 4 mil (0.1 mm) thick.

c. Manufactured for direct burial service.

2.5 CEILING TACKS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [Specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

B. Description:

1. Steel construction.

2. Head: 3/4-inch (19-mm) diameter; color coded.

C. Color-Coding and Lettering Size: Conform to ASME A13.1.

2.6 LABELS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [Specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

B. Description:

1. [**Aluminum**] [**Polyester**] [**Laminated Mylar**] <_____> construction.

2. Minimum Size: 1.9 by 0.75 inches (48 by 19 mm).

3. Adhesive backed, with printed identification [**and bar code**].

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:

a. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

b. Substitutions: [**Specified in Section 01 60 00 - Product Requirements**] [**Not permitted**].

2. Description:

a. [**Anodized aluminum**] [**Reinforced nylon**] <_____> construction.

b. Furnish hasp with erasable label surface.

c. Minimum Size: 7-1/4 by 3 inches (184 by 76 mm).

B. Valve Lockout Devices:

1. Manufacturers:

a. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

b. Substitutions: [**Specified in Section 01 60 00 - Product Requirements**] [**Not permitted**].

2. Description:

a. [**Nylon**] [**Steel**] [**Plastic**] <_____> construction.

b. Furnish device preventing access to valve operator and accepting lock shackle.

2.8 SUSTAINABILITY CHARACTERISTICS

Insert sustainable design characteristics in this Article to suit content of this Section and Project sustainable design requirements specified in Section 01 81 13. The following two Paragraphs contain examples.

A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Material and Resource Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content [**including:**] [**.**]

Insert list of materials specified in this Section required to have recycled content.

a. <_____>.

2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles (800 km) of Project Site [**including:**] [**.**]

Insert list of materials specified in this Section required to be regional materials.

a. <_____>.

PART 3 EXECUTION

3.1 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Prepare surfaces as specified in Section 09 90 00 - Painting and Coating for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting as specified in Section 09 90 00 - Painting and Coating.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.

D. Labels:

1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.

2. For unfinished covering, apply paint primer before applying labels.

E. Tags:

1. Install tags using corrosion-resistant chain.

2. Number tags [**consecutively by location**] [**as indicated in tag schedule**].

F. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

G. Identify valves in main and branch piping with tags.

H. Piping:

1. Identify piping, concealed or exposed, with [**plastic pipe markers**] [**plastic tape pipe markers**] [**stenciled painting**].

2. [**Use tags on piping 3/4-inch (20-mm) diameter and smaller.**]

3. Identify service, flow direction, and pressure.

4. Install in clear view and align with axis of piping.

5. Locate identification not to exceed 20 feet (6 m) on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Ceiling Tacks:

1. Provide ceiling tacks to locate valves above T-bar-type panel ceilings.

2. Locate in corner of ceiling panel closest to equipment.

3.3 ATTACHMENTS

When relying on separate schedules, tables, illustrations, or forms to specify product requirements, include list of each attachment. Include identical list of attachments in Project Manual table of contents.

Insert attachments following END OF SECTION.

Consider following examples when developing Project schedule.

A. Identification:

1. <_____>.

a. Identification type.

b. Background size.

c. Background color.

d. Lettering size.

e. Lettering color.

B. Valve Tags:

1. <_____>.

a. Tag material.

b. Tag size.

c. Tag shape.

d. Tag color.

END OF SECTION

SECTION 40 60 04
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified and required to furnish, install, calibrate, test, start-up, commission and place in satisfactory operation a complete Computer Control System (CCS). CCS shall be as specified in Division 40 and as shown on the Drawings. The system includes, but is not limited to the following major equipment:
   1. Computer Control System.
   2. Instrumentation
   3. Process and Local Control Panels.
   4. Intermediate Termination Panels.

B. The CCS shall be designed to monitor, store, display, and log process, equipment operating information, alarms, and to perform various process control functions and generate various reports. The unit processes, which the CCS shall monitor, and control are shown on the Drawings and described herein.

C. Process and Instrumentation Diagrams (P&ID's), of this Section and the other Division 40 Sections, illustrate and describe the overall CCS functional and operational requirements.

D. SUPPLIER shall configure all computer control system software for the supplied CCS. However, CONTRACTOR shall be responsible for hardware configuration, loop testing of signals, and communications testing for new and modified existing control equipment through the Computer Control System under ENGINEER supervision.

E. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.
   1. Section 01 78 23, Operation and Maintenance Data.
   2. Section 40 60 06, Computer Control System Factory Testing.
   3. Section 40 60 07, Process Control System Start-Up, Commissioning and Field Testing.
   4. Section 40 60 08, Process Control System Training.
   5. Section 40 60 52, Process Control System Primary Sensors and Field Instruments.
   6. Section 40 60 65, Process Control System Panels and Enclosures.
   7. Section 40 60 66, Process Control System Panel Instruments and Devices.

1.2 QUALITY ASSURANCE

A. General:
   1. The CCS shall be furnished by a single Supplier who shall assume responsibility for providing a complete and integrated system.
   2. All equipment, components and materials required shall be furnished by the single Supplier who shall assume the responsibility for adequacy and performance of all items.
   3. The Supplier shall identify those system components, which are not of its manufacture.
   4. The Supplier shall supply its company's Quality Assurance Plan, and for components which are not of its manufacture, the component manufacturer's Quality Assurance Plan. The plans shall include, but not necessarily be limited to: method of testing, raw material criteria, methods of documentation, station control, "Burn-In", final tests and serialization coding and packaging. Said plans shall be in accordance with M.I.L.-105D.

B. Supplier's Qualifications:

1. Be a financially sound firm having at least five years continuous experience in designing, implementing, supplying and supporting instrumentation and control systems, which are comparable to the CCS in terms of hardware, software, cost and complexity.
2. Have manufactured and supported standard lines of digital processing and control equipment and application software continuously for the last five years.
3. Have in existence at the time of bid advertisement, an experienced engineering and technical staff capable of designing, implementing, supplying and supporting the CCS and handling the CCS submittals and training requirements.
4. Provide system hardware components and software packages of fully developed, field proven standardized designs and therefore shall furnish a system, which is not a highly unique, custom one-of-a-kind system.
5. Have a minimum of two years experience in hardware application and programming of computer control systems and data highway systems.
6. Provide standard course offerings in general process control applications and in operation, programming and maintenance of the control system and equipment at a facility specifically utilized for training purposes. The facility shall have been in operation continuously for the last two years.
7. Have a thorough working knowledge of water treatment processes and control philosophy in accordance with standard practices of the water treatment industry.
8. Have a system of traceability of the manufactured units and purchased components through production, assembly and testing.
9. Have a system of "Burn-In" for all components and available supportive documentation.
10. Have a demonstrated record of prompt response to field failures.
11. Have a documented program of failure analysis.
12. Have a record of prompt shipments in accordance with contract obligations required for previous projects.
13. Shall have a warranty covering parts, spare parts and labor and in the case of microprocessor-based equipment and its appurtenances, a guaranteed availability clause.
14. Shall have proof of compliance with relevant NEC, OSHA, MIL, NRC, ISA, SAMA, NFPA, UL and API standards and all relevant state and local codes.

C. Technical Proposal Requirements: The apparent low, responsive, responsible Bidder shall submit to OWNER a copy of a Technical Proposal from the Supplier that has selected to provide the CCS. The Technical Proposal shall be submitted 30 days after the Notice to Proceed. The Technical Proposal shall be complete and contain all information as specified below:
   1. Financial Statement: Include the value of computer control systems delivered during the last two fiscal years. Also, include the value of other process instrumentation and controls shipped during the period.
   2. Experience:
      a. Provide evidence of compliance with the specific experience requirements listed in Paragraph 1.2.B., above, in the form of an experience certification signed by an officer of the company.
      b. Describe at least three completed municipal projects utilizing instrumentation and control equipment identical to or similar to (indicate which) that specified. Indicate owner, value, completion date, names and phone numbers of owner's representatives familiar with each project. Letters of recommendation may be submitted.
      c. Furnish list of last ten projects completed.
   3. Personnel: Provide a listing of those personnel committed to be assigned to the Project. List shall include Project Manager, Project Engineer, field representative, local service representative, and sales representative. Indicate addresses of personnel not based at supplier's main office. Provide documentation including resumes of personnel demonstrating experience in water treatment applications.

4. Exceptions: List all exceptions and deviations from the requirements of the Specifications. Reference Section Number, Article, and Paragraph of proposed variance and provide an explanation of why the proposed substitution meets (or exceeds) the functional or equipment requirements specified.
5. Shipment Records: Provide evidence of timely delivery of equipment on past projects.
6. Computer Control System Hardware and Software:
   a. Provide a general system configuration drawing and include designations for model numbers and types of the proposed CCS and all other proposed system components.
   b. Provide descriptive literature and manufacturer's catalog information covering all aspects of the hardware design and software functions and capabilities of the specific CCS and data highway system proposed for the CCS.
7. Hardware and Software:
   a. Provide descriptive literature and catalog information covering the features and capabilities of all proposed hardware components.
   b. Describe standard software packages proposed, including any customized software required to meet the functional intent of the system Specifications. Descriptions shall address the following:
      1) Overview of system software including the functions, organization and interrelationship of the major software modules provided.
      2) Estimated UPS memory requirements to accomplish the specified graphic display, logging, reporting and alarming functional requirements.
         a) Examples of graphic displays, methods of display access and procedures for display definition and generation, including use of the standard symbols library and capabilities for generating and storing user defined symbols in the symbol library.
         b) Real-time data logging and reporting software features and capabilities including examples of logs and reports, procedures for automatic reporting and logging file setups, limitations on sampling and computing frequency for data acquisition and logging, and utilities for log file and report modifications and file maintenance.
         c) Alarm handling software features and capabilities including an alarm display example, methods of defining alarms and alarm files, automatic printing of alarms, acknowledgements and return to normal conditions, chronological sorting and time-tagging of alarms, and alarm file maintenance utilities.
         d) Use of system level diagnostics for monitoring the performance of and detecting and reporting faults associated with the communications data highway.
8. Instrumentation and Panel Mounted Devices: Provide descriptive literature and catalog cuts for each type of sensor, transmitter, indicator, and other such devices required by the Project.
9. Training: Provide information and literature as to the organization proposed and the factory facilities to be utilized for the training specified. Indicate the qualifications of the factory training staff.
10. Start-Up and Field Testing: Indicate how the Availability Demonstration will be accomplished.
11. Maintenance: Provide the following information:
    a. Location of service facility along with minimum and maximum response time.
    b. Location of parts facility with delivery time and method.

D. Operating Experience or Bonding Alternative:
   1. The treatment facilities outlined in the Contract Documents, included herein, have been designed to meet stringent quality standards. OWNER and ENGINEER have selected and designed a CCS to provide effective monitoring and control for the treatment facilities required to meet these stringent quality criteria limitations. The criteria for selection of this system includes, but is not limited to, the following:
      a. The use of standard, "non-custom" equipment and application software.

b. The ability of OWNER'S personnel to make modifications and adjustments in the field to react to actual field conditions.
c. The ability of OWNER to obtain training of OWNER'S personnel in well established equipment manufacturer training programs.
d. The availability of factory service and a well stocked spare parts inventory, which could be drawn upon by OWNER in emergency situations.

2. The requirements listed in Paragraph 1.2.B, above, include specific experience requirements. Should a Supplier lack the required five years experience, it will have the option of posting a performance bond in the amount of 100 percent of the system equipment price. This bond shall cover a period of time that a supplier is deficient from the five-year experience requirement. For example, if a Supplier has only two years experience, the Supplier must post, along with an experience certification signed by an officer of the company, a bond in the amount of 100 percent of the system equipment price for a period of three years following acceptance of the system by OWNER. The purpose of this bond shall be to indemnify OWNER against all losses incurred by reason of the failure of any system or equipment in any aspect of the quality standards required or intended by these Specifications. OWNER considers losses to include costs incurred to remove a defective system, modify structures as required, purchase and install replacement systems and costs involved with correcting, to OWNER'S satisfaction, all system and equipment deficiencies to the quality standards required and intended by these Specifications. The premium cost of this bond shall be included in the price bid for this equipment. The bond shall be in addition to any other bonds specified in the Contract Documents. All Suppliers lacking the total five years operating experience shall submit, as part of the specified Technical Proposal submittal, a copy of the bond from an acceptable surety along with a letter from the surety stating that it will issue the bond for the full value of the equipment price.

E. Supplier's Responsibility:

1. CONTRACTOR shall retain the CCS Supplier to undertake the responsibilities specified below. However, execution of these specified duties by the system supplier shall not relieve CONTRACTOR of the ultimate responsibility for the CCS.
a. Design, fabrication, implementation and applications programming of the CCS and all subsystems in accordance with the Contract Documents and all referenced standards and codes.
b. Preparation, assembly and correction of all CCS submittals in accordance with the Contract Documents.
c. Proper interfacing of the CCS hardware, software, field devices and panels, including required interfacing with packaged control systems furnished by other equipment suppliers, and with the plant electrical system.
d. Supervision of the installation of CCS, instruments, panels, consoles, cabinets, wiring and other components required.
e. Calibration, testing, start-up and commissioning of the CCS.
f. Training of OWNER'S personnel in operation and maintenance of the monitoring and control system.
g. Handling of all warranty obligations for the control system components.
h. Maintenance of two reproducible copies of the complete system and running software at the Supplier's facility for the duration of the warranty period. Software copies shall be maintained on the bulk storage medium used by the Supplier for system program development and shall be directly loadable on the supplied system.

F. Reference Standards:
1. The following organizations have generated standards that are to be used as guides in assuring quality and reliability of components and systems; govern nomenclature; define parameters of configuration and construction, in addition to specific details in the Contract Documents:
a. ISA, The Instrumentation, Systems and Automation Society.

b. API, American Petroleum Institute.
c. UL, Underwriters' Laboratories, Inc.
d. AWWA, American Water Works Association.
e. NRC, Nuclear Regulatory Commission.
f. NEMA, National Electrical Manufacturers Association.
g. OSHA, Occupational Safety and Health Administration.
h. ANSI, American National Standards Institute.
i. MIL, Military Standards.
j. NFPA, National Fire Protection Association.
k. SAMA, Scientific Apparatus Manufacturers Association.
l. NFPA, National Fire Protection Association 79, Annex "D" Standards.
m. IEEE, Institute of Electrical and Electronic Engineers.
n. NEC, National Electrical Code, 1999.
o. FM, Factory Mutual.
p. Applicable local Process Control Standards.

1.3 COORDINATION AND PROGRESS MEETINGS

A. CONTRACTOR shall be responsible for scheduling and coordinating the system installation with regard to all other Work on the site and in accordance with the provisions of the General Conditions. Said coordination shall be documented on the Project Schedule.

B. Routine progress and coordination meetings will be scheduled by ENGINEER. CONTRACTOR and a representative of the system Supplier shall be required to attend two meetings each month.

C. The purpose of the meetings shall be to review the progress of the Work involving the CCS and provide coordination for installation of the equipment to ensure that the Project Schedule is met.

D. Representatives at the meetings shall have the competence and authority to make any and all necessary decisions. Decisions and statements made at the meetings shall commit CONTRACTOR and system Supplier to agreed procedures and schedules.

1.4 SYSTEM SUPPLIER PROJECT PERSONNEL

A. CONTRACTOR shall require the system Supplier to provide the following project personnel:
1. Project Manager:
   a. The system Supplier shall appoint a Project Manager who shall coordinate and schedule all Work and assure that the Project Schedule is met.
   b. The Project Manager shall act as the liaison with CONTRACTOR for the installation of the CCS equipment and shall assist in all matters required for proper coordination and interfacing of the equipment and processes.
2. On-Site Project Engineer:
   a. System supplier to appoint a full-time, on-site Project Engineer to remain during the period from the system supplier's control panel installation through Final Completion of the Work.
   b. Project Engineer to ensure control system installation remains on schedule and to communicate to the Project Manager where potential problems may arise.
   c. Project Engineer shall assist the Field Engineer with loop testing and to ensure existing plant processes are not interrupted during testing.
3. Field Engineer:
   a. The system Supplier shall appoint a Field Engineer with responsibilities as follows:
      1) Provide advice and technical consultation relative to installation techniques and procedures for equipment furnished.
      2) Installed system checkout, calibration, adjustment, start-up and commissioning, including tuning of every control loop.
      3) Maintenance services during availability demonstration.
      4) Involvement in the on-site system training of plant personnel.

5) Resolving of control problems encountered during initial start-up, testing and commissioning of all CCS equipment.

b. The Field Engineer shall have a minimum of five years experience in systems engineering and start-up and shall have a thorough working knowledge of both the hardware and software supplied for the CCS.

4. Training Personnel:

a. Comply with requirements of Section 40 60 08, Process Control System Training.

1.5 SUBMITTALS

A. Shop Drawings:

1. General:

a. Shop Drawing submittals are to be in accordance with the requirements of the Contract Documents.

b. Shop Drawing preparation shall not commence until after the Pre-Submittal Meeting specified below.

c. Manufacture of the CCS shall not commence until related submittals have been approved by ENGINEER.

d. Shop Drawings shall be submitted in complete packages grouped to permit review of related items as generally outlined in Paragraph 1.5.A.3., below.

e. Review of Shop Drawings will be for conformance with Contract Documents and with regard to functions specified to be provided.

2. Pre-Submittal Meeting:

a. CONTRACTOR shall arrange and conduct a Pre-Submittal Meeting on the CCS within 3 days of notification of preliminary acceptance of the proposed CCS and Supplier by OWNER and ENGINEER.

b. Pre-Submittal Meeting shall be attended by representatives of CONTRACTOR, OWNER, the CCS Supplier, and ENGINEER. CONTRACTOR shall allot one full eight hour day for the meeting and that time shall be included in the price of this Contract.

c. Purpose of the Pre-Submittal Meeting shall be to review informally and approve the manner in which the CCS Supplier intends to respond to the requirements of the Contract Documents before any submittals are prepared.

d. CONTRACTOR shall prepare the items listed below for presentation at the Pre-Submittal Meeting. The information shall be submitted to ENGINEER three weeks prior to the date of the meeting.

1) List of equipment and materials required for the CCS and the brand and model, which CONTRACTOR proposes to use for each item.

2) List of proposed exceptions to the Contract Documents along with a brief explanation of each. Approval shall be subject to a formal submittal.

3) Sample of each type of submittal specified herein. These may be submittals prepared for other projects.

4) A flow chart showing the steps to be taken in preparing and coordinating each control system submittal to ENGINEER, and a list of proposed submittals.

5) Bar chart type schedule for all CCS related activities from the Pre-Submittal Meeting through start-up, training and commissioning. Particular emphasis shall be given to dates relative to submittals, design, fabrication, programming, factory testing, deliveries, installation and field-testing. The schedule shall be subdivided to show activities relative to each major item or group of items when everything in a given group is on the same schedule.

6) General outline of the type of tests to be performed to verify that all sensors/transducers, instruments and digital processing equipment are functioning properly.

3. Submittal Requirements:

a. Product information for all sensors/transducers and field and panel instruments. Include the following:

1) Manufacturer's product name and complete model number.
2) Instrument tag number from Contract Documents.
3) Manufacturer's data sheets and catalog literature. Provide data sheets as shown in ISA-20-1981. For instruments not included in ISA-20, submit data sheets using a similar format.
4) Description of construction features.
5) Performance and operation data.
6) Installation and mounting details, instructions and recommendations.
7) Service requirements.
8) Dimensions.
9) List of recommended spare parts.

b. Panels, Consoles and Cabinets Information:
1) Layout Drawings, include the following:
2) Front, rear, and internal panel views to scale.
3) Dimensional information.
4) Tag number and functional name of components mounted in and on panel, console or cabinet.
5) Product information on all panel components.
6) Nameplate location and legend including text, letter size and colors to be used.
7) Location of anchoring connections and holes.
8) Location of external wiring and/or piping connections.
9) Mounting and installation details.
10) Calculations for cooling.

c. Wiring and/or piping diagrams, include the following:
1) Name of panel, console or cabinet.
2) Wiring sizes and types.
3) Piping sizes and types.
4) Terminal strip numbers.
5) Color coding.
6) Functional name and manufacturer's designation for components to which wiring and piping are connected.
7) Electrical control schematics in accordance with NFPA 79 Standards.
8) Plan showing equipment layout in each area.

d. Field wiring and piping diagrams, include the following:
1) Wiring and piping sizes and types.
2) Terminal strip numbers.
3) Color coding.
4) Conduits in which wiring is to be located.
5) Location, functional name and manufacturer's designation of items to which wiring and/or piping are connected.
6) Point-to-point wiring diagrams.
7) Instrument loop diagrams for all analog display, control and I/O loops prepared using ISA standard symbols in accordance with ISA Standard S5.4, include the following:
8) Instrument tag numbers from Contract Documents.
9) Functional name of each item.
10) Manufacturer's model, product, or catalog number for each item.
11) Location of each item.

e. Process Control System I/O Loop Wiring Diagrams: Prepare drawings on a module-by-module basis and include the following information:
1) Rack numbers, slot number, module type and module terminal point numbers. Also, include location and identification of all intermediate panel and/or terminal block and strip numbers to which I/O wiring and power supply wiring is connected. Identify all power supply circuit numbers and ratings.
2) Wiring sizes, types, wire numbers and color-coding.
3) Designation of conduits in which field I/O wiring is to be run.

4) Location, functional name, tag numbers and manufacturer model numbers of panel and field devices and instruments to which I/O wiring and power supply wiring is connected. For discrete I/O devices use NFPA 79 electrical symbols tagged with designation shown on the Drawings.

f. Programmable Logic Controller Communication Registers: Listing of all contiguous register locations used in serial communications to the CCS.

B. System Operation and Maintenance Manuals:
1. Furnish Operation and Maintenance Manuals for the CCS in accordance with Section 01 33 04, Operation and MaintenanceManuals, and the supplemental requirements below.
2. The Operation and Maintenance Manuals shall include the following:
a. Name, address and telephone number of the control system Supplier's local service representative.
b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.
c. Copy of all approved submittal information and system Shop Drawings as specified herein with corrections made to reflect actual system as tested and delivered to the site for installation. Half-size black line reproductions shall be provided for all Shop Drawings larger than 11 by 17-inches.
d. Manufacturer's original copies of hardware, software, installation, assembly and operations manuals for control system components and peripheral devices. Manuals shall include the following information:
1) General descriptive information covering the basic features of the equipment.
2) Physical description covering layout and installation requirements and all environmental constraints.
3) Functional and operational descriptions covering the procedures for start-up, shutdown, and calibration of control system equipment and explaining how the various control functions are performed.
4) Principles of operation explaining the logic of operation; provide information covering operation to a component level.
5) Maintenance procedures covering checkout, troubleshooting, and servicing; checkout procedures shall provide the means to verify the satisfactory operation of equipment, troubleshooting procedures shall serve as a guide in determining faulty components and servicing procedure shall cover requirements and recommended time schedule for calibration, cleaning, lubrication and other housekeeping and preventive maintenance procedures.
6) As-built wiring, schematic and logic diagrams.
7) Safety considerations relating to operation and maintenance procedures.

C. Record Drawings and Documentation:
1. CONTRACTOR and CCS Supplier shall revise all system Shop Drawings, submittals and software documentation to reflect as-built conditions in accordance with the requirements of the Contract Documents and the supplemental requirements below.
2. shall be submitted to the ENGINEER to replace outdated drawings and documentation contained in the System Operation and Maintenance Manuals. Half-size black line sets shall be provided for all drawings larger than 11 by 17-inches. Specific instructions for outdated drawing removal and replacement shall be provided with the Record Drawing submittal.
3. Half-size black line prints of wiring diagrams applicable to each control panel shall be placed inside a clear plastic envelope and stored in a suitable print pocket or container inside each control panel.

D. Reports:
1. Two copies of the following reports shall be submitted to ENGINEER and OWNER:
a. Factory Test Reports if specified in Section 40 60 06, Computer Control System Factory Testing.

b. Installation Inspection, Field Calibration, and Field Testing Reports as specified in Section 40 60 07, Process Control System Start-Up, Commissioning and Field Testing.

1.6 EQUIPMENT DELIVERY, HANDLING AND STORAGE

A. CONTRACTOR shall make all arrangements for transportation, delivery and storage of the equipment and materials in accordance with the requirements of the Contract Documents, requirements of the system Supplier, and requirements of equipment manufacturers.

B. CCS equipment shall be packaged at the factory prior to shipment to protect each item from damage during shipment and storage. Containers shall be protected against impact, abrasion, corrosion, discoloration or other damages. Clearly label contents of each container and provide information on the required storage conditions necessary for the equipment. Keep OWNER and ENGINEER informed of equipment delivery.

C. All equipment shall be handled and stored in accordance with manufacturer's instructions and relevant organization standards. Equipment shall be protected from weather, moisture and other conditions that could cause damage. Items that require a controlled environment for storage such as panels and microprocessor units shall be stored in a climate-controlled warehouse or facility. System Supplier shall notify CONTRACTOR, in writing, with copies to OWNER and ENGINEER of the storage requirements and recommendations for the equipment prior to shipment.

1.7 GENERAL DESIGN REQUIREMENTS

A. Power Supplies:
1. All electrically powered equipment and devices shall be suitable for operation on 115-volt, 10 percent, 60 Hz, 2 Hz power. If a different voltage or closer regulation is required, a suitable regulator or transformer shall be provided.
2. Appropriate power supplies shall be furnished by CONTRACTOR for all two wire transmitters, loops for monitoring discrete inputs and all necessary outputs. Power supplies shall be mounted in enclosures and installed in the appropriate control room or field panel.
3. Design all power supplies for a minimum of 130 percent of the maximum simultaneous current draw.
4. Furnish a power on-off switch or an air circuit breaker for each item requiring electrical power.
5. Provide isolation transformers, line voltage regulators and power distribution panels for the distributed digital portions of the CCS to eliminate electrical noise or transients entering on the primary power line.

