SECTION 226713 - PROCESSED WATER PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

This Section may include provisions for LEED 2009, LEED v4, ASHRAE 189.1, IgCC, and Green Globes. Note that some sustainable design requirements are either mandatory or optional requirements that may be inserted in the Section Text using the hypertext links. Other requirements that are associated with sustainable design, and may be considered "best practice" or retained even if a sustainable design standard is not a Project requirement, are discussed in the Evaluations.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section includes [**reagent-water**] [**deionized-water**] [**distilled-water**] [**and**] [**reverse-osmosis-water**] piping, fittings, and valves, including the following:

CPVC pipe and fittings.

PP pipe and fittings for heat-fusion joints.

PP pipe and fittings for electro-fusion joints.

PVC pipe and fittings.

PVDF pipe and fittings.

Glass pipe and fittings.

Stainless steel tubing and fittings.

CPVC valves.

PP valves.

PVC valves.

PVDF valves.

Glass ball valves.

Stainless steel ball valves.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. RO: Reverse osmosis.
			1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Sustainable Design Submittals:
				5. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Retain "Seismic Qualification Data" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Sections specifying mechanical vibration, supports, and seismic controls. See ASCE/SEI 7 for certification requirements for equipment and components.
				6. Seismic Qualification Data: For water piping, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

Retain "Welding certificates" Paragraph below if retaining "Welding Qualifications" Paragraph in "Quality Assurance" Article.

* + - * 1. Welding certificates.

Retain "Field quality-control reports" Paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
			1. QUALITY ASSURANCE

Retain "Welding Qualifications" Paragraph below if shop or field welding is required. If retaining, also retain "Welding certificates" Paragraph in "Informational Submittals" Article.

* + - * 1. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
				2. ASME Compliance: Comply with ASME B31.3 “Power Piping” for piping conveying fluid at a pressure of 15 psig or greater.
1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. PERFORMANCE REQUIREMENTS
				1. Minimum Working Pressure Ratings:

Retain one or more of "Reagent-Water Piping," "Deionized-Water Piping," "Distilled-Water Piping," and "RO Water Piping" subparagraphs below for specific purified-water piping systems.

Reagent-Water Piping: **[20 psig] [40 psig] [50 psig] [100 psig] <Insert pressure**> unless otherwise indicated.

Deionized-Water Piping: [**50 psig**] [**100 psig**] [**150 psig**] <Insert pressure> unless otherwise indicated.

Distilled-Water Piping: [**50 psig**] [**100 psig**] [**150 psig**] <Insert pressure> unless otherwise indicated.

RO Water Piping: [**50 psig**] [**100 psig**] [**150 psig**] <Insert pressure> unless otherwise indicated.

Retain "Seismic Performance" Paragraph below with "Seismic Qualification Data" Paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Water piping shall withstand the effects of earthquake motions determined in accordance with [**ASCE/SEI 7**] <**Insert requirement**>.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the piping system will remain in place without separation of any parts when subjected to the seismic forces specified[**and the piping system will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table, for requirements to be inserted in subparagraph below.

<Insert requirements for Component Amplification Factor and Component Response Modification Factor>.

* + - 1. PLASTIC PIPE AND FITTINGS
				1. Standards: Comply with NSF 14, NSF 61, and NSF 372.

CPVC pipe and fittings in "CPVC Pipe and Fittings, Schedule 40" Paragraph below are available in NPS 1/4 to NPS 16 (DN 8 to DN 400). Fittings are available in NPS 1/4 to NPS 6 (DN 8 to DN 150). Joints are the solvent-cemented type. This piping is suitable for some noncritical purified-water services but should not be used for high-purity water.

Socket-welded fittings are not recommended for purified water or water for injection distribution systems, particularly where microbial control is desired. Socket-welded plastic tubing/piping is occasionally used. This process requires skilled personnel who have performed the heat welding operation several times and are qualified to obtain required results to eliminate crevices.

* + - * 1. CPVC Pipe and Fittings, Schedule 40: ASTM F441/F 441M pipe; with plain ends for solvent-cemented joints and ASTM F438 socket-type fittings.
				2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

GF Piping Systems.

Approved equivalent.

CPVC pipe and fittings in "CPVC Pipe and Fittings, Schedule 80" Paragraph below are available in NPS 1/4 to NPS 16 (DN 8 to DN 400). Fittings are available in NPS 1/4 to NPS 8 (DN 8 to DN 200). Joints are the solvent-cemented type. This piping is suitable for some noncritical purified-water services but should not be used for high-purity water.

* + - * 1. CPVC Pipe and Fittings, Schedule 80: ASTM F441 pipe; with plain ends for solvent-cemented joints and ASTM F439 socket-type fittings.
				2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

GF Piping Systems.

Approved equivalent.

* + - * 1. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.

PP pipe and fittings for heat-fusion joints in "PP Pipe and Fittings for Heat-Fusion Joints" Paragraph below are available in NPS 1/2 to NPS 4 (DN 15 to DN 100) for socket-type, heat-fusion joining and to at least NPS 12 (DN 300) for butt-type, heat-fusion joining.

