**SECTION 22 67 00**

**PROCESSED WATER SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES**

**BASED ON DFD MASTER SPECIFICATION DATED 10/1/12**

***This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.***

**P A R T 1 - G E N E R A L**

**SCOPE**

This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:

PART 1 - GENERAL

 Scope

 Reference

 Reference Standards

 Shop Drawings

Operation and Maintenance Data

 Quality Assurance

 Delivery, Storage, and Handling

 Design Criteria

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PART 2 - PRODUCTS

 Pure Water

PART 3 - EXECUTION

 General

 Preparation

 Erection

 Welded Pipe Joints

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 Pure Water

 Piping System Leak Tests

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**RELATED WORK**

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 22 08 00 – Commissioning of Plumbing

22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

22 05 14 - Plumbing Specialties

**REFERENCE**

Applicable provisions of Division 1 govern work under this section.

**REFERENCE STANDARDS**

ANSI A21.4

ANSI A21.11

ANSI A21.51

ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe

ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

ASTM D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings

ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

ASTM D3222 Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials

ASTM D4101 Propylene Plastic Injection and Extrusion Materials

ASTM F437 Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80

ASTM F438 Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40

ASTM F441 Chlorinated Poly Vinyl Chloride (CPVC Plastic Pipe, Schedules 40 and 80

ASTM F493 Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe and Fittings

ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings at Consumers Sites

NFPA 99 Health Care Facilities

**SHOP DRAWINGS**

Schedule from the contractor indicating the ASTM specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, specification contained in this section.

***Manufacturer's statement is appropriate on large or specialized projects and may be deleted on small projects.***

# OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

***Delete the following if there are no additional requirements.***

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. ***[A/E and commissioning provider to define detailed operation and maintenance data requirements for equipment specifications added to this section.]***

**QUALITY ASSURANCE**

Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.

Order all PVC, polypropylene, and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.

Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the State.

**DELIVERY, STORAGE, AND HANDLING**

Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

Offsite storage agreements will not relieve the contractor from using proper storage techniques.

Storage and protection methods must allow inspection to verify products.

**DESIGN CRITERIA**

Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, ANSI or AWWA specifications as listed in this specification.

Construct all piping for the highest pressures and temperatures in the respective system.

Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.

Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

**WELDER QUALIFICATIONS**

Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.

***Welder certifications are required to be renewed every three years. If qualification papers are needed on a project, verify that they are current.***

Before any polyethylene fusion welding is performed, Contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.

The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

**P A R T 2 - P R O D U C T S**

**PURE WATER**

Polypropylene pipe and fittings, copolymer ASTM D-4101, Schedule 80 or SDR 11, 150 psi rating at 68oF, maximum 200oF, heat fusion fittings using ***(electrofusion, socket fusion, conventional butt fusion)***.

***Generally for 5 megohm-cm resistivity and lower quality water suitable for general lab use such as CAP type II and III or ASTM D1193 Type II, III or IV or USP pharmaceutical use.***

Polypropylene pipe and fittings, Type 110 or 120 homopolymer, ASTM D4101, Schedule 80 or SDR 11, 150 psi rating at 68oF, maximum 200oF, heat fusion fittings using ***(socket fusion, conventional butt fusion, infrared butt fusion)***.

***Generally for 16 megohm-cm resistivity and lower quality water suitable for general lab use such as CAP type I, II and III or ASTM D1193 Type II, III or IV, USP pharmaceutical use or biomedical use ASTM D1193.***

Polyvinylidene Fluoride (PVDF) virgin unpigmented pipe and fittings, ASTM D3222, Schedule 80 pipe and Schedule 80 fittings or SDR series rated for 230 psi at 68oF, maximum 280oF, heat fusion fittings using ***(conventional butt fusion, infrared butt fusion, bead and crevice free (BCF) fusion)***.

***Generally for above 16 megohm-cm resistivity water suitable for ultra-high purity use, semiconductor processing (SEMI), lab use such as CAP type I or ASTM D1193 Type I, USP pharmaceutical use, biomedical use ASTM D1193 or water for injection.***

***Select one of the above materials and joining systems based on water purity requirements. Polypropylene and PVDF have similar resistance to bacteria growth. PVDF has a smoother surface finish, higher temperature rating, is not susceptible to UV or ozone degradation (as is polypropylene) but costs 4 to 6 times as much as polypropylene.***

Valves, unions, flanges and piping specialties to be constructed of same material as pipe and fittings and rated for 150 psi at 68oF.

**P A R T 3 - E X E C U T I O N**

**GENERAL**

Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

**PREPARATION**

Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

**ERECTION**

Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.

Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.

Maintain piping in clean condition internally during construction.

Provide clearance for installation of insulation, access to valves and piping specialties.

Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

***This requirement is based on NFPA 70, 384-4 and 450-47.***

Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

**THREADED PIPE JOINTS**

Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

**SOLVENT WELDED PIPE JOINTS**

Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.

Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the **DFD** Project Representative.

# PURE WATER

Installers to be certified in writing by pipe manufacturer as having been trained, tested and evaluated with manufacturer’s written procedures for installing and heat fusing pipe and fitting types required by project. Heat fusion equipment to be furnished by pipe and fitting manufacturer. All procedures for handling pipe, facing pipe, heat fusion, support and expansion compensation to comply with manufacturer’s recommendations.

Store indoors and handle pipe and fittings to maintain cleanliness, prevent exposure to sunlight or heat and prevent surface scarring or scratching. Maintain piping caps and sealed fitting/valve bags in place until installation. Follow ASTM D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings requirements. Throughout project, remove and evaluate sample joints by cutting longitudinally or into straps per ASTM D2657. Inspect for melt pattern, bond continuity, voids, strength and excessive crevice or bead development. Modify installation procedures as required to obtain even melt, continuous bond and minimal crevice and bead development.

Maintain record of installer’s name and date of installation for piping within each room. Include record along with installer’s certifications in operation and maintenance manuals.

Upon system completion, fill system with distilled or RO water. Pressure test and flush system of all impurities. Disinfect with continuously circulated solution of distilled or RO water and hydrogen peroxide in concentration and for duration recommended by pure water equipment manufacturer. Flush with distilled or RO water until no trace of hydrogen peroxide remains. Test for hydrogen peroxide by adding drops of potassium permanganate solution to sample of system water. If drops turn brown, hydrogen peroxide is present. If drops remain purple, no hydrogen peroxide is present. Flush systems designed for 16 megohm-cm or higher water quality with a minimum of 10 times the volume of the piping.

**PIPING SYSTEM LEAK TESTS**

Isolate or remove components from system which are not rated for test pressure. Perform final testing for medical and lab gas with all system components in place. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.

If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.

For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

Entire test must be witnessed by the Division's representative. All pressure tests are to be documented on **Division of Facilities Development** forms to be provided to the contractor.

 Test Initial Test Final Test

## System Medium Pressure Duration Pressure Duration

Pure Water Distilled Water N/A 150 psig 8 hr

# CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 2208 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

# AGENCY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION