

**Interdisciplinary Science Building
Webster University
Cannon Design Project No. 004561.01**

Project: Webster ISB Substitution Request Number: 24
From: _____
To: Melissa Pirtle stl-
cac@cannondesign.com Date: 7/1/16
Re: _____ Contract For: _____

Specification Title: Processed Water Systems Description: RO/DI Equipment And Piping
Material
Section: 2.3-2.5 Page: 226700-6 Article/Paragraph: 2.3-2.5

Proposed Substitution: Georg Fisher PPro-Seal Fusion Weld
Trade Name: Pipefitters
Model No.: _____
Manufacturer: Georg Fischer
Address: 9271 Jeronimo
Irvine, CA 92618
Phone: 800-854-4090 Manufacturer Web Page: [http://www.georgfischer.com/content/gf/co
m/en.html](http://www.georgfischer.com/content/gf/co
m/en.html)

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

Savings to Owner for
accepting substitution: Thirty Thousand Dollars (\$ 30,000)

Proposed substitution
changes Contract Time: ☒ No ☐ Yes [Add] [Deduct] _____ days.

The Undersigned Bidding General Contractor/Construction Manager Certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified products.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

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- The following supporting data is attached to this request and verifies the above statements:

☐ Drawings

☒ Product Data

☐ Samples

☐ Tests

☐ Reports

☒ Other (explain) PPro-Seal has been used in high profile laboratory projects all across

the St. Louis area. Instances where piping crossed plenum spaces, piping was wrapped

With plenum rated duct wrap.

Submitted by: Alex Chambers

Signed by: Alex Chambers

Contractor: icon Mechanical

Address: 1616 Cleveland Blvd

Granite City, IL 62040

Phone: 618-452-0035 : achambers@iconmech.com

Review and Action

☐ Substitution approved – Make submittals in accordance with the Specifications.

☒ Substitution approved as noted – Make submittals in accordance with the Specifications.

☐ Substitution rejected – Use specified materials.

☐ Substitution received too late – Use specified materials.

Comments:

1. Valves and piping accessories at each floor level shall remain accessible for adjustment and service.
2. Fire Wrapping shall be installed in full accordance with the manufacturers recommendations for the specific application.
3. The contractor is fully responsible for obtaining approvals form all governing authorities prior to installation.

Mike Whitworth WES July 21, 2106

Signed by: _____ Date: _____



Icon Mechanical

1616 Cleveland Blvd. • Granite City, IL 62040
www.iconmech.com

PROJECT: Webster ISB

PROJECT NO: 5768

CONTRACTOR: Paric

CONTRACT NO: 150510001

ARCHITECT: Cannon

DATE: 6/27/16

REQUEST FOR INFORMATION NO. 008

FROM: icon Mechanical	TO: Paric / Cannon / TAO
SUBJECT: RO/DI Piping Material Change and Price Deduct	
RESPONSE REQUIRED BY:	DRAWING/SPEC REFERENCE: 226700
QUESTION: The current specified piping for the process water system is listed with a plenum rating and very high water purity. The cost of this material is very high as is the labor to install. The only plenum spaces are in the corridors. The specified piping is for water of much greater purity than that of what we have for this building. Can the piping material be changed from the current SYGEF PVDF piping to a Polypropylene "PPro-Seal" piping?	
SUGGESTION/IMPACT: <u>Suggestion:</u> It is suggested to change to the PPro-Seal piping in lieu of the SYGEF PVDF piping. With SYGEF PVDF piping, all joints must be made on the ground with a very expensive and time consuming IR weld machine, which will make it difficult for facilities staff to add branch lines or drops in the future. PPro-Seal uses electrofusion welds which can be made above ceiling in tight places and is readily available at a local vendor at very low cost. PPro-Seal is used all over the St. Louis area for RO/DI systems. To accommodate the non-plenum rated PPro-Seal piping, crossing the plenum (the corridors) will be kept to a bare minimum and that piping that does cross the plenum will be wrapped with a plenum rated insulation (this has been done on recent projects). At the full height walls in the corridors, to avoid any future penetrations being made and not sealed, icon will install labels every few feet that read something like, "Do not penetrate drywall" or "Seal any and all penetrations through wall". This is something that can be discussed with facilities staff as well. Plenum rated CPVC is also considered for an alternate piping material. PPro-Seal piping material submittal is attached. <u>Impact:</u> The estimated potential DEDUCT and CREDIT to Webster for the change in piping material is \$30,000+.	
ANSWERED BY: RESPONSE:	
ESTIMATED COST (IF KNOWN): \$30,000 CREDIT to Webster	REQUESTED BY: Alex Chambers



PPro-Seal™
Natural Polypropylene
Piping System

→Pipe, Valves, Fittings
→Electrofusion
→Mechanical Joint



GF Piping Systems PPro-Seal™

High Purity Natural Polypropylene

PPro-Seal pipe, valves and fittings are manufactured from a virgin polypropylene copolymer that meets the requirements of ASTM D4101 and is compliant with FDA 21.CFR 177.1520 Sections A1, B and C.

There are no plasticizers, pigments or any other contaminants that could affect the fluid medium. The result is a highly pure product ideal for use in piping systems where purity is not only required, but is essential.

To preserve cleanliness and prevent contamination in transit, all PPro-Seal pipe, valves and fittings are specially packaged at the point of manufacture.

Applications

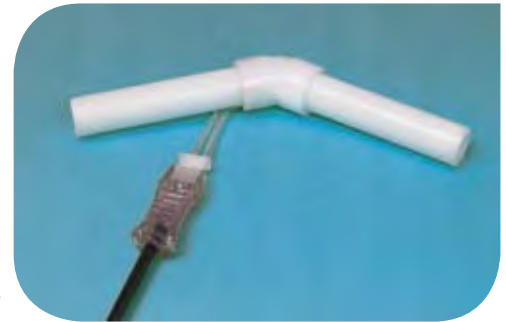
Natural Polypropylene's (PPn) chemical and physical properties make it ideal for laboratory and industrial piping where mixtures of acids, bases, and solvents are involved, such as

- deionized water systems
- reverse osmosis systems
- chemical effluent treatment plants
- chemical processing
- food and beverage processing



Joining Methods

The PPro-Seal system utilizes the patented Fuseal® electrofusion joining method, using electrical resistance coils that are energized by one of our state of the art fusion units.



Threaded fittings are also available and are an ideal solution if future disassembly is needed.

An engineer or contractor can combine the benefits of the PPro-Seal electrofusion joint and the mechanical joint in a single system. PPro-Seal joints are made quickly, surely and economically.

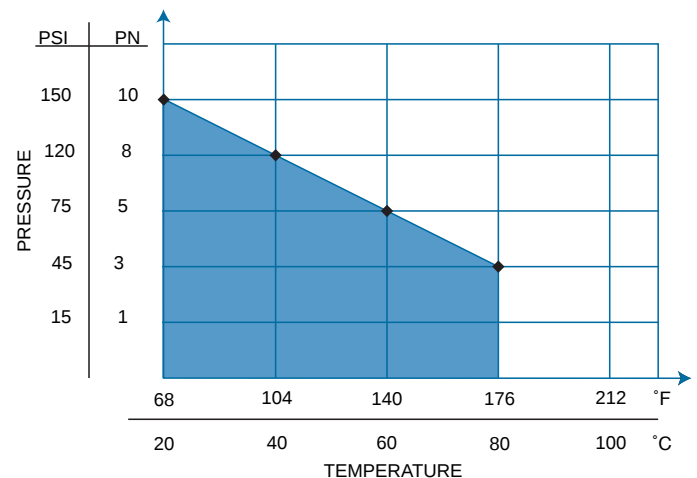
The MSA250-SE or EX unit is the most advanced fusion unit in our industry, featuring advanced transformer technology. These units can be used to join all the George Fischer Sloane, Inc. specified products including Fuseal, Fuseal Squared™, and Fuseal 25/50™ PVDF.