* + - * 1. PP Pipe and Fittings for Heat-Fusion Joints: Made from ASTM D4101 PP resin.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

GF Piping Systems: Georg Fischer LLC.

IPEX USA LLC.

NIBCO INC.

Orion Fittings; A Watts Water Technologies Company.

Town & Country Plastics, Inc.

Approved equivalent.

* + - * 1. PP Pipe and Fittings, Schedule 40: Schedule 40 or SDR 11 dimensions; with socket- or butt-fusion fittings matching pipe dimensions.

PP pipe and fittings for electro-fusion joints in "PP Pipe and Fittings for Electro-Fusion Joints" Paragraph below are available in NPS 1/2 to NPS 3 (DN 15 to DN 80).

* + - * 1. PP Pipe and Fittings for Electro-Fusion Joints: Made from ASTM D4101 PP resin.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

GF Piping Systems: Georg Fischer LLC.

IPEX USA LLC.

NIBCO INC.

Orion Fittings; A Watts Water Technologies Company.

Town & Country Plastics, Inc.

Approved equivalent.

PP Pipe and Fittings, Schedule 80: Schedule 80 or SDR dimensions; with socket fittings matching pipe dimensions.

Electro-Fusion Fitting: Electrical-resistance heating coil for PP piping joints.

PVC pipe and fittings in "PVC Pipe and Fittings, Schedule 40" Paragraph below are available in NPS 1/8 to NPS 24 (DN 6 to DN 600). Fittings are available in NPS 1/8 to NPS 12 (DN 6 to DN 300). Joints are the solvent-cemented type. This piping is suitable for some noncritical purified-water services but should not be used for high-purity water.

* + - * 1. PVC Pipe and Fittings, Schedule 40: ASTM D1785 pipe; with plain ends for solvent-cemented joints and ASTM D2466 socket-type fittings.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

GF Piping Systems.

Approved equivalent.

PVC pipe and fittings in "PVC Pipe and Fittings, Schedule 80" Paragraph below are available in NPS 1/8 to NPS 24 (DN 6 to DN 600). Fittings are available in NPS 1/8 to NPS 12 (DN 6 to DN 300). Joints are the solvent-cemented type. This piping is suitable for some noncritical purified-water services but should not be used for high-purity water.

* + - * 1. PVC Pipe and Fittings, Schedule 80: ASTM D1785 pipe; with plain ends for solvent-cemented joints and ASTM D2467 socket-type fittings.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

GF Piping Systems.

Approved equivalent.

* + - * 1. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.

PVDF pipe and fittings in "PVDF Pipe and Fittings" Paragraph below are available in NPS 3/8 to NPS 4 (DN 7 to DN 100) for socket-type, heat-fusion joining and to at least NPS 12 (DN 300) in butt-type, heat-fusion joining.

* + - * 1. PVDF Pipe and Fittings: Made from ASTM D3222 PVDF resin.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

GF Piping Systems: Georg Fischer LLC.

NIBCO INC.

Orion Fittings; A Watts Water Technologies Company.

Approved equivalent.

PVDF Pipe and Fittings, Schedule 40: Schedule 40 or SDR 11 dimensions; with socket- or butt-fusion fittings matching pipe dimensions.

PVDF Pipe and Fittings, Schedule 80: Pipe made in accordance with ASTM D3222, Schedule 80 or SDR; with socket-fusion fittings matching pipe dimensions.

* + - 1. GLASS PIPE AND FITTINGS

Temperature and pressure ratings of piping in this article are low and decrease with an increase in pipe size. See manufacturer's literature.

Piping in this article is available in NPS 1 to NPS 6 (DN 25 to DN 150). Joints are the coupled type.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Ace Glass, Inc.

Pegasus Industrial Specialties, Inc.

QVF.

Approved equivalent.

* + - * 1. Glass Pipe and Fittings: Beaded borosilicate glass made for process-piping applications.
				2. Couplings: Stainless steel band type with fluororubber liner, thermoplastic-elastomer seal, and bolt.
			1. STAINLESS STEEL TUBING

Tubing in this article is available in NPS 1 to NPS 8 (DN 25 to DN 200). Joints are welded type. Wall thicknesses in NPS 1 to NPS 4 (DN 25 to DN 100) are suitable for butt-welded joints. Tubing larger than NPS 4 (DN 100) should have Schedule 10 or greater wall thickness and beveled-wall welded joints.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

LinkPlus USA.

Shaw Stainless & Alloy Piping.

WEBCO Industries.

Approved equivalent.

* + - * 1. Stainless Steel Tube: ASTM A270, Grade TP304L or TP316L, seamless, sanitary tube of pharmaceutical quality, with wall thickness **[not less than ASTM A312, Schedule 5] <Insert wall-thickness data>** unless otherwise indicated; with seamless, stainless steel fittings matching tube thickness and grade, for welded joints.
				2. Stainless Steel Tube Fittings: Fabricated of same material and thickness as tubing for butt welding.
				3. Finish on Inside Surface of Tubes and Fittings: [**Ra 20-micro-inch maximum**] <**Insert finish**> roughness.

Retain "Finish on Outside Surface of Tubes and Fittings" Paragraph below if applicable.

