

SPECIAL SPECIFICATION

SECTION 15090S

POLYMER PROCESS PIPING SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe and pipe fittings.
- B. Valves.
- C. Pipe Spacing and supports.

1.02 REFERENCES/PROJECT REQUIREMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. ANSI B31.9 - Building Service Piping.
- C. ANSI/ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- D. ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- E. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- F. ASTM F441 - Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40, 80 and 120.
- G. ASTM D2464 - Threaded Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- H. ASTM F437 - Threaded Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- I. ASTM D2467 - Socket Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

- J. ASTM F439 - Socket Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- K. ASTM D2564 - Poly (Vinyl Chloride) (PVC) Solvent Cement.
- L. ASTM F493 - Chlorinated Poly (Vinyl Chloride) (CPVC) Solvent Cement.
- M. ASTM F656 - Poly (Vinyl Chloride) (PVC) Joint Primers.
- N. ASTM D2855 - Poly (Vinyl Chloride) (PVC) Joint Cementing Procedures.
- O. ANSI B16.5 - 150 lb. Pipe Flanges and Flanged Fittings.
- P. ASTM D4101 - Standard Specification for Polypropylene Plastic Injection and Extrusion Materials.
- Q. ASTM D3222 - Standard Specification for unmodified (Poly Vinylidene Fluoride) (PVDF) Molding Materials.
- R. ASTM D2657 - Standard Practice for Heat Joining Polyolefin Pipe and Fittings.
- S. **Section 15250 S Pipe and Equipment Insulation for the MicroFab.**
- T. Section 13085S Seismic Protection
- U. **ASTM D3307-1 Standard Specification for Perfluoroalkoxy (PFA) Fluorocarbon Resin Molding and Extrusion Materials.**

1.03 DEFINITIONS

- A. not used

1.04 SYSTEM DESCRIPTION

- A. not used

1.05 SUBMITTALS

- A. Submit under provisions of Sections 01300 and 15050.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.06 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASTM D2657 as listed above.
- C. Welders Certification: In accordance with ASTM D2657.
- D. Maintain one copy/copies of each document on site.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.08 - 1.15

- A. not used

1.16 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01300.

1.17 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01300.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.18 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

- B. Installer: Company specializing in performing the work of this section with minimum three years documented experience.

1.19 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.20 EXTRA MATERIALS

- A. Not used

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Polypropylene (PP) Pipe and Fittings: Asahi, George Fischer or approved equal.
- B. Flame retardant polypropylene Pipe and Fittings: **Enfield**, George Fischer or approved equal.
- C. Polyvinylidene Fluoride (PVDF) Piping and Fittings: George Fischer or approved equal.
- D. Polyvinylchloride (PVC) Pipe and Fittings: Chemtrol, Spears, Asahi, George Fisher or approved equal.
- E. Chlorinated Polyvinylchloride (CPVC) Pipe and Fittings: Chemtrol, Spears, Asahi, George Fisher or approved equal.

2.02 EXISTING PRODUCTS

- A. not used

2.03 MATERIALS

- A. Polypropylene Piping and **Components for RO water, DI recycling water, 50% NaOH Acid Waste and Fluoride Waste:**
 - 1. ASAHI Pro-150 and/or Pro-45 pipe or George Fischer **Fuseal** Polypropylene Pipe conforming to ASTM D-4101 or approved equal.
 - 2. Pipe: Hydro-statically rated at 150 psi for Pro-150 and 45 psi for Pro-45 and conform to ASTM D2837-85

3. Fittings: Conform to same requirements specified for pipe.
4. Butt-welded construction with an approved welding device, certified personnel and meeting the requirements of ASTM D2657 Section 9.
5. Field inspect joints for flaws or discontinuities in weld bead.
6. Flanged Connections, where indicated: Make using stub end and backing ring arrangements, with approved gasketing material. Refer to Drawings for gasket specification.
7. Double Contained Piping: Duo-Pro Thermoplastic Pipe by ASAHI or FloSate with primary and secondary containment material consisting of Pro-150 pipe.
8. Minimum Hanger Spacing:

Size (inches)	PRO 45 Spacing (feet)	PRO 150 Spacing (feet)	Size (inches)	PRO 45 Spacing (feet)	PRO 150 Spacing (feet)
3/8	1.7	3.0	6	3.9	7.0
1/2	1.7	3.0	8	4.1	7.5
3/4	1.7	3.0	10	4.7	8.5
1	1.9	3.5	12	5.2	9.5
1-1/4	2.2	4.0	14	5.5	10.0
1-1/2	2.5	4.5	16	5.8	10.5
2	2.8	5.0	18	6.3	11.5
3	3.0	5.5	20	6.6	12.0
4	3.3	6.0	24	7.4	13.5

9. Hanger Spacing for Double Contained Piping: Follow same table as for single containment pipe; use secondary pipe diameter to determine hanger spacing.
10. PP Pipe Installed Outdoors: Protected from UV radiation by insulation **with aluminum jacket**.
11. Heat Tracing: Per manufacturer's recommendations for piping external to any temperature controlled area or where extreme temperature differences may be encountered. See engineering guide distributed by piping manufacturer for appropriate heat tracing methods. Double contained piping shall have heat tracing installed on the outer pipe surface with insulation.