Flow, Temperature and Pressure Rating

PPro-Seal's smooth interior walls result in lower pressure loss and a higher volume of flow that results in a Hazen-Williams C Factor of 150.

PPro-Seal handles corrosive fluids up to 176°F (80°C), beyond the range of many thermoplastics. The maximum pressure for the electrofusion system is 150 psi (10 bar) @ 68°F (20°C).

Threaded systems are not recommended for pressure applications.



Easy and Reliable Solution for Natural Polypropylene Piping Systems



→ Excellent Chemical and Corrosion Resistance

PPro-Seal has excellent resistance to attack by most organic and inorganic chemicals in common use. In general, it is attacked only by strong oxidizing acids and is weakened by certain organic solvents and chlorinated hydrocarbons.

Like all thermoplastic products, PPro-Seal will not rust, pit, scale or corrode. PPro-Seal is not subject to electrolysis, providing years of maintenance-free, leak-free service.

→ Rugged

PPro-Seal has excellent impact strength at ambient temperatures and retains much of its impact resistance down to 0°F (-17.8°C).

Dimensions

PPro-Seal pipe, valves and fittings are available in standard IPS sizes from ½" to 3" and threaded fittings are available in standard IPS sizes from ½" to 2".

True Union Ball Valves

PPro-Seal True Union Ball Valves Type 375 meet the same rigid design and construction as other George Fischer valves, featuring PTFE seats backed with FPM O-rings, a blowout-proof stem with double seals, a floating ball design, and a fully serviceable and adjustable seat carrier. The valves are supplied with both electrofusion socket and female NPT threaded end connectors.



Specification for PPro-Seal Piping System

Natural Polypropylene Pipe and Fittings

Pipe will be manufactured to the dimensions and tolerances of ASTM D1785 as supplied by George Fischer Sloane, Inc. Fittings will be manufactured to the dimensions and tolerances of George Fischer Sloane, Inc. and be compatible with the pipe. The material will be natural virgin copolymer polypropylene with no added plasticizers, pigments or re-grind that meets the requirements of ASTM D4101 and is compliant with FDA 21.CFR 177.1520 Sections A1, B and C. All pipe and fittings shall have a pressure rating up to 150 psi at 68°F. All pipe and fittings shall be packaged in polybags at the point of manufacturing to preserve cleanliness.

Pipe and fittings are joined by either electrofusion or threaded connections. Electrofusion joints will conform to ASTM F1290 and consist of a polypropylene coated wire. Threaded joints will conform to NPT dimensions and tolerances. (Note: Threaded fittings are not recommended for pressure systems).

PPro-Seal Type 375 Natural Polypropylene Valve

Ball valves shall be of True Union design with two-way blocking capability as supplied by George Fischer Sloane, Inc. Valves shall have a blow-out proof stem with double stem seals. All O-rings shall be FPM and the valve seats shall be PTFE with an elastomeric backing of the same material as the valve seals. The valve shall be of floating ball design with full Schedule 80 bore. All ball valves shall have an adjustable seat carrier that can be adjusted or removed using the valve handle as a spanner wrench. All valves shall be supplied with both electrofusion socket and NPT threaded end connectors. The material will be natural virgin copolymer polypropylene with no added plasticizers, pigments or re-grind that meets the requirements of ASTM D4101 and is compliant with FDA 21.CFR 177.1520 Sections A1, B and C. The valve Type 375 shall have a pressure rating up to 150 psi at 68°F. All valves shall be packaged in containers at the point of manufacturing to preserve cleanliness.

The technical data given in this publication implies no warranty of whatever kind and is subject to change without notice. Please consult our Terms and Conditions of Sale.

GF Piping Systems

Natural Polypropylene Piping System

Specification Submittal Data Sheet

PPro-Seal™ Natural Polypropylene Pipe and Fittings

Pipe

Pipe will be manufactured to the dimensions and tolerances of ASTM D1785. The material will be from natural virgin copolymer polypropylene with no added plasticizers, pigments or re-grind that is compliant with US Food and Drug Administration regulations 21.CFR 177.1520 Sections A1, B & C, USP 25 Class VI, and conforms to ASTM D4101. All pipes shall be packaged in polybags at the point of manufacturing to preserve pipe cleanliness.

☒ PPn Sch.80 Group II Pipe - 10 ft. Lengths

Fittings

Fittings will be manufactured to the dimensions and tolerances of George Fischer Sloane, Inc. The material will be from natural virgin copolymer polypropylene with no added plasticizers, pigments or re-grind that is compliant with US Food and Drug Administration regulations 21.CFR 177.1520 Sections A1, B & C, USP 25 Class VI, and conforms to ASTM D4101. All fittings shall be packaged in polybags at the point of manufacturing to preserve fitting cleanliness.

☒ PPn Sch.80 Molded - Electrofusion

☐ PPn Sch.80 Molded - Threaded

Joining

Pipe and fittings are joined by either electrofusion or threaded connections. Electrofusion joints will conform to ASTM F1290 and consist of a polypropylene jacketed wire. Threaded joints will conform to NPT dimensions and tolerances. (Note: Threaded fittings are not recommended for pressure systems).

☒ Electrofusion

☐ Threaded

Job Name: _____

Job Location: _____

Engineer: _____

Contractor: _____

Representative: _____

GF Piping Systems

Natural Polypropylene Piping System

Specification Submittal Data Sheet

PPro-Seal™ Natural Polypropylene True Union Ball Valve Type 375

Ball Valve

Ball valves shall be of True Union design with two-way blocking capability. Valves shall have a blow out proof stem with double stem seals. All O-rings shall be FPM and the valve seats shall be PTFE with an elastomeric backing of the same material as the valve seals. The valve shall be of floating ball design with full Schedule 80 bore. All ball valves shall have an adjustable seat carrier that can be adjusted or removed using the valve handle as a spanner wrench. The material will be natural virgin copolymer polypropylene with no added plasticizers, pigments or re-grind that meets the requirements of ASTM D4101 and is compliant with FDA 21.CFR 177.1520 Sections A1, B & C, and USP 25 Class VI. The valve Type 375 shall have a pressure rating up to 150 psi at 68°F. All valves shall be packaged in containers at the point of manufacturing to preserve cleanliness.

☒ PPn True Union Ball Valve Type 375

Joining

Valves are joined to pipe and fittings by either electrofusion or threaded connections. Electrofusion joints will conform to ASTM F1290 and consist of a polypropylene jacketed wire. Threaded joints will conform to NPT dimensions and tolerances. (Note: Threaded fittings are not recommended for pressure systems).

☒ Electrofusion

☐ Threaded

Job Name: _____

Job Location: _____

Engineer: _____

Contractor: _____

Representative: _____

GF Piping Systems

Natural Polypropylene Piping System

Specification Submittal Data Sheet

PPro-Seal™ Natural Polypropylene Diaphragm Valve Type 515

Diaphragm Valve

Diaphragm valves upper body will be of glass-filled polypropylene material connected to lower body with no exposed metal fasteners. All interior metal parts are to be sealed from outside influence. A position indicator must be present to determine diaphragm position. Diaphragms to be from EPDM material with EPDM, FPM, NBR, PTFE/EPDM, PTFE/PFM blended elastomer backing. Metal threaded bushings shall be molded into lower body to facilitate mounting. Diaphragm valves lower body material will be natural virgin polypropylene with no added plasticizers, pigments or re-grind that meets the requirements of ASTM D4101 as pertains to type I homopolymer compound having a minimum tensile strength of 4350 psi at 73°F when tested in accordance with ASTM D-638 and shall have a melt point which initiates at 316°F. The melt flow index (at 374°F) shall be 0.4–0.8 grams per 10 minutes in accordance with ASTM D-1238. The valve Type 515 shall have a pressure rating up to 150 psi at 68°F. All valves shall be packaged in containers at the point of manufacturing to preserve cleanliness.