* + - * 1. Finish on Outside Surface of Tubes and Fittings: <**Insert finish**>.
			1. TRANSITION FITTINGS
				1. Couplings, flanges, or other manufactured fittings; same size as, with pressure rating at least equal to, and ends compatible with piping to be joined.
			2. CPVC VALVES

Valves in "CPVC Ball Valves" Paragraph below are available in NPS 1/4 to NPS 2 (DN 8 to DN 50) and NPS 2-1/2 to NPS 4 (DN 65 to DN 100) from some manufacturers. Verify that valve selections are available from manufacturers retained.

* + - * 1. CPVC Ball Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

IPEX USA LLC.

NIBCO INC.

Plast-O-Matic Valves, Inc.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standards: Comply with MSS SP-122 and ASTM F1970.

Pressure Rating: **[150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D1784 CPVC compound.

Body Design: Union type.

End Connections: Detachable, socket.

Ball: ASTM D1784 CPVC compound.

Port: Full.

Seats: PTFE.

Stem: ASTM D1784 CPVC compound.

Stem Seals: **[EPDM] [FKM**]-rubber O-rings.

Handle: Tee shaped.

Valves in "CPVC Butterfly Valves" Paragraph below are available in at least NPS 2 (DN 50) and larger.

* + - * 1. CPVC Butterfly Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

IPEX USA LLC.

NIBCO INC.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: Comply with ASTM F1970.

Pressure Rating: **[150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D1784 CPVC compound.

Body Design**: [Lug] [or] [wafer**] type.

Seat: [**EPDM] [FKM**] rubber.

Disc: **[ASTM D1784 CPVC compound] [ASTM D4101 PP resin] <Insert material**>.

Stem: Stainless steel.

Stem Seals: **[EPDM] [FKM**]-rubber O-rings.

Handle: Lever type with locking device.

Valves in "CPVC Ball-Check Valves" Paragraph below are available in NPS 2 (DN 2) and smaller.

* + - * 1. CPVC Ball-Check Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

IPEX USA LLC.

NIBCO INC.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: Comply with ASTM F1970.

Pressure Rating: **[150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D1784 CPVC compound.

Body Design: Union type.

End Connections: Detachable, socket.

Ball: ASTM D1784 CPVC compound.

Seat and Seals: [**EPDM**] [**or**] [**FKM**]-rubber O-rings.

Valves in "CPVC Swing-Check Valves" Paragraph below are available in at least NPS 2 (DN 50) and larger.

* + - * 1. CPVC Swing-Check Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: Comply with ASTM F1970.

Pressure Rating: [**150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D1784 CPVC compound.

Body Design: Bolted-bonnet type.

End Connections: Flanged.

Shaft: ASTM D1784 CPVC compound.

Disc and Arm: ASTM D1784 CPVC compounds.

Gasket and Seals: [**EPDM] [or] [FKM]** rubber.

Valves in "CPVC Diaphragm Valves" Paragraph below are available in at least NPS 3/4 to NPS 4 (DN 20 to DN 100).

* + - * 1. CPVC Diaphragm Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

NIBCO INC.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: Comply with ASTM F1970.

Pressure Rating: **[150 psig] <Insert pressure> at [73 deg F] <Insert temperature>.**

Body Material: ASTM D1784 CPVC compound.

Body Design: Bolted-bonnet type.

End Connections for NPS 2 and Smaller: Detachable, socket.

End Connections for NPS 2-1/2 and NPS 3: Flanged.

Diaphragm: [**EPDM] [FKM]** rubber.

Seals: [**EPDM] [FKM**]-rubber O-rings.

Handle: Wheel type.

* + - 1. PP VALVES

Valves in "PP Ball Valves" Paragraph below are available in NPS 1/4 to NPS 2 (DN 8 to DN 50) and NPS 2-1/2 to NPS 4 (DN 65 to DN 100) from some manufacturers. Verify that valve selections are available from manufacturers retained.

* + - * 1. PP Ball Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

GF Piping Systems: Georg Fischer LLC.

IPEX USA LLC.

NIBCO INC.

Orion Fittings; A Watts Water Technologies Company.

Plast-O-Matic Valves, Inc.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: MSS SP-122.

Pressure Rating: **[150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D4101 PP resin.

Body Design: Union type.

End Connections: Detachable, butt or socket.

Ball: ASTM D4101 PP resin.

Port: Full.

Seats: PTFE.

Stem: ASTM D4101 PP resin.

Stem Seals: FKM-rubber O-rings.

Handle: Tee shaped.

Valves in "PP Butterfly Valves" Paragraph below are available in at least NPS 2 (DN 50) and larger.

* + - * 1. PP Butterfly Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

IPEX USA LLC.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Pressure Rating: [**150 psig**] **<Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D4101 PP resin.

Body Design: [**Lug] [or] [wafer**] type.

Seat: FKM rubber.

Disc: [**ASTM D4101 PP resin] <Insert material**>.

Stem: Stainless steel.

Stem Seals: FKM-rubber O-rings.

Handle: Lever type with locking device.

Valves in "PP Ball-Check Valves" Paragraph below are available in NPS 2 (DN 50) and smaller.

* + - * 1. PP Ball-Check Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

NIBCO INC.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Pressure Rating: [**150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D4101 PP resin.