B. Signal Requirements:
1. The control system shall be designed to use 4 to 20mA DC analog signals, unless otherwise specified.
2. Provide signal converters and repeaters, where required. In addition, analog inputs to the computer control system shall be through appropriate repeaters to provide signal isolation where series looped with other devices, and to allow the loop to maintain integrity even if the computer control system is out of service. Power supplies shall be sized adequately for signal converter and repeater loads.
3. Signals shall be isolated from ground.
4. Signals shall not have a transient DC voltage exceeding 300 volts over one millisecond nor a DC component over 300 volts.
5. The system and associated input/output wiring will be used in a plant environment where there can be high energy AC fields, DC control pulses, and varying ground potentials between the sensors/transducers or input contact locations and the system components. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

C. Miscellaneous:

1. All instrumentation and CCS components shall be heavy-duty types, designed for continuous service in a municipal treatment plant environment. The system shall contain products of a single manufacturer, where possible, and consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and be capable of field expansion through the installation of plug-in circuit cards and additional cabinets as necessary. Design all logic and control loops to fail-safe.
2. All instrumentation and CCS components shall be designed to return automatically to accurate measurement within 15 seconds upon restoration of power after a power failure or when transferred to standby power supply.
3. Surge protection shall be provided for all instruments and all other CCS components, which could be damaged by electrical surges.
4. All field-mounted instruments and CCS components shall be designed for installation in humid and corrosive service conditions. All field mounted instrument enclosures and appurtenances shall conform to NEMA 4X requirements, unless otherwise specified.
5. All relays with interconnections to field devices shall be wired through terminal blocks. Terminals as part of the relay base are not an acceptable alternate.
6. All panel mounted instruments, switches, and other devices shall be selected and arranged to present a pleasing coordinated appearance. All front of panel mounted devices shall be of the same manufacturer and model line.
7. All components furnished, including field and rear of panel instruments, shall be tagged with the item number and nomenclature indicated on the Contract Documents and the Instrument Index.
8. Ranges and scales specified herein shall be coordinated to suit equipment actually furnished.
9. Field-mounted devices shall be treated with an anti-fungus spray.
10. Field-mounted devices shall be protected from exposure to freezing temperatures and shaded from direct sunlight.

D. Environmental Conditions:
1. The control system shall be designed and constructed for continuous operation under the following temperature and humidity conditions:
   a. Control Rooms:
      1) Ambient Temperature: 60°F to 80°F normal range; 40°F to 105°F occasional maximum extremes.
      2) Relative Humidity: 80 percent, normal; 95 percent maximum.
   b. Indoor locations for digital processing equipment hardware, control panels and instruments:
      1) Ambient Temperature: 40°F to 120°F.
      2) Relative Humidity: 98 percent maximum.
   c. Outdoor locations for instruments:
      1) Ambient Temperature: -10°F to 131°F.
      2) Relative Humidity: 100 percent maximum.

E. System Designs:
1. Range, scale and setpoint values specified in other Division 40, Instrumentation and Controls, Sections are for initial setting and configuration. Modifications to these values may be required based on actual equipment furnished, as necessary, to implement proper and stable process action determined as systems are placed in operation. These modifications shall be provided at no additional cost to OWNER.
2. For any items where ranges, scales and setpoints may not have been specified, CONTRACTOR shall submit a recommendation to ENGINEER for review.

PART 2 - PART 2 - PRODUCTS (NOT USED)

PART 3 - PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 40 60 06
COMPUTER CONTROL SYSTEM
FACTORY TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform factory testing, before shipment, at the manufacturer's facility to verify that system components are functioning properly and that they meet the functional and performance requirements of the Contract Documents.
   2. CONTRACTOR shall submit information on factory testing procedures to verify that testing shall fulfill the requirements as specified herein. Submittal shall be made at least two months in advance of any scheduled testing and shall include dates of scheduled tests.
   3. CONTRACTOR shall notify ENGINEER, in writing, at least four weeks before expected initiation of tests. OWNER and ENGINEER may elect to be present at CONTRACTOR'S facilities during operational test of system equipment, either for individual units or as an integrated system. Presence of OWNER and ENGINEER during testing does not relieve CONTRACTOR from conforming to the requirements of the Contract Documents and shall in no way imply acceptance of the equipment.

1.2 INSPECTION

A. All panels, consoles and cabinets shall be inspected. Inspection shall include, but not be limited to, the following:
   1. Nameplates and tags.
   2. Wire sizes and color-coding.
   3. Terminal block contact ratings and numbers.
   4. Annunciator and terminal block spares.
   5. Proper wiring practices and grounding.
   6. Enclosure flatness, finish, and color.

1.3 SYSTEM HARDWARE OPERATIONAL TESTING

A. All input/output devices and components shall be tested to verify operability and basic calibration.

B. All system hardware components equipment shall be tested to verify proper operation of the equipment as standalone units. Test shall include, but not be limited to, the following:
   1. AC/DC power checks.
   2. Power fail/restart tests.
   3. Diagnostics checks.
   4. Test demonstrating that all specified equipment functional capabilities are working properly.

C. All system components shall be tested to verify that communication between units is working properly.

D. An integrated system test with all system equipment connected (excluding field sensors and instruments) shall be performed to verify that all equipment is performing properly as an integrated system.

1.4 SYSTEM SOFTWARE DEMONSTRATION

A. CONTRACTOR shall demonstrate all system software utility and security programs incorporated into the system to illustrate the various specified functions and capabilities.

B. CONTRACTOR shall demonstrate the operation and display of all software based on a simulation of ten percent of total input/output count, both analog and discrete, as selected by the manufacturer. In addition, OWNER shall randomly select, at the time of the test, additional inputs and outputs to be simulated in an amount approximately equal to ten percent of total input/output count. Demonstration shall show that the monitoring and control application software associated with the input/output points performs the functions intended.

C. System performance shall be tested using a fully integrated system, including all software and hardware, if applicable. To achieve this, the entire control system, including all the peripheral devices and all interconnecting cables, shall be assembled on the factory test floor and simulated inputs applied. CONTRACTOR shall carry out a full system test, during which the entire system shall operate continuously without failure in accordance with the requirements of the Contract Documents. CONTRACTOR shall provide process input/output simulation panel prior to the test:
   1. Toggle switches to simulate field or other input contacts.
   2. Indicating lights to simulate outputs from tested panels.
   3. Control relays to simulate Motor Control Center coil inputs.
   4. Time relays to simulate position switches.
   5. Signals to indicate every 4 to 20mA DC output from tested panel.
   6. Potentiometers to simulate 4 to 20mA DC inputs to tested panel.
   7. Every device shall have nameplate with description and device's P&ID tag number. Nameplates shall be removable and interchangeable for multiple use of panel during the test.

D. Demonstration of communication between controller to remote I/O shall be included in the Test Procedure, where applicable.

E. Operator Interfaces: Prior to the staging and testing of the system, the display environments shall have been configured in accordance with the agreed upon display structure, loaded and data base parameters linked to the specified fields. During this phase of the factory acceptance test, the overall display structure shall be demonstrated, including environment configurations, passwords, security, etc. The memo display contents shall be reviewed to demonstrate how an operator navigates within the overall display structure. Each graphic display shall be reviewed for correctness in terms of the layout, symbols, color scheme, etc. The operation of standard alarm management displays (Current Alarm Display, Alarm History, etc.) shall also be demonstrated.

PART 2 - PART 2 - PRODUCTS (NOT USED)

PART 3 - PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 40 60 07
PROCESS CONTROL SYSTEM
START-UP, COMMISSIONING AND FIELD TESTING

PART 1 - GENERAL

1.1 SYSTEM START-UP, COMMISSIONING AND FIELD TESTING RESPONSIBILITIES

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install all equipment and coordinate all activities required to perform start-up, commissioning and field testing of the Process Control System. Field testing shall include an integrated system field test and operational availability demonstration.

B. CONTRACTOR shall retain the services of the Instrumentation Supplier and Computer Control System vendor to supervise and/or perform start-up, commissioning and field testing of all system components. As part of these services, the Instrumentation Supplier shall include for the equipment items not manufactured by the Instrumentation Supplier, the services of an authorized manufacturer's representative to check the equipment installation and place the equipment in operation. The manufacturer's representative shall be thoroughly knowledgeable about the installation, operation and maintenance of the equipment.

C. CONTRACTOR shall submit to the ENGINEER a schedule with proposed start dates and test procedure guidelines for start-up, commissioning, and field testing at least four weeks in advance. Prior to testing each process area, CONTRACTOR shall install Computer Control System (CCS) software, including any modifications, and perform independent software configuration testing. Complete testing of each process area through the CCS shall be documented by CONTRACTOR and submitted to the ENGINEER upon successful completion.

1.2 SYSTEM CHECK-OUT AND START-UP

A. CONTRACTOR under the supervision of the Instrumentation Supplier, and other equipment suppliers as applicable, shall perform the following:
   1. Check and approve the installation of all computer control system components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation. Check-out shall include the following items as a minimum:
      a. All wiring shall be checked at each termination point for correct wire size, type, color, termination and wire number.
      b. Analog wiring shall be checked for correct polarity and ground continuity at each termination point in the loop.
      c. All control and monitoring loops shall be checked for signal continuity from source (such as field instrument/equipment, control panel, etc.) to end destination (Intermediate Termination Panels, ITP).
   2. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in this Work, they should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.
   3. All instruments and devices shall be checked to verify compliance with the Specifications and approved Shop Drawings.

B. CONTRACTOR shall provide all test equipment required to perform the testing during system checkout and start-up.

C. CONTRACTOR shall furnish to the ENGINEER certified calibration reports for field instruments and devices specified in Section 40 60 52, Process Control System Primary Sensors and Field Instruments, and panel mounted devices specified in Section 40 60 66, Process Control System Panel Instruments and Devices, as soon as calibration is completed.
   1. Receipt of any calibration certificate shall in no way imply acceptance of the work or instrument.
   2. The calibration certificate forms shall be prepared and furnished by CONTRACTOR.
   3. Each calibration certificate shall be signed and dated by an authorized representative of CONTRACTOR. Three copies of each completed certificate shall be submitted to ENGINEER.

D. CONTRACTOR shall furnish ENGINEER two copies of an installation inspection report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by authorized representatives of both CONTRACTOR and the Instrumentation Supplier.

E. Approved Operation and Maintenance manuals as specified in Section 40 60 04, Process Control System General Requirements, and a schedule for training must be approved prior to commencing integrated system field tests.

F. All spare parts must be on site and accepted prior to commencing integrated system field tests.

1.3 COMMISSIONING

A. Following the Process Control System checkout and initial operation, CONTRACTOR, under the supervision of the Instrumentation Supplier, shall perform a complete system test in the presence of the ENGINEER to verify that all equipment is operating properly as a fully integrated system, and that the intended monitoring and control functions are fully implemented and operational.
   1. Commissioning can only begin when all instruments and control panels are installed and wired. Operation and Maintenance manuals as specified in Section 40 60 04, Process Control System General Requirements and a schedule for training must be approved prior to Commissioning.
   2. All spare parts must be on site and accepted prior to Commissioning.
   3. CONTRACTOR shall submit to the ENGINEER a schedule for Commissioning, including a proposed start date and Commissioning test sheet examples at least three weeks in advance.

B. Commissioning shall be divided into two parts. Part I will exercise field signals between field equipment or instrumentation and each Intermediate Termination Panel (ITP). Part II shall exercise input/output signals from each ITP though the Computer Control Systems' workstation graphic display. CONTRACTOR shall make the necessary arrangements in each ITP to isolate field wiring from the CCS and allow concurrent Part 1 and Part II testing. CONTRACTOR shall, as a minimum, perform the following checks for each test:
   1. All wiring shall be checked at each termination point for correct wire size, type, color, termination and wire number.
   2. All instruments and devices shall be checked to verify compliance with the Specifications and approved Shop Drawings. The calibration of analog devices shall be verified including the zero and span.
   3. Analog wiring shall be checked for correct polarity and ground continuity at each termination point in the loop.
   4. All analog loops shall be verified at each termination point at 0%, 10%, 25%, 50%, 75%, 90% and 100% signal levels.

C. CONTRACTOR shall provide the following documentation for use during the Commissioning effort. This documentation is in addition to that included in Section 40 60 04, Process Control System General Requirements.
   1. Complete panel schematic and internal point-to-point wiring interconnect drawings as detailed in Section 40 60 04, Process Control System General Requirements.
   2. Complete electrical control schematics in accordance with NFPA 79 Standards.

3. Complete panel layout drawings as detailed in Section 40 60 04, Process Control System General Requirements.
4. Complete field wiring diagrams as detailed in Section 40 60 04, Process Control System General Requirements.
5. Complete instrument loop diagrams as detailed in Section 40 60 04, Process Control System General Requirements.
6. Completed Calibration Certificates for all field and panel devices which require adjustment or calibration.
7. CONTRACTOR shall provide one set of Commissioning documentation for the OWNER'S personnel, one set for the ENGINEER'S use, one set for field use, and the required number of sets for CONTRACTOR'S use.
8. The Drawings corrected and modified during Commissioning shall form the basis for the "As-Built" Record Drawing requirement as specified in Section 40 60 04, Process Control System General Requirements.

D. Any defects or problems found during the Commissioning effort shall be corrected by CONTRACTOR and then retested to demonstrate proper operation.

1.4 INTEGRATED SYSTEM FIELD TEST

A. Following the completion of Process Control System checkout and initial operation, the CONTRACTOR shall begin CCS software testing. CONTRACTOR, under the supervision of the Instrumentation Supplier and CCS vendor, shall remain on-site and be available during this period to correct instrumentation and control system hardware problems, if necessary. The integrated field test shall be performed to verify all equipment/instrumentation is operating properly as a fully integrated system with the CCS, and that the intended monitoring and control functions are fully implemented and operational.