B. Flame Retardant Polypropylene Piping and Components **for Acid Waste and Fluoride Waste:**

1. **Enfield and** George Fischer Polypropylene Pipe conforming to ASTM D-4101 or approved equal.
2. Pipe: Hydro-statically rated at 30-foot head of water
3. Fittings: Conform to same requirements specified for pipe.
4. Electrofusion construction with an approved electrofusion device, certified personnel and meeting the requirements of ASTM F1290.
5. Field inspect joints for flaws or discontinuities in fusion joint.
6. Flanged Connections, where indicated: Make using stub end and backing ring arrangements, with approved gasketing material. Refer to Drawings for gasket specification.
7. **Double Contained Piping: Encase Pipe by Enfield.**
8. Minimum Hanger Spacing at 73°F:

Size (inches)	Spacing (feet)		Size (inches)	Spacing (feet)	
1-1/2	4.75		6	8	
2	5.25		8	8.5	
3	6.25		10	9.5	
4	6.75		12	10	

. Heat Tracing: Per manufacturer's recommendations for piping external to any temperature controlled area or where extreme temperature differences may be encountered. See engineering guide distributed by piping manufacturer for appropriate heat tracing methods. Double contained piping shall have heat tracing installed on the outer pipe surface with insulation.

C. Polyvinylidene Fluoride (PVDF) Piping and Components **for DI water and H2SO4:**

1. **Asahi**, George Fischer SYGEF HIGH PURITY (HP) PVDF pipe, fittings and valves, or approved equal, shall be utilized where noted, otherwise, standard SYGEF PVDF material, or approved equal is acceptable.

2. Material of the highest quality natural unpigmented virgin PVDF homopolymer conforming to ASTM D-3222.
3. Pressure ratings for PVDF piping through 4 inch (110 mm): 232 psi (16 bar).
4. Pressure ratings for PVDF piping greater than 4 inch (110 mm): 150 psi (10 bar).
5. Pipe shall be manufactured in a cleanroom environment per +GF+ specifications.
6. Fittings: SYGEF HP Infrared butt fusion fittings designed for use in +GF+ IR-63 or IR-225 welding tool.
7. HP fittings: Pre-cleaned and double bagged upon arrival at job site.
8. Join pipe with +GF+ IR-63 or IR-225 welding tool by certified welders trained by +GF+ personnel.
9. Field inspect joints for flaws or other discontinuities in weld area and replaced if integrity of joint is questionable.
10. Minimum Hanger Spacing: As follows for fluids at 20 degrees C (68 degrees F):

Size (OD)(mm)	Size (OD) (in)	Minimum Hanger Spacing (inches)
20	1/2	37.5
25	3/4	39.375
32	1	43.250
40	1-1/4	49.250
50	1-1/2	55.125
63	2	59.0
75	2-1/2	65.0
90	3	70.875
110	4	78.75
160	6	94.488
200	8	100.394
225	9	106.3

11. If fluids are at higher temperatures, correct hanger spacing per manufacturer's recommendations. See +GF+ Engineering guide for SYGEF HP PVDF Pipe.
12. **Double Contained Piping: Duo-Pro Thermoplastic Pipe by ASAHI or FloSate with primary and secondary containment material consisting of Pro-150 pipe.**

13. Gaskets: Expanded PTFE, with full face or bolt alignment hole construction by W.L. Gore, or equal.

D. Polyvinyl Chloride (PVC) Piping and Components:

1. PVC pipe, fittings and valves to be manufactured by Chemtrol, Asahi, Fisher, Spears or approved equal.
2. Material manufactured in accordance with ASTM D-1784, grey color.
3. Protect pipe and fittings with UV inhibitors to provide for long term outdoor exposure.
4. Socket Welded Fittings: Manufactured with diameters, lengths and wall thickness' as in accordance with ASTM D-2467.
5. Fittings: Heavy duty, hub style.
6. Flanges: One-piece solid design and compatible with ANSI B16.5 Class 150 metal flanges.
7. Unions: O-ring seal type with interchangeable components with true union ball valves for system versatility.
8. Pipe: Meet pressure requirements of ASTM D-1785 for pressure rated piping systems.
9. Valves, Unions and Flanges: Pressure rated at 150 psi for water service at 73 degree F, non-shock, with minimum burst requirement of 3.3 times rated pressure.
10. Mark pipe and fittings with manufacturer's name, material, ASTM number or alternate symbol indicating compliance with applicable standards, NSF seal of approval for conveyance of potable water and country of manufacture.
11. All pipe shall have solvent welded connections in accordance with ASTM D-2564. Under no circumstances is back welding allowed on pipe to pipe joints, pipe to fitting joints or any other configuration. Otherwise, installation shall be as specified by manufacturer's printed instructions.
12. Hanger spacing shall be per manufacturer's recommendations.