Body Design: Union type.

End Connections: Detachable, socket.

Ball: ASTM D4101 PP resin.

Seat and Seals: FKM-rubber O-rings.

Valves in "PP Swing-Check Valves" Paragraph below are available in at least NPS 2 (DN 50) and larger.

* + - * 1. PP Swing-Check Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Hayward Flow Control; Hayward Industries, Inc.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Pressure Rating: [**150 psig**] **<Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D4101 PP resin.

Body Design: Bolted-bonnet type.

End Connections: Flanged.

Shaft: ASTM D4101 PP resin.

Disc and Arm: ASTM D4101 PP resin.

Gasket and Seals: FKM rubber.

Valves in "PP Diaphragm Valves" Paragraph below are available in at least NPS 3/4 to NPS 4 (DN 20 to DN 100).

* + - * 1. PP Diaphragm Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

GF Piping Systems: Georg Fischer LLC.

NIBCO INC.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Pressure Rating: [**150 psig**] **<Insert pressure> at [73 deg F] <Insert temperature**>

Body Material: ASTM D4101 PP resin.

Body Design: Bolted-bonnet type.

End Connections for NPS 2 and Smaller: Detachable, socket.

End Connections for NPS 2-1/2 and NPS 3: Flanged.

Diaphragm: FKM rubber.

Seals: FKM-rubber O-rings.

Handle: Wheel type.

* + - 1. PVC VALVES

Valves in "PVC Ball Valves" Paragraph below are available in NPS 1/4 to NPS 2 (DN 8 to DN 50) and NPS 2-1/2 to NPS 4 (DN 65 to DN 100) from some manufacturers. Verify that valve selections are available from manufacturers retained.

* + - * 1. PVC Ball Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

IPEX USA LLC.

NIBCO INC.

Plast-O-Matic Valves, Inc.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standards: Comply with MSS SP-122 and ASTM F1970.

Pressure Rating: [**150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D1784 PVC compound.

Body Design: Union type.

End Connections: Detachable, socket.

Ball: ASTM D1784 PVC compound.

Port: Full.

Seats: PTFE.

Stem: ASTM D1784 PVC compound.

Seals: [**EPDM] [FKM**]-rubber O-rings.

Handle: Tee shaped.

Valves in "PVC Butterfly Valves" Paragraph below are available in at least NPS 2 (DN 50) and larger.

* + - * 1. PVC Butterfly Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

NIBCO INC.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: Comply with ASTM F1970.

Pressure Rating: [**150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D1784 PVC compound.

Body Design: [**Lug] [or] [wafer**] type.

Seat: [**EPDM] [FKM**] rubber.

Disc: [**ASTM D1784 PVC compound] [ASTM D4101 PP resin] <Insert material**>.

Stem: Stainless steel.

Stem Seals: [**EPDM] [or] [FKM**]-rubber O-rings.

Handle: Lever type with locking device.

Valves in "PVC Ball-Check Valves" Paragraph below are available in NPS 2 (DN 50) and smaller.

* + - * 1. PVC Ball-Check Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

IPEX USA LLC.

NIBCO INC.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: Comply with ASTM F1970.

Pressure Rating: [**150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D1784 PVC compound.

Body Design: Union type.

End Connections: Detachable, socket.

Ball: ASTM D1784 PVC compound.

Seat and Seals: [**EPDM**] [**or**] [**FKM**]-rubber O-rings.

Valves in "PVC Swing-Check Valves" Paragraph below are available in at least NPS 2 (DN 50) and larger.

* + - * 1. PVC Swing-Check Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Hayward Flow Control; Hayward Industries, Inc.

IPEX USA LLC.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: Comply with ASTM F1970.

Pressure Rating: [**150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D1784 PVC compound.

Body Design: Bolted-bonnet type.

End Connections: Flanged.

Shaft: ASTM D1784 PVC compound.

Disc and Arm: ASTM D1784 PVC compounds.

Gasket and Seals: [**EPDM**] [**or**] [**FKM**] rubber.

Valves in "PVC Diaphragm Valves" Paragraph below are available in at least NPS 3/4 to NPS 4 (DN 20 to DN 100).

* + - * 1. PVC Diaphragm Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Hayward Flow Control; Hayward Industries, Inc.

NIBCO INC.

Spears Manufacturing Company.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: Comply with ASTM F1970.

Pressure Rating: [**150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D1784 PVC compound.

Body Design: Bolted-bonnet type.

End Connections for NPS 2 and Smaller: Detachable, socket.

End Connections for NPS 2-1/2 and NPS 3: Flanged.

Diaphragm: [**EPDM] [FKM]** rubber.

Seals: [**EPDM] [FKM**]-rubber O-rings.

Handle: Wheel type.

* + - 1. PVDF VALVES

Valves in "PVDF Ball Valves" Paragraph below are available in NPS 1/4 to NPS 2 (DN 8 to DN 50) and NPS 2-1/2 to NPS 4 (DN 65 to DN 100) from some manufacturers. Verify that valve selections are available from manufacturers retained.

* + - * 1. PVDF Ball Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

GF Piping Systems: Georg Fischer LLC.

NIBCO INC.