B. Following software testing and demonstration of all system functions, the Process Control System including field sensors/transducers and instruments shall be running and fully operational for a continuous 48 hour period. The Operational Availability Demonstration specified below shall not begin until the continuous 48 hour integrated system test has been successfully completed and OWNER and ENGINEER agree that the Operation Availability Demonstration can begin.

C. CONTRACTOR shall provide the following documentation for use during the integrated field test effort.
1. Complete panel schematic and internal point-to-point wiring interconnect drawings as detailed in Section 40 60 04, Process Control System General Requirements.
2. Complete panel layout and electrical control schematics drawings as detailed in Section 40 60 04 Process Control System General Requirements.
3. Complete field wiring diagrams as detailed in Section 40 60 04, Process Control System General Requirements.
4. Complete instrument loop diagrams as detailed in Section 40 60 04, Process Control System General Requirements.
5. Completed Calibration Certificates for all field and panel devices which require adjustment or calibration.
6. CONTRACTOR shall provide one set of the documentation required for the integrated field test effort for the OWNER’S personnel, one set for the ENGINEER’S use, one set for field use, and the required number of sets for the CONTRACTOR’S use.
7. The drawings corrected and modified during Shop Drawing review and integrated field tests shall form the basis for the "As-Built" Record Drawing requirement as specified Section 40 60 04, Process Control System General Requirements.

D. Any defects or problems found with the instrumentation, control system hardware, control panel components/wiring and field devices during the integrated field testing effort shall be corrected by CONTRACTOR and then retested to demonstrate proper operation.

1.5 OPERATIONAL AVAILABILITY DEMONSTRATION

A. Operational Availability Demonstration (OAD) shall begin following completion of the integrated system field test as specified above and shall continue until a time frame has been achieved wherein the instrumentation and control system hardware availability meets or exceeds 99.7 percent for seven consecutive days and no system failures have occurred which result in starting the OAD over again. During the OAD the system shall be available to plant operating personnel for use in normal operation of the Plant.

B. For the purpose of the Operational Availability Demonstration, the system shall be defined as consisting of the following systems and components:
   1. PLC, OIT, and Physical Controls.

C. The conditions listed below shall constitute system failures which are considered critical to the operability and maintainability of the system. The Operational Availability Demonstration shall be terminated if one or more of these conditions occur. Following correction of the problem, a new seven consecutive day OAD shall begin.
   1. Failure to repair a hardware or software problem within 120 consecutive hours from the time of notification of a system failure.
   2. Recurrent hardware problems: If the same type of problem occurs three times or more.

D. The following conditions shall constitute a system failure in determining the system availability based on the equation specified in Paragraph 1.5.E., below
   1. Failure of PLC, OIT, or equipment fault/failed conditions.
   2. Loss of communications between devices on the communications network.
   3. Failure of one or more input/output components.
   4. Failures of any type affecting ten or more input/output points simultaneously.
   5. Failure of any type affecting one or more regulatory control loops or sequential control strategies thereby causing a loss of the automatic control of the process variable or process sequence operation.
   6. Failure of power supply. Where redundant power supplies are provided, failure of one power supply shall not constitute a system failure provided the backup power supply operates properly and maintains supply power. Failure of the backup supply to operate properly and maintain supply power shall constitute a system failure.
   7. Failure of three or more primary sensors/transducers or field instruments simultaneously.

E. The system availability shall be calculated based on the following equation:

$$A = \frac{MTBF}{MTBF + MTTR} \times 100\%$$

where, A = system availability in percent

MTBF = average time interval between consecutive system failures
MTTR = mean time required to repair system failures

F. Time between failures shall be the period between the time that a reported system failure has been corrected and the time of subsequent notification of CONTRACTOR that another system failure has occurred in terms of operating hours.

G. Time to repair shall be the period between the time that CONTRACTOR is notified of a system failure and the time that the system has been restored to proper operation in terms of hours with an allowance for the following dead times which shall not be counted as part of the time to repair period.
   1. Actual travel time for service personnel to get to the plant site up to a maximum of six hours from the time CONTRACTOR is notified of a system failure.

2. Time for receipt of spare parts to the plant site once requested up to a maximum of 24 hours. No work shall be done on the system while waiting for delivery of spare parts.
3. Dead time shall not be counted as part of the system available period. The dead time shall be logged and the duration of the OAD extended for an amount of time equal to the total dead time.

H. Completion of a 15 consecutive day period without any restarts of the OAD and with a system availability in excess of 99.7 percent will constitute acceptance of the Process Control System by OWNER. CONTRACTOR shall submit a request of acceptance after 30 consecutive day period without any restarts to the ENGINEER for approval.

I. All parts and maintenance materials required to repair the system prior to completion of the OAD shall be supplied by CONTRACTOR, at no additional cost to OWNER. If parts are obtained from the contractual spare parts inventory, they shall be replaced to provide a full complement of parts as specified.

J. A Process Control System Malfunction/Repair Reporting Form shall be completed by the OWNER and ENGINEER to document system failures, to record CONTRACTOR notification, arrival and repair times and CONTRACTOR repair actions. Format of the form shall be developed and agreed upon prior to the start of the OAD.

PART 2 - PART 2 - PRODUCTS (NOT USED)

PART 3 - PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 40 60 08
PROCESS CONTROL SYSTEM
TRAINING

PART 1 - GENERAL

1.1 REQUIREMENTS AND RESPONSIBILITIES

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform and coordinate all required training at times acceptable to OWNER and ENGINEER.

B. CONTRACTOR shall retain the services of the Instrumentation Supplier to provide operation and maintenance training for all Process Control System equipment as specified herein.

C. For equipment items not manufactured by the Instrumentation Supplier, the Instrumentation Supplier shall provide for on-site training by an authorized representative of the equipment manufacturer as part of the Instrumentation Supplier's services. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.

D. CONTRACTOR shall be responsible for all costs associated with training both on-site and at the supplier's facilities and shall provide all required materials, texts and required supplies.

E. All training shall be conducted in the normal eight hour working days until conclusion of the training course. For training at the supplier's facility, the course instructor shall be assigned full time and shall not perform other duties throughout the period of the course.

1.2 SUBMITTALS

A. CONTRACTOR shall submit his plan for training. Included in the plan shall be course outlines and schedules for training to be provided at the supplier's facilities.

1.3 TRAINING AT THE SUPPLIER'S FACILITY

A. General:
   1. CONTRACTOR shall provide an Instrumentation Supplier who shall perform standardized, structured training courses at an established training facility staffed with regular full time training instructors covering both operation and maintenance of the system equipment furnished by the Instrumentation Supplier.
   2. All training shall be scheduled so that it has been completed prior to the start of the factory testing of the system.
   3. OWNER will send the following personnel to attend training courses at the Instrumentation Supplier's facilities.
      a. Operations Training: 1 person.
      b. Maintenance Training: 1 person.

B. Operator Training Course:
   1. Provide 1 day, eight hours per day, course covering the structure and the functions of the PLC and OIT and other system components and devices. The course shall familiarize the student with the procedures for applying the system to process control problems and develop student-programming capability.
   2. As a minimum, the course shall cover the following topics:
      a. Overview of systems functional capabilities.
      b. Equipment overview including system component functions, operating principals and proper use.
      c. Loading and start-up of the digital system hardware components.

d. Use of system commands.
e. Development of programs and control schemes.
f. Development and use of system displays.
g. Programming concepts and techniques.
h. Use of bulk storage device for system backup.

C. Maintenance Training Course:
1. Provide a 1 day, eight hours per day, course covering preventive and troubleshooting maintenance for the system components. The course shall familiarize the student with diagnostic capabilities of the system, both software and hardware, and also the routine maintenance procedures on the system and the common peripheral devices.
2. As a minimum the course shall cover the following topics:
a. System overview description including the power subsystems and logic components of the processor bus.
b. Description of the maintenance and troubleshooting aids of the system including software diagnostic programs.
c. Description of all bus operations.
d. Description of peripheral and process interface devices.

1.4 ON-SITE TRAINING

A. Primary Sensors/Transducers and Field Instruments:
1. Provide on-site operation and maintenance training by Instrumentation Supplier and the equipment manufacturer representatives prior to placing the equipment in continuous operation. The services of equipment manufacturer's representatives shall be provided for a minimum of eight hours for each type of instrument provided.
2. Training shall accomplish the following:
a. Provide instruction covering use and operation of the equipment to perform the intended functions.
b. Provide instruction covering procedures for routine, preventive and troubleshooting maintenance, including equipment calibration.
c. Explain procedures for placing the equipment in and out of operation and explain necessary actions and precautions to be taken regarding the overall Process Control System.

B. Training covering the control equipment:
1. The Instrumentation Supplier shall provide 1 days of operations training covering all system components.
2. Training course shall accomplish the following:
a. Provide all instructions required to operate and utilize all system components.
b. Provide all instruction required to monitor and control the system processes from the designated control panel.
c. Explain procedures for control of the system during scheduled or rescheduled shutdown and the subsequent start-up.
d. Provide instructions for routine preventative and troubleshooting maintenance.

C. PLC Training:
1. The CCS Supplier shall provide training that covers PLC as follows:
a. Provide an overview of system hardware and software.
b. It shall train people in configuration, operation and programming PLC's.
c. The emphasis shall be placed on how to perform set point changes, minor programming changes, range changes, diagnostics and upkeep of documentation.

d. Instruction for hardware and software maintenance, troubleshooting and maintenance planning.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 40 60 51
PROCESS CONTROL SYSTEM
PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Instrumentation control loops.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 01 - General Requirements.
   2. Section 40 60 04 – Process Control System General Requirements

1.2 QUALITY ASSURANCE

A. PLC Program and SCADA Screen development shall comply with NTUA SCADA Standards.

1.3 SYSTEM DESCRIPTION

A. The control loop descriptions provide the functional requirements of the control loops represented in the Contract Documents.
   1. Descriptions are provided as follows:
      a. Control system overview and general description.
      b. Major equipment to be controlled.
      c. Major field mounted instruments (does not include local gages).
      d. Manual control functions.
      e. Automatic control functions/interlocks.
      f. Major indications provided at local control panels and motor starters/VFD's.
      g. Remote indications and alarms.

B. The control loop descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions but are rather intended to supplement and complement the Drawings and other Specification Sections.
   1. The control loop descriptions shall not be considered equal to a bill of materials.

C. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on Drawings.

1.4 SUBMITTALS

A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Control Strategy for Record Documents:
   1. Obtain this Specification Section in electronic format (Microsoft Word) from Engineer at beginning of Project.
   2. Revise and update the file monthly during construction and start-up to reflect all changes that occur due to specific equipment and systems supplied on the Project.
      a. Show all revisions in 'track change' mode.
      b. Change Specification Section Title to read "Control Loop Descriptions - Contractor Record Document."

c. Reference all changes by Request for Information (RFI) number or Change Proposal Request (CPR) number.
d. Submit revised file monthly to Engineer for review.

3. Deliver the revised and updated file as a final control loop description Record Document in the Operation and Maintenance Manual described in Specification Section 01 78 23.
4. Provide both paper copy and electronic copy of the Record Document control loop descriptions in the Operation and Maintenance Manual described in Specification Section 01 78 23.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION (CONTROL LOOPS)

3.1 GENERAL OVERVIEW

A. The Cottonwood BPS flow path includes one storage reservoir, one discharge reservoir, two VFDs, and a vendor provided pump skid.
   1. Cottonwood BPS shall pump water from the storage reservoir to the discharge reservoir. BPS shall run based on both reservoir levels.
   2. The storage reservoir level shall be continuously monitored by a single level transmitter, a level switch low and a level switch high.
   3. The discharge reservoir level shall be continuously monitored by a single level transmitter, a level switch low and a level switch high.

B. The Nazlini BPS flow path includes one storage reservoir, one discharge reservoir, two VFDs, and a vendor provided pump skid.
   1. Nazlini BPS shall pump water from the storage reservoir to the discharge reservoir. BPS shall run based on both reservoir levels.
   2. The storage reservoir level shall be continuously monitored by a single level transmitter, a level switch low and a level switch high.
   3. The discharge reservoir level shall be continuously monitored by a single level transmitter, a level switch low and a level switch high.

C. The Tolani Lakes BPS flow path includes two storage reservoirs, one discharge reservoir, three VFDs, and a vendor provided pump skid.
   1. Tolani Lakes BPS shall pump water from the two storage reservoirs to the discharge reservoir. BPS shall run based on all three reservoir levels.
   2. The storage reservoir level shall be continuously monitored by a single level transmitter, a level switch low and a level switch high.
   3. The discharge reservoir level shall be continuously monitored by a single level transmitter, a level switch low and a level switch high.

D. The Yellowhair BPS flow path includes one storage reservoir, one discharge reservoir, two VFDs, and a vendor provided pump skid.
   1. Yellowhair BPS shall pump water from the storage reservoir to the discharge reservoir. BPS shall run based on both reservoir levels.
   2. The storage reservoir level shall be continuously monitored by a single level transmitter, a level switch low and a level switch high.
   3. The discharge reservoir level shall be continuously monitored by a single level transmitter, a level switch low and a level switch high.