- ☐ PPN Diaphragm Valve Type 515
- ☐ Standard lockable handle
- ☐ Graduated position indicator
- ☐ Optional limit switch package

Joining

Valves are joined to pipe and fittings by electrofusion connections. Electrofusion joints will conform to ASTM F1290 and consist of a polypropylene jacketed wire.

- ☐ Electrofusion

Job Name: _____

Job Location: _____

Engineer: _____

Contractor: _____

Representative: _____

PPro-Seal Installation and Engineering Data

Thermal Expansion Compensation

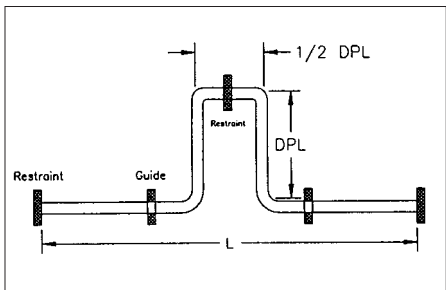
PPro-Seal Expansion Loop

Polypropylene PPro-Seal		Length of Run (feet)									
		10	20	30	40	50	60	70	80	90	100
Pipe Size	O.D. of Pipe	Minimum Deflected Pipe Length (inches)									
1 1/2"	1.900	22	31	37	43	48	53	57	61	65	68
2"	2.375	24	34	42	48	54	59	64	68	72	76
3"	3.500	29	41	51	59	66	72	78	83	88	93
4"	4.500	33	47	58	67	74	81	88	94	100	105
6"	6.625	40	57	70	81	90	99	107	114	121	128
8"	8.625	46	65	80	92	103	113	122	130	138	146

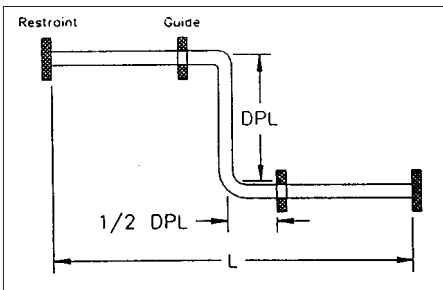
PPro-Seal Offsets and Change of Directions

Polypropylene PPro-Seal		Length of Run (feet)									
		10	20	30	40	50	60	70	80	90	100
Pipe Size	O.D. of Pipe	Minimum Deflected Pipe Length (inches)									
1 1/2"	1.900	31	43	53	61	68	75	81	86	92	97
2"	2.375	34	48	59	68	76	84	90	97	103	108
3"	3.500	41	59	72	83	93	102	110	117	124	131
4"	4.500	47	67	81	94	105	115	124	133	141	149
6"	6.625	57	81	99	114	128	140	151	161	171	180
8"	8.625	65	92	113	130	146	160	172	184	195	206

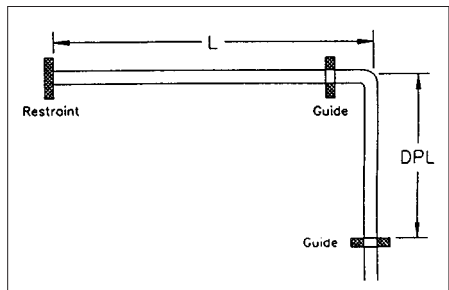
Expansion Loop and Offset Configuration for Polypropylene



Expansion Loop



Expansion Offset



Change of Direction

Pressure Rated System

The PPro-Seal Electrofusion piping system is pressure rated at 150 psi (10 bar) @ 72°F (23°C). The derating factors for elevated temperatures are as follows:

Derating Factor for PPro-Seal Electrofusion

106°F	142°F	178°F
0.7	0.5	0.25

PPro-Seal Valve Pressure Ratings

Valves are pressure rated at:

Size	1/2"	3/4"	1"	1 1/2"	2"
psi (bar)	150	140	140	120	150

8

Surge Pressure

The following table gives the surge pressure (water hammer) in copolymer polypropylene pipe for various velocities at 73°F (23°C). The surge pressure should be added to the static line pressure to determine the maximum system operating pressure. In no case should this be over 1 1/2 times the recommended working pressure. This will, under normal conditions, ensure adequate safety to absorb the shock of closing valves.

Surge Pressure, Ps (psi) — Schedule 80 PP

$$P_s = V \left(\frac{E t}{E t + 3 \times 10^5 D_i} \right)^{1/2}$$

Where:

V = Water Velocity,
ft./sec.

E = Modulus of Elasticity
1.5 x 10⁵ psi

t = Wall Thickness, in.

Water Velocity (ft./sec.)	Nominal Pipe Size (in.)				
	1/2	3/4	1	1 1/2	2
1	23.5	20.9	20.0	17.1	15.9
2	47.0	41.8	40.0	34.2	31.6
3	70.5	62.7	60.0	51.3	47.4
4	94.0	83.6	80.0	68.4	63.2
5	117.5	104.5	100.0	85.5	79.0
6	141.0	125.4	120.0	102.6	94.8

Support Spacing

When thermoplastic piping systems are installed above ground, they must be properly supported to avoid unnecessary stresses and possible sagging. On horizontal runs, hangers of the various types should be used at approximately the spacing given in the following chart. Note that additional support is needed as temperatures increase. At elevated temperatures, continuous support, in the form of a smoothly textured structural angle or channel, is required.

Support Spacing, (ft.), Copolymer Polypropylene — Schedule 80

Pipe Size (in.)	1/2	3/4	1	1 1/2	2
73°F	3 3/4	4	4 1/2	5	5 1/2
120°F	3 1/2	3 3/4	4	4 3/4	5
140°F	3	3 1/2	3 3/4	4 1/4	4 1/2
160°F	3	3	3 1/2	4	4 1/4
180°F	2 3/4	3	3 1/4	3 3/4	4

Table based on .100 in. sag between supports.

Short Term Collapse Pressure

Polypropylene pipe is often used for suction lines or in applications where external pressures are applied to the pipe, such as in heat exchangers or underwater loading conditions. The differential pressure rating of the pipe is determined by derating the short term collapse pressures. Collapse pressure must be adjusted for temperature differences other than for room temperature. The Short-Term Collapse Pressure chart used to adjust pipe pressure rating may be used for this purpose (see note below table).

Short Term Collapse Pressure (psi), Pressure Polypropylene — Schedule 80

Pipe Size (in.)					
1/2	3/4	1	1 1/4	1 1/2	2
1011	876	823	612	412	278

Note: These are short term ratings, long term should be reduced by 1/3 to 1/2 of the short term ratings.

Soil Load — Schedule 80 Pipe

Underground pipe is subjected to external loads caused by the weight of the backfill material and by loads applied at the surface of the fill. These can range from static to dynamic loads.

Static loads comprise the weight of the soil above the top of the pipe and any additional material that might be stacked above ground. An important point is that the load in a flexible pipe will be less than on a rigid pipe buried in the same manner. This is because the flexible conduit transfers part of the load to the surrounding soil and not the reverse. Soil loads are minimal with narrow trenches until a pipe depth of 10 feet is attained.

Dynamic loads are loads caused by moving vehicles such as trucks, trains and other heavy equipment. For shallow burial conditions, live loads should be considered and added to static loads, but at depths greater than 10 feet, live loads have very little effect.

Live Loads for Buried Flexible Pipe (lb./in.ft.)

Pipe Size (in.)	H 20 Wheel Loads for Various Depths of Pipe (lb./in. ft.)				
	2	4	6	8	10
2	309	82	38	18	16
3	442	118	56	32	21
4	574	154	72	42	27
6	837	224	106	61	40
8	1102	298	141	82	53
10	1361	371	176	101	66
12	1601	440	210	120	73

Note: H 20 wheel load is 16,000 lb./wheel



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2882 Dow Avenue
Tustin, California 92780-7258
USA
Phone +1 (714) 731-8800
Toll free (800) 854-4090
us.ps@georgfischer.com
www.gfpiping.com

Submittal Package for PPro-Seal Piping Systems

Date:	
Project Name:	
Submitted To:	
From:	

This document includes:

1. Submittal Form
2. Technical Information – material
3. Product Information
 - a. PPro-Seal Natural
4. Joining Technology
 - a. Electro Fusion
5. Warranty Statement



PPro-Seal™
Natural Polypropylene
Piping System

→Pipe, Valves, Fittings
→Electrofusion
→Mechanical Joint



GF Piping Systems PPro-Seal™

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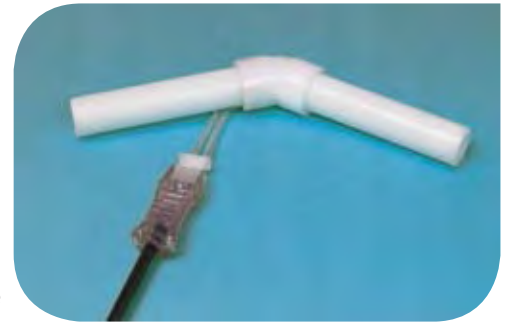
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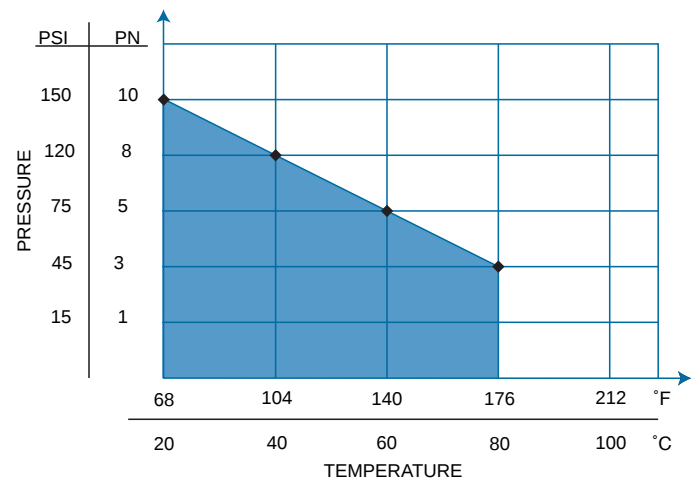
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→ Rugged

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Dimensions

PPro-Seal pipe, valves and fittings are available in standard IPS sizes from ½" to 3" and threaded fittings are available in standard IPS sizes from ½" to 2".

True Union Ball Valves

PPro-Seal True Union Ball Valves Type 375 meet the same rigid design and construction as other George Fischer valves, featuring PTFE seats backed with FPM O-rings, a blowout-proof stem with double seals, a floating ball design, and a fully serviceable and adjustable seat carrier. The valves are supplied with both electrofusion socket and female NPT threaded end connectors.



Specification for PPro-Seal Piping System

Natural Polypropylene Pipe and Fittings

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Pipe and fittings are joined by either electrofusion or threaded connections. Electrofusion joints will conform to ASTM F1290 and consist of a polypropylene coated wire. Threaded joints will conform to NPT dimensions and tolerances. (Note: Threaded fittings are not recommended for pressure systems).

PPro-Seal Type 375 Natural Polypropylene Valve

Ball valves shall be of True Union design with two-way blocking capability as supplied by George Fischer Sloane, Inc. Valves shall have a blow-out proof stem with double stem seals. All O-rings shall be FPM and the valve seats shall be PTFE with an elastomeric backing of the same material as the valve seals. The valve shall be of floating ball design with full Schedule 80 bore. All ball valves shall have an adjustable seat carrier that can be adjusted or removed using the valve handle as a spanner wrench. All valves shall be supplied with both electrofusion socket and NPT threaded end connectors. The material will be natural virgin copolymer polypropylene with no added plasticizers, pigments or re-grind that meets the requirements of ASTM D4101 and is compliant with FDA 21.CFR 177.1520 Sections A1, B and C. The valve Type 375 shall have a pressure rating up to 150 psi at 68°F. All valves shall be packaged in containers at the point of manufacturing to preserve cleanliness.

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PPro-Seal Installation and Engineering Data

Thermal Expansion Compensation

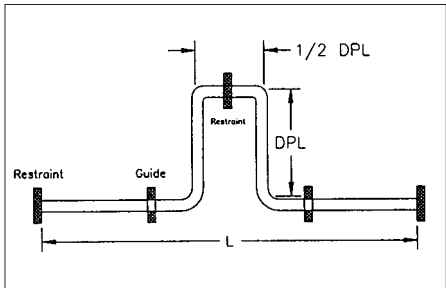
PPro-Seal Expansion Loop

Polypropylene PPro-Seal		Length of Run (feet)									
		10	20	30	40	50	60	70	80	90	100
Pipe Size	O.D. of Pipe	Minimum Deflected Pipe Length (inches)									
1 1/2"	1.900	22	31	37	43	48	53	57	61	65	68
2"	2.375	24	34	42	48	54	59	64	68	72	76
3"	3.500	29	41	51	59	66	72	78	83	88	93
4"	4.500	33	47	58	67	74	81	88	94	100	105
6"	6.625	40	57	70	81	90	99	107	114	121	128
8"	8.625	46	65	80	92	103	113	122	130	138	146

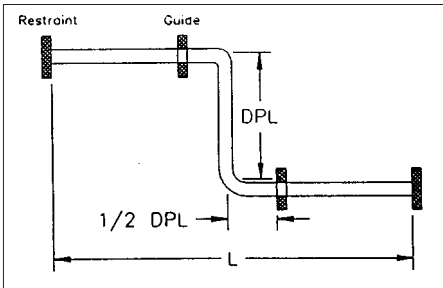
PPro-Seal Offsets and Change of Directions

Polypropylene PPro-Seal		Length of Run (feet)									
		10	20	30	40	50	60	70	80	90	100
Pipe Size	O.D. of Pipe	Minimum Deflected Pipe Length (inches)									
1 1/2"	1.900	31	43	53	61	68	75	81	86	92	97
2"	2.375	34	48	59	68	76	84	90	97	103	108
3"	3.500	41	59	72	83	93	102	110	117	124	131
4"	4.500	47	67	81	94	105	115	124	133	141	149
6"	6.625	57	81	99	114	128	140	151	161	171	180
8"	8.625	65	92	113	130	146	160	172	184	195	206

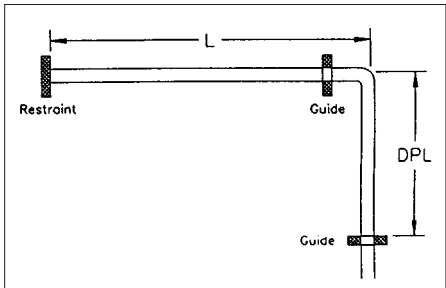
Expansion Loop and Offset Configuration for Polypropylene



Expansion Loop



Expansion Offset



Change of Direction

Pressure Rated System

The PPro-Seal Electrofusion piping system is pressure rated at 150 psi (10 bar) @ 72°F (23°C). The derating factors for elevated temperatures are as follows:

Derating Factor for PPro-Seal Electrofusion

106°F	142°F	178°F
0.7	0.5	0.25

PPro-Seal Valve Pressure Ratings

Valves are pressure rated at:

Size	1/2"	3/4"	1"	1 1/2"	2"
psi (bar)	150	140	140	120	150

8

Surge Pressure

The following table gives the surge pressure (water hammer) in copolymer polypropylene pipe for various velocities at 73°F (23°C). The surge pressure should be added to the static line pressure to determine the maximum system operating pressure. In no case should this be over 1 1/2 times the recommended working pressure. This will, under normal conditions, ensure adequate safety to absorb the shock of closing valves.

Surge Pressure, Ps (psi) — Schedule 80 PP

$$P_s = V \left(\frac{E t}{E t + 3 \times 10^5 D_i} \right)^{1/2}$$

Where:

V = Water Velocity,
ft./sec.

E = Modulus of Elasticity
1.5 x 10⁵ psi

t = Wall Thickness, in.

Water Velocity (ft./sec.)	Nominal Pipe Size (in.)				
	1/2	3/4	1	1 1/2	2
1	23.5	20.9	20.0	17.1	15.9
2	47.0	41.8	40.0	34.2	31.6
3	70.5	62.7	60.0	51.3	47.4
4	94.0	83.6	80.0	68.4	63.2
5	117.5	104.5	100.0	85.5	79.0
6	141.0	125.4	120.0	102.6	94.8

Support Spacing

When thermoplastic piping systems are installed above ground, they must be properly supported to avoid unnecessary stresses and possible sagging. On horizontal runs, hangers of the various types should be used at approximately the spacing given in the following chart. Note that additional support is needed as temperatures increase. At elevated temperatures, continuous support, in the form of a smoothly textured structural angle or channel, is required.

Support Spacing, (ft.), Copolymer Polypropylene — Schedule 80

Pipe Size (in.)	1/2	3/4	1	1 1/2	2
73°F	3 3/4	4	4 1/2	5	5 1/2
120°F	3 1/2	3 3/4	4	4 3/4	5
140°F	3	3 1/2	3 3/4	4 1/4	4 1/2
160°F	3	3	3 1/2	4	4 1/4
180°F	2 3/4	3	3 1/4	3 3/4	4

Table based on .100 in. sag between supports.

Short Term Collapse Pressure

Polypropylene pipe is often used for suction lines or in applications where external pressures are applied to the pipe, such as in heat exchangers or underwater loading conditions. The differential pressure rating of the pipe is determined by derating the short term collapse pressures. Collapse pressure must be adjusted for temperature differences other than for room temperature. The Short-Term Collapse Pressure chart used to adjust pipe pressure rating may be used for this purpose (see note below table).

Short Term Collapse Pressure (psi), Pressure Polypropylene — Schedule 80

Pipe Size (in.)					
1/2	3/4	1	1 1/4	1 1/2	2
1011	876	823	612	412	278

Note: These are short term ratings, long term should be reduced by 1/3 to 1/2 of the short term ratings.

Soil Load — Schedule 80 Pipe

Underground pipe is subjected to external loads caused by the weight of the backfill material and by loads applied at the surface of the fill. These can range from static to dynamic loads.

Static loads comprise the weight of the soil above the top of the pipe and any additional material that might be stacked above ground. An important point is that the load in a flexible pipe will be less than on a rigid pipe buried in the same manner. This is because the flexible conduit transfers part of the load to the surrounding soil and not the reverse. Soil loads are minimal with narrow trenches until a pipe depth of 10 feet is attained.

Dynamic loads are loads caused by moving vehicles such as trucks, trains and other heavy equipment. For shallow burial conditions, live loads should be considered and added to static loads, but at depths greater than 10 feet, live loads have very little effect.

Live Loads for Buried Flexible Pipe (lb./in.ft.)

Pipe Size (in.)	H 20 Wheel Loads for Various Depths of Pipe (lb./in. ft.)				
	2	4	6	8	10
2	309	82	38	18	16
3	442	118	56	32	21
4	574	154	72	42	27
6	837	224	106	61	40
8	1102	298	141	82	53
10	1361	371	176	101	66
12	1601	440	210	120	73

Note: H 20 wheel load is 16,000 lb./wheel

Section 3

PPro-Seal™ Natural PP Piping System

Serviced by GF Little Rock



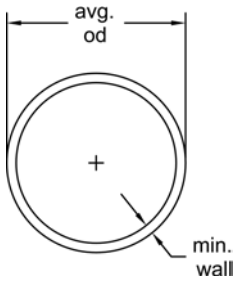
PPro-Seal™ Natural PP

PPro-Seal Pipe

Schedule 80 PPn

20' lengths available upon request

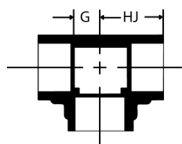
All pipe must be ordered in lift quantities to maintain cleanliness.



Size [inch]	lengths [ft]	Part No.	Lift Qty [ft]	Minimum Order Qty [ft]	avg. od [inch]	min. wall [inch]	
1/2	10	N8008-005AA *	250	250	0.840	0.147	
3/4	10	N8008-007AA *	150	150	1.050	0.154	
1	10	N8008-010AA *	100	100	1.315	0.179	
1 1/2	10	N8008-015AA *	40	40	1.900	0.200	
2	10	N8008-020AA *	30	30	2.375	0.218	
3	10	N8008-030AA *	10	10	3.500	0.300	

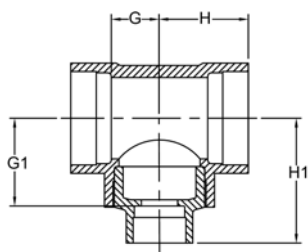
PPro-Seal™ Natural PP

PPro-Seal Electrofusion Fittings



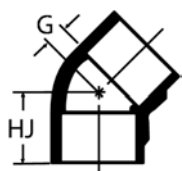
Tee (S x S x S)

Size [inch]	Part No.	Minimum Order Qty	G [inch]	HJ [inch]	
1/2	801-005F	5	0.51	1.22	
3/4	801-007F	5	0.58	1.36	
1	801-010F	5	0.70	1.67	
1 1/2	801-015F	2	1.00	2.03	
2	801-020F	2	1.26	2.32	
3	801-030F	1	1.87	3.72	



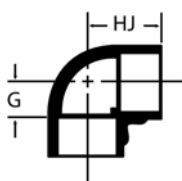
Tee - Reducing (S x S x S)

Size [inch]	Part No.	Minimum Order Qty	G [inch]	G1 [inch]	H [inch]	H1 [inch]	
1 x 1/2	801-130FFB *	2	0.70	1.75	1.67	2.46	
1 1/2 x 1/2	801-209F	2	0.88	1.35	1.91	1.88	
1 1/2 x 1	801-211FFB *	2	1.00	2.03	2.03	3.00	
2 x 1/2	801-247F	2	0.86	1.62	2.02	2.16	
2 x 1	801-249FFB *	2	1.26	2.29	2.32	3.26	



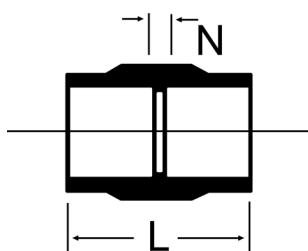
45° EII (S x S)