Orion Fittings; A Watts Water Technologies Company.

Plast-O-Matic Valves, Inc.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Standard: MSS SP-122.

Pressure Rating: [**150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D3222 PVDF resin.

Body Design: Union type.

End Connections: Detachable, butt or socket.

Ball: ASTM D3222 PVDF resin.

Port: Full.

Seats: PTFE.

Stem: ASTM D3222 PVDF resin.

Stem Seals: FKM-rubber O-rings.

Handle: Tee shaped.

Valves in "PVDF Butterfly Valves" Paragraph below are available in at least NPS 2 (DN 50) and larger.

* + - * 1. PVDF Butterfly Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Colonial Engineering, Inc.

GF Piping Systems: Georg Fischer LLC.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Pressure Rating: [**150 psig] <Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D3222 PVDF resin.

Body Design: [**Lug] [or] [wafer**] type.

Seat: FKM rubber.

Disc: [**ASTM D3222 PVDF resin] <Insert material**>.

Stem: Stainless steel.

Stem Seals: FKM-rubber O-rings.

Handle: Lever type with locking device.

Valves in "PVDF Ball-Check Valves" Paragraph below are available in NPS 2 (DN 50) and smaller.

* + - * 1. PVDF Ball-Check Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Asahi/America.

GF Piping Systems: Georg Fischer LLC.

NIBCO INC.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Pressure Rating: [**150 psig**] **<Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D3222 PVDF resin.

Body Design: Union type.

End Connections: Detachable, socket.

Ball: ASTM D3222 PVDF resin.

Seat and Seals: FKM-rubber O-rings.

Valves in "PVDF Swing-Check Valves" Paragraph below are available in at least NPS 2 (DN 50) and larger.

* + - * 1. PVDF Swing-Check Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

Thermoplastic Valves, Inc

Or equal.

Description:

Pressure Rating: [**150 psig**] **<Insert pressure> at [73 deg F] <Insert temperature**>.

Body Material: ASTM D3222 PVDF resin.

Body Design: Bolted-bonnet type.

End Connections: Flanged.

Shaft: ASTM D3222 PVDF resin.

Disc and Arm: ASTM D3222 PVDF resins.

Gasket and Seals: FKM rubber.

Valves in "PVDF Diaphragm Valves" Paragraph below are available in at least NPS 3/4 to NPS 4 (DN 20 to DN 100).

* + - * 1. PVDF Diaphragm Valves:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American Valve, Inc.

Asahi/America.

GF Piping Systems: Georg Fischer LLC.

NIBCO INC.

Thermoplastic Valves, Inc.

Approved equivalent.

Description:

Pressure Rating: [**150 psig**] **<Insert pressure> at [73 deg F] <Insert temperature>.**

Body Material: ASTM D3222 PVDF resin.

Body Design: Bolted-bonnet type.

End Connections for NPS 2 and Smaller: Detachable, socket.

End Connections for NPS 2-1/2 and NPS 3: Flanged.

Diaphragm: FKM rubber.

Seals: FKM-rubber O-rings.

Handle: Wheel type.

* + - 1. GLASS BALL VALVES

Temperature and pressure ratings of valves in this article are low and decrease with an increase in valve size. See manufacturers' literature.

Valves in this article are available in NPS 1 to NPS 2 (DN 25 to DN 50).

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Andrews Glass Co.

QVF.

Approved equivalent.

* + - * 1. Description:

Minimum Pressure Rating: 70 psig.

Body Material: Borosilicate glass with TFE-lined metal flanges.

Body Design: Straight-through type.

End Connections: Flanged.

Ball: Borosilicate glass.

Port: Regular.

Seats: TFE.

Stem: Fused alumina.

Stem Seal: TFE.

Handle: Lever type.

* + - 1. STAINLESS STEEL BALL VALVES

Valves in this article are available in NPS 1/2 to NPS 2 (DN 15 to DN 50). At least one manufacturer makes a comparable socket-weld ball valve in NPS 2-1/2 to NPS 4 (DN 65 to DN 100).

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Apollo Valves; a part of Aalberts Integrated Piping Systems.

Marwin Valve; Richards Industries.

Metso Automation USA Inc.

Milwaukee Valve Company.

NIBCO INC.

Spirax Sarco Limited.

Approved equivalent.

* + - * 1. Description:

Standard: MSS SP-110.

Minimum CWP Rating: 1000 psig.

Body Material: Stainless steel.

Body Design: Three-piece bolted body type.

End Connections: Socket welding.

Seats: PTFE or TFE.

Stem: Stainless steel.

Ball: Stainless steel, vented.

Port: Full.

Handle: Lever type.

1. EXECUTION
	* + 1. INSTALLATION OF PIPING
				1. General Locations and Arrangements: Drawing and details indicate general location and arrangement of water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

Retain first paragraph below if piping is required to withstand seismic design loads.

* + - * 1. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
				2. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
				3. Install piping indicated to be exposed and in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
				4. Install piping above accessible ceilings to allow sufficient space for removal of ceiling panel, and coordinate with other services occupying that space.
				5. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
				6. Install piping to permit valve servicing.
				7. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure ratings unless otherwise indicated.
				8. Install piping free of sags and bends.
				9. Install fittings for changes in direction and branch connections.
				10. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Retain first paragraph below for piping that penetrates an exterior concrete wall or concrete slab.