3.2 BOOSTER PUMP (TYPICAL)

A. Each Booster Pump shall be equipped With a Hand-Off-Auto selector switch at the starter and an Auto/Manual selector switch at the SCADA HMI and OIT. These two selectors shall determine the pump mode of operation.

B. Local Manual Control Mode: when the Hand-Off-Auto selector switch is in the hand position the motor shall start and run continuously or shall run via local start and stop pushbuttons where equipped. The PLC shall not be able to control the motor.

C. Remote Manual Control Mode: when the Hand-Off-Auto selector switch is in the auto position an operator may place the motor into remote manual mode from the SCADA HMI or OIT. When in remote manual mode the operator may start and stop the motor from the SCADA HMI or OIT.

D. Remote Automatic Control Mode: when the Hand-Off-Auto selector switch is in the auto position an operator may place the motor into remote automatic mode from SCADA HMI or OIT. When in remote automatic mode the motor shall run via the booster station loop description.

E. PLC program shall allow for bump-less transfer from remote manual to remote auto modes and vice versa.

F. Where the motor is in remote mode and called to run either manually or automatically but does not report a running status back to the PLC. A fail to run alarm shall be generated.

G. The PLC shall automatically log pump running hours.

H. Status Display:
   1. Booster Pump Running Status
   2. Booster Pump Local Status
   3. Booster Pump Remote Status
   4. Booster Pump Remote Manual Status
   5. Booster Pump Remote Automatic Status
   6. Booster Pump Speed
   7. Run Time Hours

I. Alarms:
   1. Booster Pump VFD Fault Alarm
   2. Booster Pump High Discharge Pressure Alarm

J. OIT/SCADA Controls:
   1. Booster Pump Remote Manual/Automatic Select
   2. Booster Pump Remote Manual Start
   3. Booster Pump Remote Manual Stop
   4. Booster Pump Remote Manual Speed Command (30-100%)
   5. Alarm Reset

K. Equipment Ranges

Setpoint	Range	Starting Value
Booster Start Level (Discharge Reservoir(s))	0-XXft	xxft
Booster Stop Level (Storage Reservoir(s))	0-XXft	xxft
Booster Stop Level (Discharge Reservoir(s))	0-XXft	xxft

L. Interlocks:

Interlock	Loop #	Response	Local / PLC
VFD Fault	YA-110 YA-120 YA-130	Shut Down Booster Pumps	Local

Communication Fault	XXX-XXX	Shut Down Booster Pumps after 300 sec	Local
Discharge High Pressure Alarm	PAH-110 PAH-120 PAH-130	Shut Down Booster Pumps	Local
Discharge Reservoir Level Switch High Alarm	LSH-202	Shut Down Booster Pumps	PLC
Storage Reservoir Level Switch Low Alarm	LSL-101 or LSL-101A	Shut Down Booster Pumps	PLC
Low Suction Pressure Cutoff	PIT-105	Shut Down Booster Pumps	PLC

3.3 RESERVOIR LEVEL – (TYPICAL)

A. The reservoir level transmitter tracks and reports the water level in the reservoir.

B. Status Display:
   1. Reservoir Level (LIT-100)

C. Alarms:
   1. Reservoir High Level Alarm
   2. Reservoir Low Level Alarm

D. OIT/SCADA Controls: N/A

E. Equipment Set Points / Ranges

Setpoint	Range	Starting Value
Reservoir High-Level Warning	0-xxft	xxft
Reservoir Low-Level Warning	0-xxft	xxft

F. Interlocks: N/A

3.4 FLOW METER (TYPICAL)

A. Flow rate shall be continuously monitored. The flow total shall be displayed on the SCADA HMI and OIT. The flow total can be reset from the SCADA HMI and OIT.

B. Display Status:
   1. Flow Rate
   2. Flow Total

C. Alarm: N/A

D. OIT/SCADA HMI Controls:
   1. Flow Total Reset

E. Equipment Set Points / Ranges: 0-XXXXgpm

F. Interlocks: N/A

3.5 BOOSTER STATION

A. Overview:
   1. Each booster station is equipped with up to three (3) pumps which are each equipped with VFD's and shall pump water from the storage reservoir into the discharge reservoir. The pumps shall operate in a lead, lag-1, and lag-2 configuration. The booster pumps shall be automatically controlled by the PLC based on discharge reservoir level.
   2. Booster pumps BP-110, BP-120, and BP-130 shall each be assigned a starting order referred to as Lead, Lag-1, or Lag-2. The pump starting order can be assigned by the operator from SCADA or from the OIT. Additionally, at the end of each running cycle where all available pumps are off and ready, the pump shall rotate status to allow for even run time. Only one pump will be permitted to be assigned to any given start order.
   3. Booster Pumps shall only be assigned a starting order when the Hand-Off-Auto selector switch is in auto and when the automatic/manual selection utility is set to automatic in SCADA.
   4. The pump station shall automatically start and stop pumps to meet water demand by maintaining discharge reservoir level. If discharge reservoir level falls below the user designated setpoint pumps shall be added (started) and as discharge reservoir water level increases pumps shall be removed (shutdown). The pump start order shall be lead, lag-1, and lag-2. Pumps shall stop in the reverse order from which they start.

B. Lead Pump Start:
   1. When the station discharge reservoir water level falls below the user designated setpoint +deadband and the start delay timer expires, the lead pump shall be called to start.
   2. Upon starting the lead pump speed shall be varied to maintain the system discharge pressure using a PID feedback loop.

C. Adding Lag Pump(s):
   1. Where the running pump(s) are at full speed and discharge pressure +deadband cannot be maintained and the start delay timer has expired. Start the next lag pump.
   2. Adjust the pump speeds in unison to maintain system discharge pressure using a PID feedback loop.
   3. Repeat these steps to add additional lag pumps as needed.

D. Removing Lag Pump(s):
   1. Where the running pump(s) are at minimum speed and discharge pressure is being maintained +deadband and the stop delay timer has expired. Stop the last lag pump to start.
   2. Adjust the pump speeds in unison to maintain system discharge pressure using a PID feedback loop.
   3. Repeat these steps to remove additional lag pumps as needed.

E. Stopping Lead Pump:
   1. With all lag pumps stopped and the lead pump is at minimum speed and discharge pressure is being maintained +deadband and the stop delay timer has expired. Stop the lead pump.

F. Status Display:
   1. Discharge Pressure
   2. Lead Booster Pump Assignment
   3. Lag-1 Booster Pump Assignment
   4. Lag-2 Booster Pump Assignment

G. Alarms:
   1. Hi Hi Discharge Pressure Alarm
   2. Lo Lo Discharge Pressure Alarm

H. OIT/SCADA Controls:
   1. Lead Booster Pump Assignment
   2. Lag-1 Booster Pump Assignment

3. Lag-2 Booster Pump Assignment

I. Equipment Set Points / Ranges

Setpoint	Range	Starting Value
Station Pressure Setpoint	0-xxx PSI	xxx PSI
Station Pressure Deadband Setpoint	0-xxx PSI	xx PSI
Add Pump Delay Timer Setpoint	0-600 sec	60 sec
Remove Pump Delay Timer Setpoint	0-600 sec	60 sec
Hi Hi Discharge Pressure Alarm	0-600 sec	15 sec
Lo Lo discharge Pressure Alarm	0-600 sec	15 sec

J. Interlocks: N/A

END OF SECTION

SECTION 40 60 52
PROCESS CONTROL SYSTEM
PRIMARY SENSORS AND FIELD INSTRUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust, commission and place into satisfactory operation all primary sensors and field instruments furnished under this Section.
   2. Contract Documents illustrate and specify functional and general construction requirements of the sensors and field instruments and do not necessarily show or specify all components, wiring, piping and accessories required to make a completely integrated system. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
   3. CONTRACTOR shall be responsible for installing in-line flow elements (magmeter flow tubes, insert flow tubes, propeller flow meters) and for providing taps in the process piping systems for installation of other flow, pressure and temperature sensing instrumentation.

B. Coordination: Coordinate the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

C. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.
   1. Section 40 60 04, Process Control System General Requirements for Process Instrumentation.
   2. Section 40 60 06, Computer Control System Factory Testing.
   3. Section 40 60 07, Process Control System Start-up, Commissioning and Field Testing.
   4. Section 40 60 08, Process Control System Training.

1.2 QUALITY ASSURANCE

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.

B. Acceptable Manufacturers:
   1. Furnish primary sensors and field instruments by the named manufacturers.
   2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.
   3. Obtain all sensors and field instruments of a given type from the same manufacturer.
   4. The primary sensors and field devices shall be interchangeable with similar function existing primary sensors and field devices to minimize spare parts inventory.

C. Manufacturers' Responsibilities and Services:
   1. Design and manufacture the primary sensors and field instruments in accordance with the applicable general design requirements specified in Section 40 60 04, Process Control System General Requirements, and the detailed Specifications herein.
   2. Field supervision, inspection, start-up and training in accordance with the requirements of Section 40 60 07, Process Control System Start-up, Commissioning and Field Testing, and Section 40 60 08, Process Control System Training.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 40 60 04, Process Control System General Requirements.

B. Primary sensors and field instruments shall not be delivered to the site until all product information and Shop Drawings for the sensors and instruments have been approved by ENGINEER.

1.4 SUBMITTALS

A. Comply with the requirements specified in Section 40 60 04, Process Control System General Requirements.

1.5 MATERIALS OF CONSTRUCTION FOR WETTABLE PARTS

A. Provide the following materials of construction for primary sensors and field instrument (wetted) parts that come in contact with the following list of process fluids:

PROCESS FLUID	ELASTOMER	METAL	PLASTIC	OTHER
Air		Type 316 SS	Teflon	
Chemical Sump Drainage			Teflon Polypropylene	
Chlorine Gas		Hastelloy C, Monel, or Tantalum		
Glycerine Oil	Neoprene Viton Buna-N	Type 316 SS	Teflon Polypropylene PVC/CPVC	
Potable Water	Neoprene	Type 316 SS	Teflon	Ceramic
Silicone Oil	Viton Buna-N	Type 316 SS	Teflon Polypropylene	

1.6 IDENTIFICATION TAGS

A. All sensors and field instruments shall have an identification tag conforming to the following requirements:
   1. Tag numbers for sensors and field instruments shall be as listed on the Drawings and Instrument Index.
   2. Equipment tags shall be 2 inch square. The tags shall be constructed of aluminum, coated with black enamel paint. Each tag shall be engraved with the equipment identification (serialized key - 7 digit number as shown on drawings) and service description. Engraving letters shall be 1/4-inch Arial max. The tags shall be as manufactured by Brady, Model B-906, Catalog Number 87637.
   3. Instrument identification tags shall be green, 1-1/2-inch round, aluminum tags. The tags shall be engraved with the instrument loop number. Engraving letters shall be 1/4-inch Arial max. The tags shall be as manufactured by Brady, Catalog Number 49903.

4. Each tag shall be attached with fasteners of nylon-coated 48 mil stainless steel wire, Brady Catalog Number 38091, and double ferrule design brass wire clamps, Brady Catalog Number 38090, to secure the stainless steel wire.
5. All sensors and field instruments mounted on or within panels shall have the aluminum identification tag installed so that the numbers are easily visible to service personnel.

PART 2 - PRODUCTS

2.1 PROCESS TAPS, SENSING LINES AND ACCESSORIES

A. Pressure Sensing Lines and Accessories:
   1. For Process Sensing Taps in Ductile Iron, Steel and Stainless Steel Piping Systems:
      a. Material and Fittings: Type 316 stainless steel pipe (ASTM A 312) and threaded fittings and adapters (ASTM A 403) in accordance with Section 15103, Stainless Steel Pipe.
      b. Sizes: 1/2-inch minimum for main sensing piping and 1/4-inch gage and switch connections or as shown on the Drawings.
      c. Pressure Rating: Equal to or greater than the applicable system test.
   2. Shut-off Valves:
      a. Type: Full port ball.
      b. Pressure Rating: 250 psi.
      c. Body, Ball and Stem: Type 316 stainless steel.
      d. Packing: High Density TFE.
      e. Handle: Nylon with metal travel stops.
      f. Support Rings: Stainless steel.
      g. End Connections: Removable "Swageloks".
      h. Product and Manufacturer: Provide one of the following:
         1) 45 Series, as manufactured by Whitey.
   3. Manifolds:
      a. Type: Five valve and three valve meter manifolds.
      b. Materials: Type 316 stainless steel body, bonnets and stems, delrin seats, teflon packing.
      c. Product and Manufacturer: Provide one of the following:
         1) Whitey.
         2) Anderson-Greenwood

2.2 LEVEL TRANSMITTER – HYDROSTATIC

A. Type: Resonant wire or differential capacitance type liquid level (differential pressure) transmitter for measurement of tank levels. For non-pressurized tanks.

B. Required Features and Accessories:
   1. Transmitter Accuracy (includes linearity, repeatability and hysteresis): ±0.2 percent of calibrated span.
   2. Linearity: ±0.1 percent of calibrated span, typical.
   3. Repeatability: 0.075 percent of calibrated span, typical.
   4. Hysteresis: 0.075 percent of calibrated span, typical.
   5. Stability over 5 Year Period: ±0.125 percent of maximum span, or better.
   6. Power Supply Effect: Output change of less than .005 percent of calibrated output span per 1-volt change in supply voltage.
   7. Combined Process and Ambient Temperature Effect: Less than 8-inches water change per 100°F average (combined) temperature change, plus 2.5-inches water per additional five feet of capillary when used with DC 200 silicone fill.
   8. Output: 4 to 20 mA proportional to hydrostatic level.
   9. Solid state electronic components.
   10. Transmitter Sensor Wetted Parts:

a. Sensor Body and Bolting Materials: Type 316 stainless steel.
b. O-rings Seals: Viton.