Size [inch]	Part No.	Minimum Order Qty	G [inch]	HJ [inch]	
1/2	817-005F	5	0.31	1.02	
3/4	817-007F	5	0.33	1.11	
1	817-010F	5	0.39	1.36	
1 1/2	817-015F	2	0.52	1.55	
2	817-020F	2	0.64	1.70	
3	817-030F	1	0.81	2.66	



90° EII (S x S)

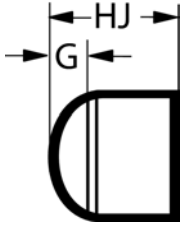
Size [inch]	Part No.	Minimum Order Qty	G [inch]	HJ [inch]	
1/2	806-005F	5	0.51	1.22	
3/4	806-007F	5	0.58	1.36	
1	806-010F	5	0.70	1.67	
1 1/2	806-015F	2	1.00	2.03	
2	806-020F	2	1.26	2.32	
3	806-030F	1	1.87	3.72	



Coupling (S x S)

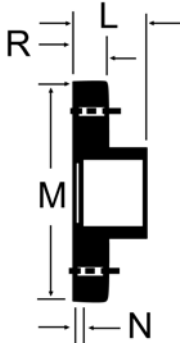
Size [inch]	Part No.	Minimum Order Qty	L [inch]	N [inch]	
1/2	829-005F	5	1.56	0.12	
3/4	829-007F	5	1.68	0.12	
1	829-010F	5	2.06	0.12	
1 1/2	829-015F	2	2.25	0.18	
2	829-020F	2	2.26	0.13	
3	829-030F	1	4.00	0.31	

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Cap (S)

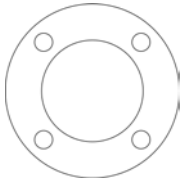
Size [inch]	Part No.	Minimum Order Qty	G [inch]	HJ [inch]	
1/2	847-005F	5	0.42	1.14	
3/4	847-007F	5	0.45	1.23	
1	847-010F	5	0.53	1.50	
1 1/2	847-015F	2	0.63	1.71	
2	847-020F	2	0.75	1.84	
3	847-030F	1	1.00	2.38	



Flange (S) without Backing Ring

Flange Backing Ring recommended for assembly
3" Flange is Van Stone Style

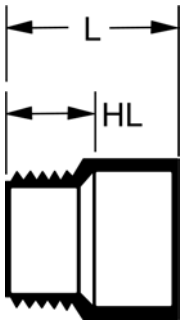
Size [inch]	Part No.	# holes	bolt hole dia. [inch]	bolt cir. dia. [inch]	L [inch]	M [inch]	N [inch]	R [inch]	
1/2	859-005F	4	0.50	2.38	0.86	3.50	0.14	0.41	
3/4	859-007F	4	0.50	2.75	0.97	3.88	0.19	0.47	
1	859-010F	4	0.50	3.13	1.16	4.25	0.19	0.53	
1 1/2	859-015F	4	0.50	3.88	1.24	5.00	0.21	0.66	
2	859-020F	4	0.63	4.75	1.34	6.00	0.28	0.71	
3	854-030F	4	0.63	6.00	2.33	7.50	0.48	1.00	



Flange Backing Ring

Flange Ring Material : PVC Coated Metal

Size [inch]	Part No.	
1/2	855-005F *	
3/4	855-007F *	
1	855-010F *	
1 1/2	855-015F *	
2	855-020F *	
3	855-030F *	



Male Adapter (MPT x S)

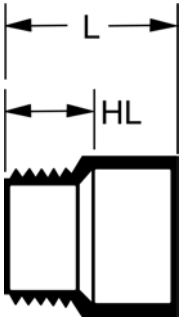
Threaded fittings not recommended for pressure applications

Size [inch]	Part No.	Minimum Order Qty	HL [inch]	L [inch]	
1/2	836-005F	5	1.02	1.73	
3/4	836-007F	5	1.05	1.83	
1	836-010F	5	1.28	2.25	
1 1/2	836-015F	2	1.32	2.35	
2	836-020F	2	1.37	2.43	
3	836-030F	1	2.08	3.93	

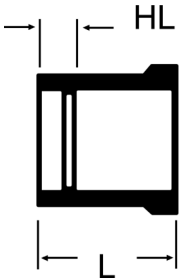
PPro-Seal™ Natural PP

Male Adapter - Reducing (S x MPT)

Threaded fittings not recommended for pressure applications

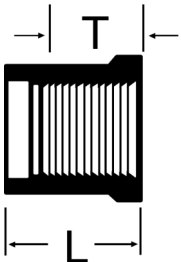


Size [inch]	Part No.	Minimum Order Qty	HL [inch]	L [inch]	
½ x ¼	836-036F	5	0.79	2.00	



Reducer Bushing (Spg x S)

Size [inch]	Part No.	Minimum Order Qty	HL [inch]	L [inch]	
¾ x ½	837-101F	5	1.14	1.86	
1 x ½	837-130F	5	1.03	1.75	
1 x ¾	837-131F	5	1.10	1.88	
1 ½ x ¾	837-210F	2	0.95	1.67	
1 ½ x 1	837-211F	2	1.03	2.00	
2 x 1	837-249F	2	1.03	2.00	
2 x 1 ½	837-251F	2	0.81	1.84	
3 x 1 ½	837-337F	1	0.91	2.40	
3 x 2	837-338F	1	0.88	2.40	



Reducer Bushing (Spg x FPT)

Threaded fittings not recommended for pressure applications

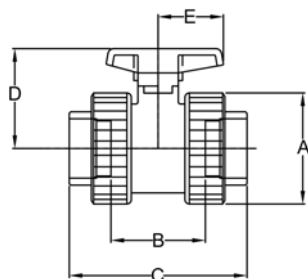
Size [inch]	Part No.	Minimum Order Qty	L [inch]	T min. [inch]	Style	
¾ x ½	838-101F ^	5	1.13	0.53	Flush	
1 x ½	838-130F ^	5	1.75	0.53	Extended	
1 x ¾	838-131F ^	5	1.31	0.55	Flush	
1 ½ x ¾	838-210F ^	2	1.67	0.55	Flush	
1 ½ x 1	838-211F ^	2	1.67	0.68	Flush	
2 x 1	838-249F ^	2	2.00	0.68	Extended	
2 x 1 ½	838-251F ^	2	1.81	0.72	Flush	
3 x 1 ½	838-337F ^	1	2.40	0.72	Flush	
3 x 2	838-338F ^	1	2.40	0.76	Flush	

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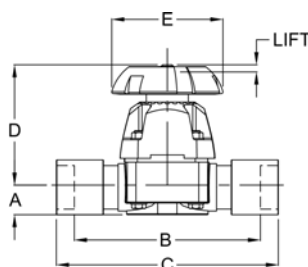
PPro-Seal Valves

Type 375 Ball Valve (S x S) and (FPT x FPT)

O-Ring Material : FPM



Size [inch]	FPM Part No.	A [inch]	B [inch]	C [inch]	D [inch]	E [inch]	
1/2	1088375005F	1.88	1.84	3.86	2.31	1.44	
3/4	1088375007F	2.27	2.08	4.37	2.50	1.44	
1	1088375010F	2.63	2.34	4.86	3.05	1.85	
1 1/2	1088375015F	3.67	3.13	5.87	3.60	2.41	
2	1088375020F	4.48	3.68	6.73	3.95	2.41	
3	1088375030F	6.51	5.67	9.60	5.28	3.07	



Type 315 Diaphragm Valve (S x S)

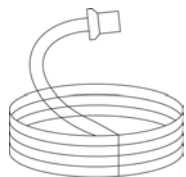
Diaphragm & Backing Ring Material : EPDM