* + - * 1. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
				2. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
			1. JOINT CONSTRUCTION
				1. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
				2. CPVC Piping Solvent-Cemented Joints: Comply with ASTM F402 for handling solvent cements, primers, and cleaners; make joints in accordance with ASTM D2846 Appendix.
				3. PP Piping Electro-Fusion Joints: Make in accordance with ASTM F1290.
				4. PP Piping Heat-Fusion Joints: Make in accordance with ASTM D2657.
				5. PVC Piping Solvent-Cemented Joints: Comply with ASTM F402 for handling solvent cements, primers, and cleaners; make joints in accordance with ASTM D2672.
				6. PVDF Piping Heat-Fusion Joints: Make in accordance with ASTM D2657.
				7. Glass Piping Joints: Make with pipe manufacturer's couplings.

Butt-welded joints in "Stainless Steel Sanitary Tubing Joints" Paragraph below are suitable for tubing NPS 4 (DN 100) and smaller.

* + - * 1. Stainless Steel Sanitary Tubing Joints: Make fully penetrated-wall, butt-welding joints without use of filler metal. Comply with AWS D1.6 for welding procedures and processes. Polish exterior of welds to match tubing.
				2. Join dissimilar pipe materials with transition fittings compatible with pipe materials being joined.
			1. INSTALLATION OF VALVES
				1. Install sectional valves close to mains on each branch and riser serving equipment.
				2. Install shutoff valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
				3. Locate valves for easy access and provide separate support where necessary.
				4. Install valves of same size as the pipe or tube in which they are installed unless otherwise indicated.
				5. Install plastic valves of the same material as the plastic pipe in which they are installed.
				6. Install glass valves in glass piping.
				7. Install stainless steel valves in stainless steel tubing.
				8. Install valves in horizontal piping with stem at or above center of pipe.

Allow enough clearance for valve movement in first paragraph below. Provide a suggested 2-inch (50-mm) distance for any obstruction.

* + - * 1. Install valves in position to allow full movement of stem and lever handle.
				2. Install swing-check valves in horizontal position with the hinge pin level.
			1. INSTALLATION OF HANGERS AND SUPPORTS

Retain first paragraph below for projects in areas that require seismic restraints.

* + - * 1. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
				2. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

Install **[carbon-steel] <Insert material**> pipe hangers for horizontal piping in noncorrosive environments.

Install [**stainless steel] [fiberglass**] pipe hangers for horizontal piping in corrosive environments.

Install [**carbon-steel] <Insert material**> pipe support clamps for vertical piping in noncorrosive environments.

Install stainless steel pipe support clamps for vertical piping in corrosive environments.

Clamps for Vertical Piping: MSS Type 8 or Type 42.

Individual, Straight, Horizontal Piping Runs:

100 Feet and Less: MSS Type 1 adjustable clevis hangers.

Longer Than 100 Feet: MSS Type 43 adjustable roller hangers.

Longer Than 100 Feet if Indicated: MSS Type 49 spring cushion rolls.

Multiple, Straight, Horizontal Piping Runs, 100 Feet or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.

Base of Vertical Piping: MSS Type 52 spring hangers.

* + - * 1. Install hangers for stainless steel tubing with the maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, locally-enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

Because of the flexibility of PP and PVDF piping, consider providing v-bottom clevis hanger: Carbon steel with galvanized finish. Break v-channel support at valves and inline devices, to cause piping to rest on channel adjacent to device. Secure pipe to channel, using nylon cable ties at 3-foot intervals.

* + - * 1. Install padded hangers for [**CPVC**] [**PP**] [**PVC**] [**PVDF**] piping with maximum horizontal spacing and minimum rod diameters to comply with manufacturer's written recommendations, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
				2. Install padded hangers for glass piping with maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, manufacturer's written recommendations, locally enforced codes, and authorities having jurisdiction, whichever are most stringent.
				3. Support horizontal piping and tubing within 12 inches of each fitting[, valve,] and coupling.
				4. Support vertical runs of stainless steel piping to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
				5. Support vertical runs of [CPVC] [PP] [PVC] [PVDF] piping to comply with manufacturer's written recommendations, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
				6. Support vertical runs of glass piping to comply with MSS SP-58, manufacturer's written recommendations, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
			1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Drawings indicate general arrangement of piping, fittings, and specialties.
				2. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
				3. Connect [**deionized-water**] [**distilled-water**] [**and**] [**RO water**] piping to equipment and service outlets with unions or flanges.
			1. IDENTIFICATION
				1. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
			2. FIELD QUALITY CONTROL

Retain one of first four paragraphs below. Retain first "Testing Agency" Paragraph below if Owner will hire an independent testing agency.

* + - * 1. Testing Agency: Director’s Representative will engage a qualified testing agency to perform tests and inspections.

Retain "Testing Agency" Paragraph below to require Contractor to hire an independent testing agency.

* + - * 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform tests and inspections" Paragraph below to require the Contractor to perform tests and inspections, and retain optional text to require Contractor to arrange for the assistance of a factory-authorized service agent.