11. Transmitter Electronics Housing: NEMA 4X rated and Buna-N O-ring sealed threaded cover constructed of die-cast, low-copper aluminum finished with an epoxy paint system.
12. Local Indicator: Provide integral 3-1/2 digit LCD output meter calibrated range value in engineering units.
13. Electrical Conduit Connection: 1/2-inch NPT.
14. Process Connections: 1/2-inch NPT.
15. Designed to operate on 4-20mA loop power..

C. Product and Manufacturer: Provide the following:
1. Endress+Hauser; Deltapilot FMB70
2. No Equal

2.3 MAGNETIC FLOWTUBE AND TRANSMITTER

A. Functions:
1. Flowtube: Produce low level, high impedance pulsed DC signal proportional to the rate of fluid flow using the principle of electromagnetic induction.
2. Pulsed DC Magnetic Flow Transmitter: Drive the flowtube coils with pulsed DC power and convert the flowtube output signal into a DC current output linear to the flow rate.

B. System (Flowtube and Transmitter) Performance Requirements:
1. System Accuracy (with Analog Output): ±0.5 percent of flow rate or better over range from 1 fps to 31 fps; ±.005 fps or better at flows below 1 fps flow range.
2. System Repeatability: ±0.15 percent of flow rate or ±.0015 fps, whichever is greater.
3. Drift: Complete zero stability.
4. Minimum Fluid Conductivity Limit: Five microsiemens per centimeter or less.
5. Minimum Pre-amp Input Impedance: 10^{12} ohms.
6. Fluid Property Effects: Accuracy unaffected by changes in fluid velocity, density, pressure, temperature or conductivity (above minimum conductivity limits).
7. Transmitter Outputs:
a. 4 to 20 mADC, direct acting and isolated, into 0 to 1000 ohms.
b. High accuracy, field adjustable scaled pulse output (0.1 to 10 Hz or greater) to drive local totalizer and provide scaled pulse output to Process Control System.
8. Power Consumption: Not to exceed 50 watts for flowtube and transmitter combined.
9. Operating Temperature: Suitable for operation with process fluid temperature from 0 to 140°F.
10. Pressure Rating: Greater than or equal to test pressure specified in Section 15050, Piping Systems, for appropriate piping system.

C. Construction and Required Features:
1. Flowtube:
a. Type: Lined metal flowtubes.
b. Interchangeability: Ratio of flow velocity to voltage reference signals generated identical for all meter sizes to permit interchangeability with transmitter without requiring circuit modifications.
c. Tube Material:
1) Meter tubes Type 304 stainless steel.
d. Electrodes:
1) Conical or elliptical shaped.
2) Material: Type 316 stainless steel.
e. Lining: PTFE, -4 to 194 deg F
f. Enclosure:
1) Materials and Rating: Cast low-copper aluminum alloy or fabricated sheet steel, NEMA 6 rated and capable of withstanding accidental submergence in 30 feet of water for 48 hours.
2) Finish: Finish exterior, except for flange faces, with a high build epoxy paint.

g. End Connections: ANSI Class 150 suitable for mating with pipe specified.
h. Electrical Connections: 3/4-inch NPT tapped holes for power conduit fitting and signal conduit fittings.

2. Pulsed DC Magnetic Flow Transmitter:
   a. Solid state construction.
   b. Pulse and analog outputs galvanically isolated from input and earth ground.
   c. Low Flow Cutoff: Provide automatic low flow cutoff circuitry to stop pulse output and local totalization when flow drops below 0.5 percent ±0.2 percent of the calibrated upper range valve.
   d. Enclosure:
      1) Die cast, low-copper aluminum alloy, NEMA 4.
      2) Finish: Epoxy coating.
   e. Mounting:
      1) Transmitter shall be remotely mounted from the flow tubes at locations shown on the Drawings.
      2) Provide complete Type 316 stainless steel mounting hardware.
      3) Type of mounting (wall, support frame or pipe stand), as required.
   f. Local Indication:
      1) LCD meter with field selectable engineering units: The engineering units shall be as specified indicated on the drawings.
      2) 7-digit electromechanical totalizer or 8 digit electronic LCD totalizer with reset and lithium battery backup. Totalizer shall be integral with transmitter and visible through viewing window, or shall be externally mounted in a separate NEMA 4X enclosure or condulet with viewing window and installed adjacent to the transmitter.
   g. Power Requirements: Designed for operation on 24VDC
   h. Communications: Ethernet/IP
3. Accessories:
   a. Shielded cable assemblies of sufficient length for connection between flowtube and transmitter electronics.
   b. Type 316 stainless steel grounding rings for flowtubes.
   c. Type 316 stainless steel grounding straps.
   d. Provide spool piece for replacement of each different size flow tube where no bypass piping is provided.
   e. Provide one calibrator suitable to calibrate all flow tubes provided.

D. Product and Manufacturer: Provide one of the following:
   1. Endress+Hauser; Promag W 400
   2. No Equal

2.4 PRESSURE TRANSMITTER

A. Type: Two-wire, differential capacitance or resonant type transmitter.

B. Required Features and Accessories:
   1. Accuracy (includes combined effects of linearity, hysteresis and repeatability): ±0.075 percent of calibrated span..
   2. Stability (drift over a six month period): Not more than ±0.25 percent of transmitter upper range limit.
   3. Ambient Temperature Effect: Total Error per 100°F change between the limits of -20°F and +180°F: Not more than ±1.0 percent of the transmitter upper range limit (maximum span).
   4. Supply Voltage Effect: Output change not greater than 0.005 percent of span for each one-volt change in supply voltage.
   5. Output:
      a. Isolated direct acting 4 to 20 mADC.
   6. Solid state electronic components.
   7. Positive overrange protection of at least 1.25 times the maximum span limit.

8. Calibration Adjustments:
    a. Zero: Adjustable in electronics compartment.
    b. Span: Coarse and fine span adjustments in electronics compartment.
9. Zero elevation and suppression capability to the extent that the amount of suppression plus calibrated span does not exceed the upper range limits of the sensor.
10. Adjustable internal damping.
11. Measuring elements protected by sealing diaphragm.
12. Built-in electrical surge and RFI protection.
13. Electric Conduit Connection: 1/2-inch NPT.
14. Process Connections: 1/2-inch NPT.
15. Designated to operate on power from receiver or remote power supply, nominal 24 VDC.
16. Type 316 stainless steel mounting bracket and hardware suitable for mounting transmitter on flat vertical surface or 2-inch diameter pipe.
17. Process Wetted Parts: Type 316 stainless steel.
18. Non-Wetted Parts:
    a. Body and Process Connection Bolting: Type 316 stainless steel.
    b. Housing and Cover: Die cast low copper aluminum alloy finished with epoxy paint system; covers shall be threaded and seated on Buna-N O-rings; NEMA 4 rating.
    c. Capsule Fill Liquid: Silicone oil.
19. Indicator: Provide integral indicator in engineering units.

C. Product and Manufacturers: Provide one of the following:
1. Endress+Hauser; Cerabar PMP71
2. No Equal

2.5 PRESSURE SWITCH

A. Type: Switch assembly with diaphragm piston actuator for sensing gage.

B. Performance Specifications:
1. Adjustable Operating Range: 0-100psig.
2. Setpoint Accuracy: ± One percent of span.
3. Actuating Setpoint: 78psi.
4. Adjustable Deadband Range and Setting:
    a. Maximum full scale, minimum seven percent of full scale.
    b. Required Deadband Setting: 2psi.
5. Switch: Snap action, SPDT rated not less than five amp resistive at 120 VAC and 1/2 amp resistive at 125 VDC. Provide DPDT contacts and other optional switch configurations when so required.
6. Switch and Reset (Deadband) Action: Adjustable, Fixed, Manual Reset or Two Stage type.

C. Construction Features:
1. Set and Reset Point Adjustments: Adjustable external adjusting nuts and pressure setting scales.
2. Process Connection: 1/4-inch NPT.
3. Housing: Copper-free die cast aluminum, NEMA 4; NEMA 7 construction required for hazardous areas.
4. External Mounting Lugs.
5. Adjusting Nuts Metal Cover with Gasket on NEMA 4 and NEMA 7 rated units.
6. Electrical Connection: 3/4-inch NPT.
7. Provide diaphragm seal.

D. Product Manufacturer: Provide pressure switch of one of the following:
1. Ashcroft; B-Series Type 400
2. Approved Equal

2.6 PRESSURE GAUGE

A. Bourdon Tube Pressure Element Type, Liquid Filled Gage (for pressure ranges of 15 psi and greater and vacuum ranges to 30-inches Hg):
   1. Performance Requirements:
      a. Accuracy: ±0.5 percent of span (ANSI B40.1 Grade 2A).
   2. Construction Features:
      a. Case:
         1) Solid front design constructed of glass filled polyester.
         2) Color: Black.
      b. Ring: Threaded, glass filled polyester.
      c. Full blowout back.
      d. Window: Glass.
      e. Dial: White with black marking; 270-degree scale.
      Bourdon Tube and Socket: Type

2.7 ANTENNA - YAGI

A. General: The device shall be capable of communicating on the 890-960 MHZ band.

B. Type: Broadband yagi antenna.

C. Required Features:
   1. Can communicate on the 890-960 MHZ band.
   2. High impact, stainless steel material.
   3. Not sensitive to wind.
   4. Operating Temperature: Up to 140°F.
   5. Provide cable weight or mounting bracket to suit installation.

D. Product and Manufacturer: Provide the following:
   1. SCALA, Model TY-900.

2.8 RADIO – 900MHZ

E. General: The device shall be capable of communicating on the 900 MHZ band.

F. Type: Long range.

G. Required Features:
   1. Capable of connecting to yagi antenna.
   2. Serial connections for RTU/PLC.
   3. Rugged industrial housing.
   4. Not sensitive to rotation.
   5. Operating Temperature: Up to 140°F.
   6. Provide cable weight or mounting bracket to suit installation.

H. Product and Manufacturer: Provide the following:

1. GE Vernova, Model SD9.

2.9 LEVEL SWITCH - FLOAT TYPE

I. General: The device shall be capable of detecting fluid level and initiating a signal.

J. Type: Direct acting float.

K. Required Features:

1. Sealed SPDT control switch (non-mercury).
2. Actuation by steel ball.
3. High impact, corrosion resistant, polypropylene float material.
4. Heavy duty, flexible 18 gauge, three connector, neoprene-jacketed cable with waterproof connection. Cable length, as required.
5. Not sensitive to rotation.
6. Operating Temperature: Up to 140°F.
7. Provide cable weight or mounting bracket to suit installation.

L. Product and Manufacturer: Provide the following:

1. Flygt, Model ENM-10.

2.10 SPARE PARTS AND TEST EQUIPMENT

A. CONTRACTOR shall furnish and deliver the spare parts and test equipment as outlined below, all of which shall be identical and interchangeable with similar parts furnished under this Section.

B. Spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. The following shall constitute the minimum spare parts: Ten (10) spare fuse of every type and trip rating used.

D. All spare parts shall have been operated and tested in the factory as part of factory testing prior to shipment of the control system.

E. For process sensors and all other analog instruments, the supplier shall submit a separate quotation for a recommended list of spare parts and test equipment. Each item recommended shall be listed and priced separately. The spare parts quotation shall contain a statement that the prices quoted are firm for a period of one year from the installation date of the equipment, and that the supplier understand that the OWNER reserves the right to purchase none, any, or all of the parts quoted. The supplier is required to show that a stock of spare parts and test equipment is obtainable within a 48-hour period.

PART 3 - EXECUTION

3.1 INSTALLATION

A. CONTRACTOR shall require the integrator to furnish the services of qualified factory-trained servicemen to assist in the installation of the instrumentation and control system equipment.

B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Transmitters and instruments that require access for periodic calibration or maintenance shall be mounted so they are accessible while standing on the floor.

C. All items shall be mounted and anchored using Type 316 stainless steel hardware, unless otherwise noted.

D. All field instruments shall be rigidly secured to walls, stands or brackets, as required, by the manufacturer and as shown on the Drawings. Mounting instruments on handrails will not be allowed.

E. Conform to all applicable provisions of the NEMA standards, NEC and local, state and federal codes when installing the equipment and interconnecting wiring.

3.2 START-UP, CALIBRATION, AND TESTING AND TRAINING

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.

+ + END OF SECTION + +

SECTION 40 60 65
PROCESS CONTROL SYSTEM
PANELS AND ENCLOSURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish, install, calibrate, test, start-up, commission and place into satisfactory operation all control panels, intermediate termination panels and/or enclosures.

B. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.
   1. Division 26, Electrical
   2. Section 40 60 04 Process Control System General Requirements.
   3. Section 40 60 06, Computer Control System Factory Testing.
   4. Section 40 60 66, Process Control System Panel Instruments and Devices.