Size [inch]	EPDM Part No.	A [inch]	B [inch]	C [inch]	D [inch]	E [inch]	Lift [ft]	
1/2	1088315005F *	0.55	5.12	6.54	3.54	3.15	0.31	
3/4	1088315007F *	0.69	5.82	7.50	4.02	3.15	0.43	
1	1088315010F *	0.83	6.06	8.00	4.67	3.70	0.51	
1 1/2	1088315015F *	1.28	8.27	10.33	5.47	4.61	0.83	
2	1088315020F *	1.53	9.10	11.22	6.77	5.98	1.10	

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PPro-Seal Fusion Accessories

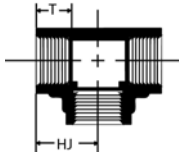
Loose Coil



Size [inch]	Part No.	Minimum Order Qty	
1/2	6076 *	10	
3/4	6077 *	10	
1	6078 *	10	
1 1/2	6086 *	10	
2	6089 *	10	
3	6091 *	10	

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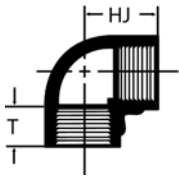
PPro-Seal Threaded Fittings



Tee (FPT x FPT x FPT)

Threaded fittings not recommended for pressure applications

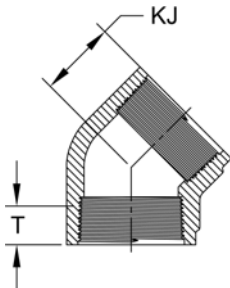
Size [inch]	Part No.	Minimum Order Qty	HJ [inch]	T min. [inch]	
1/2	805-005F	5	1.22	0.53	
3/4	805-007F	5	1.36	0.55	
1	805-010F	5	1.67	0.68	
1 1/2	805-015F	2	2.03	0.72	
2	805-020F	2	2.32	0.76	



90° EII (FPT x FPT)

Threaded fittings not recommended for pressure applications

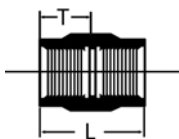
Size [inch]	Part No.	Minimum Order Qty	HJ [inch]	T min. [inch]	
1/2	808-005F	5	1.22	0.53	
3/4	808-007F	5	1.36	0.55	
1	808-010F	5	1.67	0.68	
1 1/2	808-015F	2	2.03	0.72	
2	808-020F	2	2.32	0.76	



45° EII (FPT x FPT)

Threaded fittings not recommended for pressure applications

Size [inch]	Part No.	Minimum Order Qty	KJ [inch]	T min. [inch]	
1/2	819-005F	5	1.02	0.53	
3/4	819-007F	5	1.11	0.55	
1	819-010F	5	1.36	0.68	
1 1/2	819-015F	2	1.55	0.72	
2	819-020F	2	1.70	0.76	



Coupling (FPT x FPT)

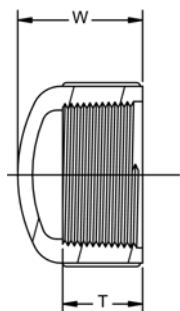
Threaded fittings not recommended for pressure applications

Size [inch]	Part No.	Minimum Order Qty	L [inch]	T min. [inch]	
1/2	830-005F	5	1.56	0.53	
3/4	830-007F	5	1.68	0.55	
1	830-010F	5	2.06	0.68	
1 1/2	830-015F	2	2.25	0.72	
2	830-020F	2	2.26	0.76	

PPro-Seal™ Natural PP

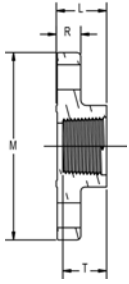
Cap (FPT)

Threaded fittings not recommended for pressure applications



Size [inch]	Part No.	Minimum Order Qty	W [inch]	T min. [inch]	
1/2	848-005F	5	1.14	0.53	
3/4	848-007F	5	1.23	0.55	
1	848-010F	5	1.50	0.68	
1 1/2	848-015F	2	1.71	0.72	
2	848-020F	2	1.84	0.76	

PPro-Seal™ Natural PP

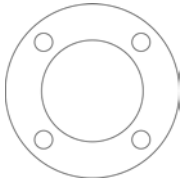


Flange (FPT) without Backing Ring

Flange Backing Ring recommended for assembly

Threaded fittings not recommended for pressure applications

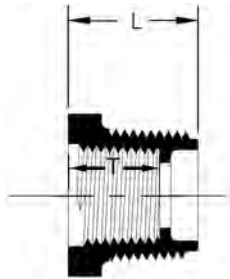
Size [inch]	Part No.	# holes	bolt hole dia. [inch]	bolt cir. dia. [inch]	L [inch]	M [inch]	R [inch]	T min. [inch]
1/2	852-005F	4	0.50	2.38	0.86	3.50	0.41	0.69
3/4	852-007F	4	0.50	2.75	0.97	3.88	0.47	0.69
1	852-010F	4	0.50	3.13	1.16	4.25	0.53	0.81
1 1/2	852-015F	4	0.50	3.88	1.24	5.00	0.66	0.88
2	852-020F	4	0.63	4.75	1.34	6.00	0.71	0.94



Flange Backing Ring

Flange Ring Material : PVC Coated Metal

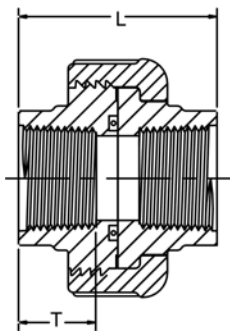
Size [inch]	Part No.
1/2	855-005F *
3/4	855-007F *
1	855-010F *
1 1/2	855-015F *
2	855-020F *



Reducer Bushing (MPT x FPT)

Threaded fittings not recommended for pressure applications

Size [inch]	Part No.	Minimu m Order Qty	L [inch]	T min. [inch]
3/4 x 1/2	839-101F ^	5	1.70	0.53
1 x 1/2	839-130F ^	5	1.77	0.53
1 x 3/4	839-131F ^	5	1.89	0.55
1 1/2 x 1	839-211F ^	2	2.00	0.68
2 x 1	839-249F ^	2	2.00	0.68
2 x 1 1/2	839-251F ^	2	1.81	0.72



Union (FPT x FPT)

Threaded fittings not recommended for pressure applications

Size [inch]	Part No.	Minimu m Order Qty	L [inch]	T min. [inch]
1/2	898-005F	5	2.00	0.53
3/4	898-007F	5	2.08	0.55
1	898-010F	5	2.50	0.68
1 1/2	898-015F	2	2.69	0.72
2	898-020F	2	2.88	0.76

PPro-Seal™ Installation Training



- Joint preparation
- Setting up ½"-3" joints
- Further information
- Written test

236 – PPro-Seal



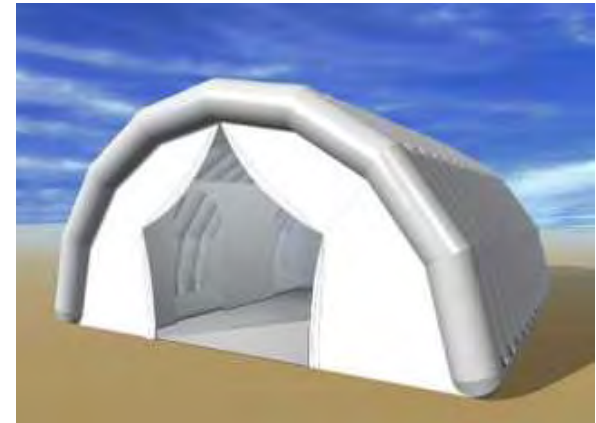
Pipe & Fitting Inspection & Storage

Pipe & fittings should be inspected upon arrival for obvious shipping damage.