* + - * 1. Perform tests and inspections**[ with the assistance of a Company Field Advisor per OGS Spec Section 014216].**

Retain test requirements in "Tests and Inspections" Paragraph below with any combination of paragraphs above.

* + - * 1. Tests and Inspections:

Test new piping and parts of existing piping that have been altered, extended, or repaired for leaks and defects.

Schedule tests and their inspections by **[authorities having jurisdiction] [Director’s Representative],** with at least 24 hours' advance notice.

Do not cover piping or put into service before inspection and approval by the [authorities having jurisdiction] [Director’s Representative] <Insert approval authority>.

Test completed piping in accordance with [authorities having jurisdiction] [Director’s Representative]. If [authorities having jurisdiction do] [Director’s Representative does] not have published procedures, perform tests as follows:

Hydrostatic Tests: Test piping at pressure of not less than 1-1/2 times the maximum system operating pressure, but not less than [**50 psig**] [**100 psig**] [**150 psig**] <**Insert value**>. Hold test for [**two**] [**four**] <**Insert number**> hours; pressure shall remain constant without pumping. Inspect system to determine visible leaks or significant pressure variations.

Exception: Do not subject glass piping to pressure above manufacturer's pressure rating for size.

If piping does not pass the test, replace leaking joints with new materials and retest until no leaks exist.

Submit separate reports for each test.

* + - * 1. Processed-water system will be considered defective if it does not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. CLEANING OF PIPING SERVING HEALTHCARE
				1. Use procedures prescribed by [**authorities having jurisdiction**] [**Director’s Representative**] or, if not prescribed, use procedures described below:

Cleaning of system as indicated or in accordance with AWWA-C601.

Before using, purge new piping and parts of existing piping that have been altered, extended, or repaired.

Remove flow indicators and flow-measuring devices before flushing. Replace after cleaning is completed.

Clean piping by flushing at a sufficient velocity and quantity to dislodge sediment or dirt with [**reagent-] [deionized-] [distilled-] [and] [RO-]** water mixture throughout the system.

After flushing, introduce chlorine or chlorine compound into the system with a dosage sufficient to give an initial residual chlorine content of 50 ppm.

Open and close valves several times to collect samples from various fixtures throughout the system during introduction of chlorine, to assure uniform distribution.

After [**12] [24] <Insert number**>-hour contact period, flush chlorinated water from system.

After flushing, provide evidence of effectiveness of disinfection by filing a report of bacteriological tests on samples taken from the system with the **[Director’s Representative] [authorities having jurisdiction**]. The report shall include the number and locations of where the samples were taken.

If satisfaction is not achieved, repeat the above disinfection process until satisfactory results are obtained. And do not put the system online until this has been obtained.

* + - 1. CLEANING OF PIPING SERVING LABORATORIES
				1. Use procedures prescribed by [**authorities having jurisdiction**] [**Director’s Representative**] or, if not prescribed, use procedures described below:

Before using, purge new piping and parts of existing piping that have been altered, extended, or repaired.

Remove flow indicators and flow-measuring devices before flushing. Replace after cleaning is completed.

Provide storage tank(s), heat exchanger(s) and pumping system(s) required for cleaning.

Clean piping by pumping at a sufficient velocity and quantity to dislodge sediment or dirt with sodium hypochlorite and [**deionized-] [distilled-] [and] [RO**-] water mixture throughout the system.

Open all taps until cleaning solution is detected, then close taps. Retain solution in the system at least [**three**] [**four**] <**Insert number**> hours.

* + - * 1. At the end of the retention period, open all faucets and taps to thoroughly flush with clean [**reagent-**] [**deionized-**] [**distilled-**] [**and**] [**RO**] water until solution is drained from the system.
			1. PIPING APPLICATION

Retain and revise applicable piping applications. Coordinate with materials specified in Part 2.

This Section includes piping, valves, and other components for processed-water systems NPS 3 (DN 80) and smaller. Most systems typically are NPS 2 (DN 50) or smaller.

* + - * 1. Transition and special fittings with pressure ratings at least equal to piping, and of same or compatible material, may be used in applications below.
				2. Pipe fittings shall be the same material as the piping to which it is connected.
				3. Reagent-Water Piping: Use[**any of**] the following piping materials for each pipe size range:

Retain one or more of nine subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings, and show points of transition from one material to another.

Piping in first subparagraph below is available in NPS 1/4 to NPS 6 (DN 8 to DN 150). This piping is suitable for some noncritical reagent-water services but should not be used for high-purity water.

Pipe Sizes [**NPS 3 and Smaller**] <**Insert pipe size range**>: Schedule 40, CPVC pipe and fittings and solvent-cemented joints.

Piping in first subparagraph below is available in NPS 1/4 to NPS 8 (DN 8 to DN 200). This piping is suitable for some noncritical reagent-water services but should not be used for high-purity water.

Pipe Sizes [**NPS 3 and Smaller**] <**Insert pipe size range**>: Schedule 80, CPVC pipe and fittings and solvent-cemented joints.

Piping in first subparagraph below is available in NPS 1/2 to NPS 4 (DN 15 to DN 100).