1.2 QUALITY ASSURANCE

A. Reference Standards: Construction of panels and the installation and interconnection of all equipment and devices mounted within shall comply with applicable provisions of the following, except where otherwise shown or specified.
   1. National Fire Protection Association 79, Annex "D" Standards.
   2. National Electrical Code (NEC).
   3. National Electrical Manufacturer's Association Standards (NEMA).
   4. American Society for Testing and Materials (ASTM).
   5. Operational Safety and Health Administration (OSHA) Regulations.
   6. State and local code requirements.
   7. Where any conflict arises between codes or standards, the more stringent requirement shall apply.
   8. All electrical materials and equipment shall be new and shall bear the label of the Underwriters' Laboratory (UL), Inc., Factory Mutual (FM) or equivalent where standards have been established and label service regularly applies.

B. General Design Requirements:
   1. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.
   2. Comply with the control descriptions of Section 40 60 51, Computer Control System Process Control Descriptions.

C. Factory Assembly and Testing:
   1. Comply with the requirements of Section 40 60 06, Computer Control System Factory Testing.

1.3 SUBMITTALS

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION REQUIREMENTS

A. Provide all electrical and/or pneumatic components and devices, support hardware, fasteners, interconnecting wiring and/or piping required to make the control panels and/or enclosures complete and operational.

B. Locate and install all devices and components so that connections can be easily made and that there is ample room for servicing each item.

C. Components for installation on panel exterior shall be located generally as shown on the Drawings. Layouts shall be submitted for approval in accordance with the requirements of Section 40 60 04, Process Control System General Requirements.

D. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.

E. Provide sub-panels for installation of all relays and other internally mounted components.

F. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master numbered terminal strips, unless otherwise specified.

G. Provide copper grounding studs for all panel equipment and panel doors.

H. Provide the following convenience accessories inside of each control panel:
   1. One 120 VAC, 20A GFCI type receptacle.
   2. One or more 120 VAC fluorescent light fixtures with 40-watt lamp and protective plastic shield to span across the width of the panel (but not less than two-thirds).
   3. One 120 VAC, 20A, snap switch, to turn on the light, mounted in an outlet box with a cover and located so that it is easily accessible from access door.
   4. Service light and receptacle shall have an internal circuit breaker and a separate power feed.

I. The bottom 12-inches of free-standing panels shall be free of all devices, including terminal strips, to provide ease of installation and testing.

J. No device on the front shall be mounted less than 36-inches above the operating floor level, unless otherwise specified.

2.2 IDENTIFICATION

A. Provide laminated plastic nameplates for identification of panels and components mounted thereon.

B. Tag all internally mounted instruments in accordance with the following requirements:
   1. Tag numbers shall be as listed in the Instrument Index or as shown on the Drawings.
   2. The Identification Tag number and services description shall be provided on a permanent sticker which shall be placed on the panel interior above the devices.
   3. The Identification Tag shall be installed so that the numbers are easily visible to services personnel.

C. Tagging of the following items shall be accomplished with the use of adhesive plastic Brady USA, Inc. labels, or equal.
   1. Tag all electrical devices (e.g., relays, timers, power supplies) mounted within control panels and enclosures.
   2. Tag all pneumatic lines.

3. Numerically tag all terminal blocks.
4. Color code and numerically tag wiring at each end.

D. Numerically code terminals on terminal strips using a Brady LS2000 Labeling System, or equal.

E. Color code and/or numerically code wiring as required by applicable standards. Wires shall be identified at each end with permanent number codes using a Brady LS2000 Labeling System, or equal.

2.3 PANELS AND ENCLOSURES

A. General:
1. Panels and enclosures shall meet the NEMA requirements for the type specified.
2. Sizes shown are estimates. CONTRACTOR shall furnish panels and enclosures amply sized to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring, tubing and other components installed within.

B. Construction Features:
1. Control panels located inside control or electrical room areas shall be NEMA 12 rated.
   a. Fabricate enclosures using minimum 14 gage steel for wall or frame mounted enclosures and minimum 12 gage for free standing enclosures. Steel shall be free of pitting and surface blemishes.
   b. Continuously weld all exterior seams and grind smooth. Also, surface grind complete removal of corrosion, burrs, sharp edges and mill scale.
   c. Reinforce sheet steel with steel angles where necessary to adequately support equipment and ensure rigidity and to preclude resonant vibrations.
   d. Panel shall be flat within 1/16-inch over a 24-inch by 24-inch area, or flat within 1/8-inch for a larger surface. Flatness shall be checked by using a 72-inch-long straight edge. Out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections.
   e. Use pan type construction for doors. Door widths shall not exceed 36-inches.
   f. Mount doors with full length heavy duty piano hinge with stainless steel hinge pins.
   g. Provide oil resistant gasket completely around each door or opening.
   h. Provide handle-operated, oil-tight, key-lockable three-point stainless steel latching system with rollers on latch-rods for easy door closing.
   i. Use stainless steel fasteners throughout.
   j. Provide interior mounting panels and shelves constructed of minimum 12 gage steel.
   k. Provide steel print pocket with white enamel finish.
   l. Provide enclosure mounting supports as required for floor, frame, or wall mounting.
   m. Provide all holes and cutouts for installation of conduit and equipment, prior to installation. Cable and piping to enter the enclosure through the bottom, unless otherwise noted. All conduit and piping openings and all conduits shall be sealed watertight.
   n. Completely clean all interior and exterior surfaces so they are free of corrosive residue, oil, grease and dirt. Zinc phosphatize for corrosion protection.
   o. One coat of primer shall be applied to all interior and exterior surfaces immediately after corrosion protection has been applied. Exterior surfaces shall then be given sufficient coats of primer surfacer, applied with sanding and cleaning between coats, until a Grade 1 finish can be produced on the finish coat.
   p. All interior surfaces shall be painted with two coats of semi-gloss white polyurethane enamel.
   q. All exterior surfaces shall be painted with a minimum of three finish coats of polyurethane enamel to ultimately produce a Grade 1 finish (super smooth; completely free of imperfections). Color to be selected by ENGINEER from complete selection of standard and custom color charts furnished by the manufacturer. Provide one extra quart of touch-up paint for each exterior finish color.

r. Primer and finish paint shall be compatible and shall be a low VOC, high solids polyurethane enamel, Hi-Solids Polyurethane B65 W300 Series as manufactured by Sherwin-Williams, Inc. or equal.

2. Control panels located in the field shall be NEMA 4X rated. Panels shall be either metallic or non-metallic, as shown on the Drawings.
3. Non-metallic Panels:
   a. Panels shall be constructed of polycarbonate or ABS, with a minimum thickness of 3/16-inch for all surfaces, except those areas requiring reinforcement.
   b. Panels shall be precision molded to form a one-pieced unit with all corners rounded.
   c. Exterior surfaces shall be gel-coated to provide a corrosion-resistant, maintenance-free satin finish that shall never require painting.
   d. Color pigments shall be molded into the resin.
   e. Color to be selected from color charts furnished by CONTRACTOR.
   f. Provide a clear plastic, gasketed, hinged door to encompass all non-NEMA 4 front of panel instruments.
   g. All hardware, including hinge and means of locking shall be corrosion resistant.
4. Metallic Panels:
   a. Panels shall be Type 316 stainless steel construction with a minimum thickness of 12 gage for all surfaces (except those areas requiring reinforcement) having a smooth brushed finish.
   b. Stainless steel fast-operating clamp assemblies on three sides of each door.
   c. Rolled lip around three sides of door and along top of enclosure opening.
   d. Hasp and staple for padlocking.
   e. Provide a clear plastic, gasketed lockable hinged door to encompass all non-NEMA 4 front of panel instruments.
   f. Provide 3-inch-high channel base assembly, with solid bottom, drilled to mate the panel to its floor pad for free-standing panel.
   g. Provide 5/16-inch diameter copper ground studs that shall be the ground connection points for all panel equipment and panel doors.
   h. Floor Pad: Refer to Part 3 of this Section.
5. Field Panels (NEMA 7):
6. General: Explosion-proof control enclosures shall be used to house monitoring and measuring devices in hazardous environments. Enclosures shall be suitable for use in NEC Class 1, Groups C&D or Class II, Groups E, F & G applications and comply with UL and CSA standards.
7. Required Features:
   a. Light weight and corrosion resistant copper-free aluminum.
   b. Integral, cast-on mounting lugs.
   c. Left side door hinges.
   d. Viewing windows sized to suit internally mounted components.
   e. Stainless steel cover bolts.
   f. Cad-plated steel mounting pans.
8. Product and Manufacturer: Provide one of the following:
   a. Adalet.
   b. Killark.
   c. Crouse-Hinds.
9. Where the application applies and with the approval of ENGINEER, wall mounted enclosures may be provided. The enclosure shall comply with Paragraphs 2.3.B.1., 2.3.B.2. or 2.3.B.3., except for the following:
   a. Locations shall be as shown on the Drawings or as specified under other Sections.
   b. Doors shall be full height.
   c. No extra holes or knockouts shall be provided. No light or convenience outlet need be provided.

C. Electrical Systems:
   1. Control of Environment:

2. Outdoor Panels:
    a. Provide adequately sized automatically controlled 120 VAC heaters, as manufactured by Hoffman, or equal, to maintain temperature inside each enclosure above 40°F to a maximum of 80°F when the outside temperature is 0°F through 40°F.
    b. Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers, if required, to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure, as shown on the Drawings. Housing shall be constructed of corrosion resistant materials. Air conditioners shall be provided with a separate circuit and drain line.
    c. Provide calculations for cooling and heating load requirements.
    d. Provide thermostats to automatically control heating and cooling requirements without need of manual operation of a heating/cooling transfer switch.
    e. Heating and coiling elements including external housing that are in contact with Plant's ambient environment shall be Heresite coated, or equal, for protection from hydrogen sulfide corrosion with hydrogen sulfide levels up to seven ppm.
3. Indoor Panels:
    a. Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louver, if required, to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure, as shown on the Drawings. Air conditioners shall be provided with a separate circuit and drain line.
    b. Provide calculations for cooling and heating load requirements.
    c. Provide thermostats to automatically control heating and cooling requirements without need of manual operation of a heating/cooling transfer switch.
    d. Heating and coiling elements including external housing that are in contact with Plant's ambient environment shall be Heresite coated, or equal, for protection from hydrogen sulfide corrosion with hydrogen sulfide levels up to seven ppm.
4. Power Source and Internal Power Distribution:
    a. General: Control panel power supply source, type, voltage, number of circuits and circuit ratings shall be as shown on the Drawings.
    b. Panels shall be provided with an internal 120 VAC with number of circuits and separate circuit breakers sized as required to distribute power to the panel components.
    c. Circuit breakers shall be 120volt and 240 Volt AC, DIN rail mounted, UL listed and provided with end caps, marking strips, insulated side jumpers and other accessories. Manufacturer shall be Phoenix Contact or Allen-Bradley.
    d. Provide an auxiliary contact to provide a "Power Fail" status to the CCS whenever any one of the circuit breakers are open as shown on the Drawings.
5. Wiring:
    a. Internal wiring shall be Type MTW stranded copper wire with thermo-plastic insulation rated for 600 V at 90°C for single conductors, color coded, conforming to the requirements of NFPA 79and Specification 01420, and labeled with wire identification.
    b. For DC panel signal wiring, use No. 16 minimum AWG shielded.
    c. For AC power wiring, use No. 14 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 amps, use sizes required by NEC and NFPA "79" Standards.
    d. Separate and shield low voltage signal wiring from power and control wiring by a minimum of 6-inches. 480-volt equipment shall be located in a separate enclosure or place a non-metallic barrier between the 480 power and other power sources.
    e. Group or bundle parallel runs of wire using covered wireways. Troughs shall have 50 percent spare capacity. When power and control wireways and low voltage analog wireways are running parallel and within 6 inches of each other, an aluminum barrier shall be installed to extend 3 – inches higher and along the entire length of the wireway.
    f. Install wire troughs along horizontal or vertical routes to present a neat appearance. Angled runs are not acceptable.
    g. Adequately support and restrain all wiring runs to prevent sagging or other movement.

h. Terminate all field wiring using forked, insulated, crimp-on connectors (soldered type not acceptable) at 600 V rated barrier type terminal strips with screwed connections and permanently affixed numeric identifiers beside each connection. Identifiers to be heat-shrink labels, as manufactured by Brady, permanent type, machine printed numbers.
i. All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device. Install loops on the hot and neutral service.
j. For internal component to component wiring only, compression type barreled, or soldered connectors are acceptable.
k. Provide spare terminals equal in number to 20 percent of the terminals used for each type of wiring (e.g., DC signal and AC power).
l. Provide grounding terminals, studs and wirings for shielded cable as per Division 01 – General requirements.
m. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
n. When DC power and/or low voltage AC power is required, provide and install the necessary power supplies and transformers in the panel.
o. All field 4-wire instruments shall be powered from an instrument lighting panel as shown on the Drawings. Provide circuit breakers to protect each circuit.
p. Provide complete wiring diagram showing "as built" circuitry. Diagram shall be enclosed in transparent plastic and placed in easily accessible pocket built into panel door.

6. Surge Protection:
7. General: Surge protection shall be provided to protect the electronic instrumentation system from surges propagating along the signal and power supply lines. The protection systems shall be such that the protection level shall not interfere with normal operation but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. These protectors shall be mounted within the instrument enclosure.
8. Product and Manufacturer: Provide one of the following:
   a. Phoenix Contact.
   b. Advanced Protection Technologies.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in conformance with NEC.