13. If fluids are at higher temperatures, correct hanger spacing per manufacturer's recommendations.

E. Chlorinated Polyvinyl Chloride (CPVC) Piping and Components for Reclaim water, Process Vacuum and Process Chilled Water:

1. Chemtrol CPVC pipe, fittings and valves or equal.
2. Material manufactured in accordance with ASTM D-1784, light grey color.
3. Protect pipe and fittings with UV inhibitors to provide for long term outdoor exposure.
4. Socket Welded Fittings: Manufactured with diameters, lengths and wall thickness' as in accordance with ASTM F-439. Components utilizing taper pipe threaded joints shall conform to ASTM F-437.
5. Pipe diameters and wall thickness to conform to ASTM F-441.
6. Fittings: Heavy duty, hub style.
7. Flanges: One piece solid design and compatible with ANSI B16.5 Class 150 metal flanges.
8. Unions: O-ring seal type with interchangeable components with true union ball valves for system versatility.
9. Pipe: Meet pressure requirements of ASTM F-441 for pressure rated piping systems.
10. Valves, Unions and Flanges: Pressure rated at 150 psi for water service at 73 degrees F, non-shock, with minimum burst requirement of 3.3 times rated pressure.
11. Mark pipe and fittings with manufacturer's name, material, ASTM number or alternate symbol indicating compliance with applicable standards, NSF seal of approval for conveyance of potable water and country of manufacture.
12. All pipe shall have solvent welded connections in accordance with ASTM F-493. Under no circumstances is back welding allowed on pipe to pipe joints, pipe to fitting joints or any other configuration. Otherwise, installation shall be as specified by the manufacturer's printed instructions.
13. Hanger spacing per manufacturer's recommendations.

14. If fluids are at higher temperatures, correct hanger spacing per manufacturer's recommendations.

F. Perfluoroalkoxy (PFA) Piping and Components for 50% NaOH and 93% H₂SO₄:

1. **Entegris Fluoroline Double Containment Tubing and Fluoroline 4100 or approved equal.**
2. **Pipe: Hydro-statically rated at 150 psi for single containment and primary piping**
3. **Fittings: Conform to same requirements specified for pipe.**
4. **Flaretek or Quickgrip Connections: Connecting PFA tubing according to manufacturer's recommended procedure.**
5. **Minimum Hanger Spacing: Support PFA tubing by using continuous support.**
6. **PFA Pipe Installed Outdoors: Protected from UV radiation by insulation with aluminum jacket.**
7. **Heat Tracing: Per manufacturer's recommendations for piping external to any temperature controlled area or where extreme temperature differences may be encountered. See engineering guide distributed by piping manufacturer for appropriate heat tracing methods. Double contained piping shall have heat tracing installed on the outer pipe surface with insulation.**

2.04 - 2.11

A. not used

PART 3 - EXECUTION

3.01 - 3.04

A. Not Used

3.02 INSTALLATION

A. Refer to Part 3 of Section 15401 - Plumbing Piping, for additional requirements.

- B. Install in accordance with manufacturer's instructions unless noted otherwise, specifically noted otherwise in writing.
- C. Provide sleeves where piping passes through walls, floors or roofs.
- D. To meet job condition, lines may be set up or down as required within limits specified herein or shown in Drawings. Make provisions for necessary venting and draining at these points.
- E. Install automatic vents at all high points in the system or otherwise where necessary.
- F. Before insulating, perform necessary hydrostatic test:
 - 1. Temporarily cap pipes as required.
 - 2. Fill with water.
 - 3. Apply as a minimum, hydrostatic pressure of 125 psig or 1.5 times operating pressure to pressurized piping. (see section 15233-S for gravity drain test)
 - 4. Inspect and repair and leaks in lines.
 - 5. Maintain test pressure for 24 hours without loss.
 - 6. Tests to be witnessed by an authorized representative of Owner.
 - 7. After completion of hydrostatic tests, apply protective coatings and insulation to pipes as per insulation specification 15250.
- G. Install pipe sizes as shown on Drawings.
- H. **Hangers should provide a minimum 0.75 in contact area to pipe and shall be free of sharp edges/burrs that may damage pipe due to friction.**

3.06- 3.15

- A. not used

END OF SECTION