Pipe Sizes [**NPS 3 and Smaller**] <**Insert pipe size range**>: PP pipe and fittings and heat-fusion joints.

Piping in first subparagraph below is available in NPS 1/2 to NPS 3 (DN 15 to DN 80).

Pipe Sizes [**NPS 3 and Smaller**] <**Insert pipe size range**>: PP pipe and fittings and electro-fusion joints.

Piping in first subparagraph below is available in NPS 1/8 to NPS 12 (DN 6 to DN 300). This piping is suitable for some noncritical reagent-water services but should not be used for high-purity water.

Pipe Sizes [**NPS 3 and Smaller**] <**Insert pipe size range**>: Schedule 40, PVC pipe and fittings and solvent-cemented joints.

Piping in first subparagraph below is available in NPS 1/8 to NPS 12 (DN 6 to DN 300). This piping is suitable for some noncritical reagent-water services but should not be used for high-purity water.

Pipe Sizes [**NPS 3 and Smaller**] <**Insert pipe size range**>: Schedule 80, PVC pipe and fittings and solvent-cemented joints.

Piping in first subparagraph below is available in NPS 3/8 to NPS 4 (DN 7 to DN 100).

Pipe Sizes [**NPS 3 and Smaller**] <**Insert pipe size range**>: PVDF pipe and fittings and heat-fusion joints.

Piping in first subparagraph below is available in NPS 1 to NPS 6 (DN 25 to DN 150).

Pipe Sizes [**NPS 3 and Smaller**] <**Insert pipe size range**>: Glass pipe and fittings and coupled joints.

Tubing in subparagraph below is available in NPS 1 to NPS 4 (DN 25 to DN 100).

Pipe Sizes [**NPS 3 and Smaller**] <**Insert pipe size range**>: Stainless steel sanitary tubing and welded joints.

* + - * 1. Deionized-Water Piping: Use[**any of**] the following piping materials for each pipe size range:

Retain one or more of five subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings, and show points of transition from one material to another.

Piping in first subparagraph below is available in NPS 1/2 to NPS 4 (DN 15 to DN 100).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: PP pipe and fittings and heat-fusion joints.

Piping in first subparagraph below is available in NPS 1/2 to NPS 3 (DN 15 to DN 80).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: PP pipe and fittings and electro-fusion joints.

Piping in first subparagraph below is available in NPS 3/8 to NPS 4 (DN 7 to DN 100).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: PVDF pipe and fittings and heat-fusion joints.

Piping in first subparagraph below is available in NPS 1 to NPS 6 (DN 25 to DN 150).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: Glass pipe and fittings and coupled joints.

Tubing in subparagraph below is available in NPS 1 to NPS 4 (DN 25 to DN 100).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: Stainless steel sanitary tubing and welded joints.

* + - * 1. Distilled-Water Piping: Use[**any of**] the following piping materials for each pipe size range:

Retain one or more of five subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings, and show points of transition from one material to another.

Piping in first subparagraph below is available in NPS 1/2 to NPS 4 (DN 15 to DN 100).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: PP pipe and fittings and heat-fusion joints.

Piping in first subparagraph below is available in NPS 1/2 to NPS 3 (DN 15 to DN 80).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: PP pipe and fittings and electro-fusion joints.

Piping in first subparagraph below is available in NPS 3/8 to NPS 4 (DN 7 to DN 100).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: PVDF pipe and fittings and heat-fusion joints.

Piping in first subparagraph below is available in NPS 1 to NPS 6 (DN 25 to DN 150).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: Glass pipe and fittings and coupled joints.

Tubing in subparagraph below is available in NPS 1 to NPS 4 (DN 25 to DN 100).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: Stainless steel sanitary tubing and welded joints.

* + - * 1. RO Water Piping: Use[**any of**] the following piping materials for each pipe size range:

Retain one or more of five subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings, and show points of transition from one material to another.

Piping in first subparagraph below is available in NPS 1/2 to NPS 4 (DN 15 to DN 100).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: PP pipe and fittings and heat-fusion joints.

Piping in first subparagraph below is available in NPS 1/2 to NPS 3 (DN 15 to DN 80).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: PP pipe and fittings and electro-fusion joints.

Piping in first subparagraph below is available in NPS 3/8 to NPS 4 (DN 7 to DN 100).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: PVDF pipe and fittings and heat-fusion joints.

Piping in first subparagraph below is available in NPS 1 to NPS 6 (DN 25 to DN 150).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: Glass pipe and fittings and coupled joints.

Tubing in subparagraph below is available in NPS 1 to NPS 4 (DN 25 to DN 100).

[**NPS 3 and Smaller**] <**Insert pipe size range**>: Stainless steel sanitary tubing and welded joints.

* + - 1. VALVE SCHEDULE

Retain and revise applicable valve applications. Coordinate with materials specified in Part 2.

* + - * 1. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

Valves shall be the same material as the piping to which they are connected.

Shutoff Duty: Install ball valves in piping NPS 2 and smaller. Install butterfly or diaphragm valves for NPS 3 piping.

Throttling Duty: Install ball valves in piping NPS 2 and smaller. Install diaphragm valves for NPS 3 piping.

END OF SECTION 226713