B. Unless otherwise noted, install indoor NEMA 4X panels on 4-inch concrete pad. Extend pad 4-inches beyond outside dimensions of base, all sides. Lay grout after panel sills have been securely fastened down.

C. Unless otherwise noted, install outdoor free standing NEMA 4X panels on a reinforced concrete pedestal:
   1. Minimum Thickness: 8-inches with No. 4 steel reinforcing bars at 12-inches on centers, each way.
   2. Minimum Size: 4-inches larger than outer dimensions of base, all sides.
   3. Seal the contact surface between the panel base along the outside perimeter of the panel using RTV sealant.

D. Install and interconnect all equipment, devices, electrical hardware, instrumentation and controls and process controller components into and out of and among the enclosures as shown on the Drawings.

3.2 TESTING AND ADJUSTMENTS

A. Perform system testing and make any adjustments necessary in accordance with this Section and Section 40 60 04, Process Control System General Requirements; Section 40 60 06, Computer

Control System Factory Testing; and Section 40 60 07, Process Control System Start-up, Commissioning and Field Testing.

B. Perform power supply, voltage adjustments to tolerances required by the appurtenant equipment.

+ + END OF SECTION + +

SECTION 40 60 66
PROCESS CONTROL SYSTEM
PANEL INSTRUMENTS AND DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish, install, calibrate, test, adjust, commission and place into satisfactory operation panel instruments and devices.
   2. Contract Documents illustrate and specify functional and general construction requirements of the panel components and do not necessarily show or specify all components, wiring, piping and accessories required to make a completely integrated system. CONTRACTOR shall provide all piping, wiring, accessories and labor required for a complete, workable and integrated system.

B. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.

C. Reference Standard:
   1. Division 26, Electrical.
   2. Section 40 60 04, Process Control System General Requirements.
   3. Section 40 60 06, Computer Control System Factory Testing.
   4. Section 40 60 65, Process Control System Panel and Enclosures.

D. Coordination: Coordinate the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

1.2 QUALITY ASSURANCE

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements for Process Instrumentation.

B. Acceptable Manufacturers:
   1. Furnish instruments and devices by the named manufacturers.
   2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied. Model number or specification requirements may vary based on manufactures availability.
   3. Obtain all instruments or devices of a given type from the same manufacturer.

C. Manufacturers' Responsibilities and Services:
   1. Design and manufacture the instruments and devices in accordance with the applicable general design requirements specified in Section 40 60 04, Process Control System General Requirements, and the detailed Specifications herein.

D. Field supervision, inspection, start-up, commissioning, and training in accordance with the requirements of Section 40 60 07, Process Control System Start-Up, Commissioning and Field Testing, and Section 40 60 08, Process Control System Training.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 40 60 04 Process Control System General Requirements.

B. Instruments and devices shall not be assembled in the panels until all product information and system Shop Drawings for respective components have been approved.

1.4 IDENTIFICATION TAGS

A. All panel instruments and devices shall have an identification tag meeting the following requirements:
   1. Tag numbers shall be derived from the P&ID, ISA number.
   2. Identifying tag number shall be permanently etched or embossed onto a stainless-steel tag which shall be fastened to the device housing with stainless steel rivets or self-tapping screws of appropriate size.
   3. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/16-inch diameter nylon-coated stainless steel wire rope.
   4. All instruments and devices mounted within panels shall have the stainless-steel identification tag installed so that the numbers are easily visible to service personnel. Front of panel mounted components shall have the tag attached to the rear of the device.
   5. Front of panel mounted components shall have nameplates which comply with the requirements specified in both, Section 40 60 65, Process Control System Panels and Enclosures.

PART 2 - PRODUCTS

2.1 POWER SUPPLIES

A. General:
   1. Single unit and multiple unit power supplies, located in control room panels, intermediate termination panels and field panels, as required.

B. Single Unit Required Features:

C. Solid state circuitry.
   1. Surface mounting.
   2. Input Power: 120 VAC, ± 10 percent, 60 Hz.
   3. Output Power: 24 VDC or as required.
   4. Line/Load Regulation: 0.005 percent.
   5. Ripple: 0.25 mv RMS.
   6. Overload Protection: Internal preset.
   7. Include mounting brackets, fuse, and mating connector for AC power plug.

D. Product and Manufacturer: Provide one of the following:
   1. Sola, SDN-C Series
   2. Phoenix Contact, Quint Series
   3. Approved Equal

2.2 CURRENT ISOLATOR

A. General:
   1. The isolating unit shall be a two wire, loop powered device. It shall accept a 4 to 20mA DC input signal and deliver a 4 to 20mA DC output.

B. Required Features:
   1. Repeatability: One percent of span.
   2. Rated for Ambient Temperature Range: -25°F to +185°F.
   3. Linearity: 0.1 percent of full scale.
   4. Provide one spare isolator.

C. Product and Manufacturer: Provide one of the following:
   1. Wilkerson.

2. A.G.M.
3. Action Pak.

2.3 CONTROL RELAYS

A. Type: General purpose, plug-in type rated for continuous duty.

B. Construction Features:
1. Coil Voltages: 24 VDC and 120 VAC, as required.
2. Contacts:
   a. Silver cadmium oxide rated not less than five amperes resistive at 120 VAC or 28 VDC continuous.
   b. For switching low energy circuits (less than 200 ma) fine silver, gold flashed contacts rated not less than three amperes resistive at 120 VAC or 28 VDC continuous shall be provided.
3. Relays to have clear plastic dust cover.
4. Relays to be UL recognized.

C. Product and Manufacturer: Provide one of the following:
1. IDEC, RH Series.
2. Type R and/or Type K, as manufactured by Square D Company.
3. Or Equal.

2.4 TIME DELAY RELAY

A. Type: Dial adjustable, plug-in type time delay relay providing delay-on-make, delay-on-break or interval operation.

B. Construction Features:
1. MOS digital circuit with transformer coupled power.
2. Switch selectable ranges as follows:
   a. One second.
   b. Ten seconds.
   c. One minute.
   d. Ten minutes.
   e. One hour.
   f. Ten hours.
3. Minimum Setting: Three percent of range, except 50 ms for one second range.
4. Contacts:
   a. Type: DPDT.
   b. Rating: Seven amps resistive at 120 VAC, seven amps at 24 VDC.
5. Housing: Plug-in design with dust and moisture resistant molded plastic case.
6. Power Input: 120 VAC and 24 VDC, as required.
7. Relays to be UL recognized.

C. Product and Manufacturer: Provide one of the following:
1. IDEC, Type GT3.
2. Or Equal

2.5 SELECTOR SWITCHES, PUSHBUTTONS AND INDICATING LIGHTS

A. General:
1. Selector switches, pushbuttons and indicating lights shall be supplied by one manufacturer and be of the same series or model type.
2. Type:
   a. Heavy duty, oiltight.
3. Provide legend plate for indication of switch, pushbutton or light function (e.g., Open-Closed, Hand-Off-Auto).
4. Mounting: Flush mounted on control panel front, unless otherwise noted.
5. NEMA rated to match panel in which mounted.

B. Selector Switches:

C. Type: Provide selector switches with number of positions as required to perform intended functions as shown on the Drawings and specified.
   1. Contacts:
      a. Provide number and arrangement of contacts as required to perform intended functions specified, but not less than one single pole, double throw contact.
      b. Type: Double break, silver contacts with movable contact blade providing scrubbing action.
      c. Rating: Compatible with AC or DC current with devices simultaneously operated by the switch contacts, but not less than ten amperes resistive at 120 volts AC or DC continuous.
   2. Switch Operator: Standard black knob.

D. Pushbuttons (Standard or Illuminated):
   1. Type: Provide momentary, booted type pushbuttons as required to perform intended functions specified and shown on the Drawings. Boot color to be red for stop buttons and black for other functions.
   2. Contacts: Comply with the requirements specified for selector switches.

E. Indicating Lights:

F. Type: Compact, integral non-transformer type.
   1. Lamps: 120 VAC, LED, long life (20,000 hours minimum).
   2. Common, push-to-test circuitry shall be provided for each panel to simultaneously test all indicating lights on the panel using a single pushbutton.

G. Button and Lens Colors:
   1. Red for indication of open, on, running.
   2. Green for indication of closed, off (ready), stopped.
   3. Amber for indication of equipment malfunction, process trouble and alarms (e.g., high level, low level, etc.).
   4. White for indication of electrical control power on.

2.6 SURGE PROTECTION DEVICE

A. General: Lightning and surge protection shall be provided for instrument and main power protection.

B. Required Features:
   1. Amp Rating: Ten kA for instruments; 20 kA for main power.
   2. Voltage Rating: Compatible with working voltage of protected device.
   3. Reaction Time: nanosecond range.
   4. Mounting: DIN rail.
   5. Enclosure Rating: Intrinsically safe, unless otherwise noted.

C. Product and Manufacturer: Provide one of the following:
   1. Phoenix Contact
   2. Advanced Protection Technologies.
   3. Approved Equal

2.7 UNINTERRUPTIBLE POWER SYSTEM

A. Uninterruptible Power System (UPS) shall be furnished to provide a reliable source of uninterruptible power with no break in DC output power during a complete or partial interruption of incoming line power. UPS shall be UL listed.

B. UPS shall be comprised of a precision hysteresis loop battery charger, sealed maintenance free batteries, a relay.

C. When DC line power fails, the UPS shall supply DC power to the transformer from the battery source. There shall be no break in the output of the system during transfer from normal DC line supply to battery supply or back to line.

D. Output capacity shall be provided to meet the load of equipment furnished.

E. Backup Run Time: 10 minutes.
   1. Output Voltage: 24VDC.
   2. Voltage Regulation: ± Three percent nominal regulation.
   3. Operating Temperature: 32°F to +104°F.

F. Product and Manufacturer: Provide one of the following:
   1. Phoenix Contact
   2. Sola, SDU
   3. Or equal.

2.8 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. General: The PLC shall provide all operational, protective, status, and alarm functions as described for the equipment control functions and as shown on the Drawings. The PLC shall be Modicon, M340 Series. The following shall outline the minimum basic PLC system requirements:
   1. PLC Processor: The processor shall be sized to support required I/O, communication, process functions, data storage, and spare I/O.
   2. Memory Type: Lithium battery backed RAM with EEPROM backup.
   3. Communications:
      a. Modbus TCP
   4. I/O Modules: Each PLC shall be equipped for input/output signal interface with field devices for control and monitoring. The discrete inputs shall be 24VDC. The discrete outputs shall be 24VDC. The analog inputs shall be 4 to 20 mADC. The analog outputs shall be isolated 4 to 20 mADC. Any other type of I/O signal interface module shall be provided as required to meet the needs of the equipment process control. A minimum of 25 percent spare I/O capacity shall be provided for each I/O type.
   5. Power Supplies: Each PLC shall be provided with a power supply(s) suitable for operation on 24VDC. Power supply(s) shall be provided for each PLC system and shall be sized to include the spare I/O capacity.
   6. I/O Chassis: Each PLC shall be provided with an I/O chassis to house I/O modules, CPU, power supplies, communication modules, and interface modules. Unused slots in the chassis shall have cover plates.
   7. Interconnection: All interconnecting cables and wires between power supplies, I/O chassis, and control system components shall be provided.

B. The application program for the PLC shall be fully documented with I/O descriptors and function annotation to be able to follow the program's control logic. A copy of the application program shall be provided to the OWNER upon project completion. The OWNER shall be provided with READ/WRITE access to the application program.

2.9 SPARE PARTS AND TEST EQUIPMENT

A. CONTRACTOR shall furnish and deliver the spare parts and test equipment as outlined below, all of which shall be identical and interchangeable with similar parts furnished under this Specification.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. The following shall constitute the minimum spare parts:
   1. Five of each type of input-output relay for each 40 or less furnished for this Contract.
   2. One replacement power supply for each type and size furnished for this Contract.
   3. A one year supply of all expendable materials.

4. One per ten (two, if fewer than twenty) of each type of panel mounted instrument including lights and pushbuttons.
5. One dozen of each type and size of fuse used in panels and instruments.

D. The following shall constitute the minimum test and calibration equipment:
1. All tooling required to insert, extract and connect any internal or external connector, including edge connectors.
2. All special calibration equipment required for system calibration.

E. All spare parts shall have been operated and tested in the factory as part of factory testing prior to shipment of the control system.

F. For process sensors and all other analog instruments, the supplier shall submit a separate quotation for a recommended list of spare-parts and test equipment. Each item recommended shall be listed and priced separately. The spare parts quotation shall contain a statement that the prices quoted are firm for a period of one year (with escalators for the next two years) subsequent to the OWNER'S acceptance of the equipment, and that the supplier understands that the OWNER reserves the right to purchase none, any, or all of the parts quoted. The supplier is required to show that a stock of spare-parts and test equipment is obtainable within a 48 hour period.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each item in accordance with manufacturers recommendations and in accordance with the Contract Documents.

B. All items shall be mounted and anchored in compliance with Section 40 60 65, Process Control System Panels and Enclosures.

3.2 START-UP, CALIBRATION, TESTING AND TRAINING

A. Comply with the requirements of Section 40 60 04 Process Control System General Requirements.

+ + END OF SECTION + +