Store pipe and fittings in a dry location, protected from direct sunlight. If material is to be stored outside, it should be covered with a light colored tarp to be kept dry and protected from UV damage.

Pipe should be laid on a flat surface to prevent warping.

High purity products should remain in protective bags until the material is in a clean environment.



Installation Environment

Material and fusion machine must be the same temperature prior to fusion. This can be achieved when components and machine are in the same environment for 2 hours.



Considerations Before Starting...

Layout

For pure water systems, the piping system should be designed to prevent dead legs and areas where water can stagnate.

Supports and Restraints

In practice, support spacing is a function of pipe size, operating temperatures, the location of heavy valves or fittings, and the mechanical properties of the pipe material. Valves should always be supported independently of the piping system.

Expansion and Contraction

All piping products expand and contract with changes in temperature. Linear expansion and contraction of any pipe on the longitudinal axis relates to the coefficient of thermal expansion for the specific material.

Water Hammer & Surge Pressure

Surge pressures due to water hammer should be considered when designing a piping system. A momentary pressure rise occurs when the flow of liquid is started and stopped quickly, as a result of the fluid's momentum. Examples of hydraulic shock occur when valves are opened or closed quickly, or pumps are started with an empty discharge line. The surge pressures should be added to the static line pressure to determine the maximum system operating pressure.

Pressure Testing

The purpose of a pressure test is to establish that the installed system will withstand the design working pressure, plus a safety margin, without any leaks. Provisions for draining the system must be made.

Flushing and Sanitizing

Once the systems are installed & tested they should be flushed to remove any foreign particles and then sanitized. Provisions for draining the system must be made.

Clamping and Supporting

There are two ways of clamping plastic pipe:

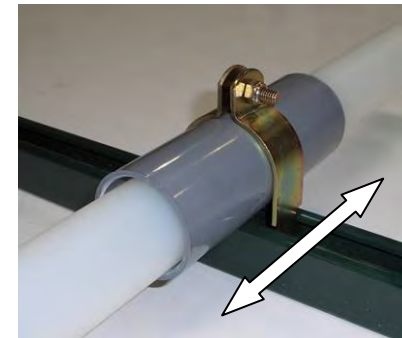
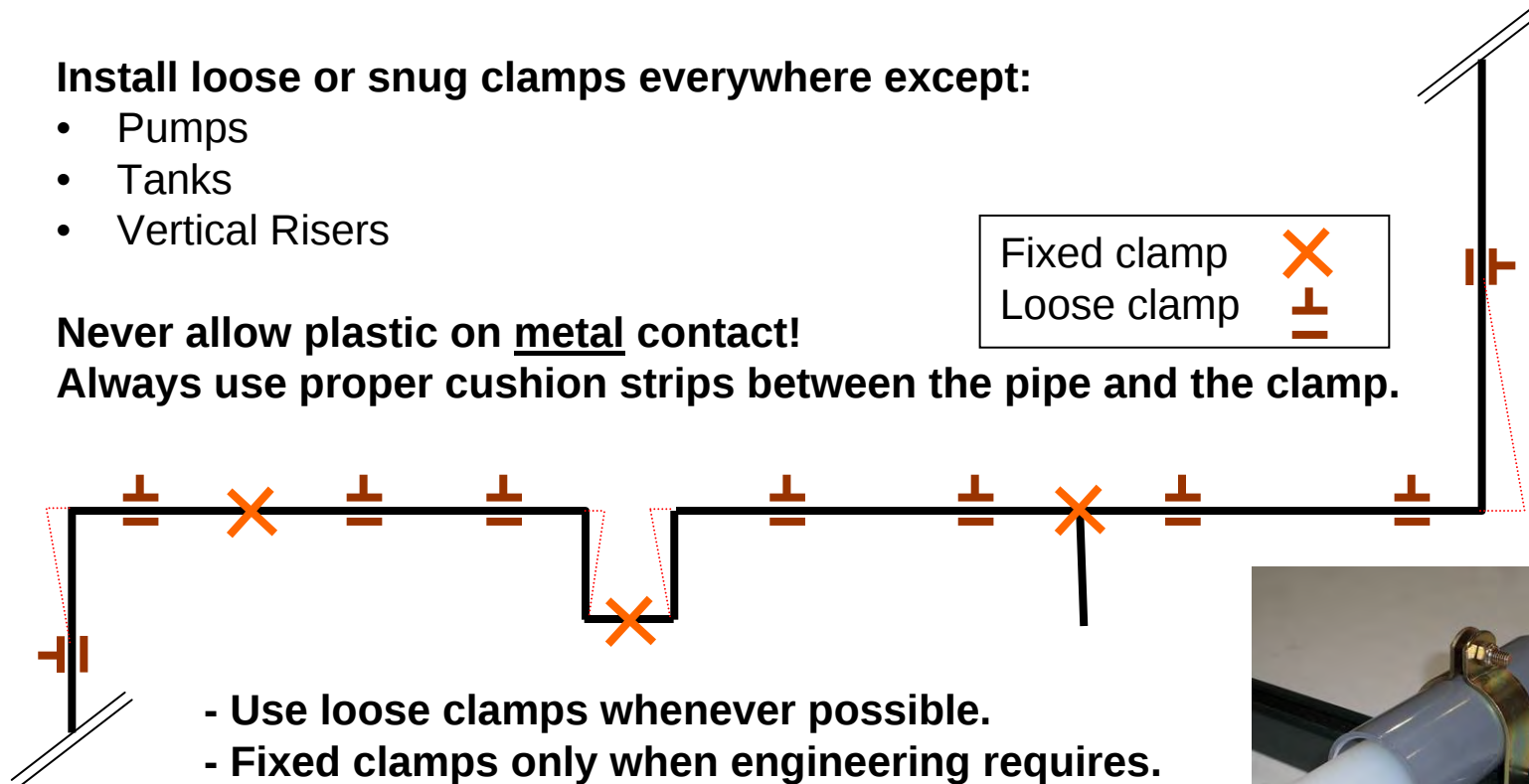
- Fixed / anchored so pipe cannot move.
- Loose / snug allowing pipe to move with expansion and contraction.

Install loose or snug clamps everywhere except:

- Pumps
- Tanks
- Vertical Risers

Never allow plastic on metal contact!

Always use proper cushion strips between the pipe and the clamp.



Clamping and Supporting

A continuous support should be used whenever:

- Spacing of supports are so close they are no longer practical.
- Any high temperature application.
- Overhead structural obstruction that does not permit hangers.

Methods of continuous support:

- Angle Iron
- Channel
- Tray
- Within another pipe



No sharp edges allowed

Always support valves independent from the pipe.

PPro-Seal™ joint preparation ½" - 3"

1.

Cut pipe end square with axis of pipe!

Use a fine tooth hand saw and miter box, a power cutoff saw with blade for plastic or a wheel type pipe cutter for plastic.

***Ratchet Type pipe cutters are not recommended*



Regardless of tool, pipe needs to remain round and square.

2.

Remove all burrs from pipe end.

Chamfer the pipe end to ease insertion of the pipe and to prevent the fusion coil from being displaced.

The deburring tool shown is from Wheeler Rex. www.wheelerrex.com
Part no. 30100, for 1" pipes.

It can be purchased from professional vendors.



PPro-Seal™ joint preparation ½" - 3"

3.

Clean pipe surface and inside of fitting socket with Isopropyl Alcohol Solution. *(i.e. IPA) The alcohol concentration has to be 70% or higher!

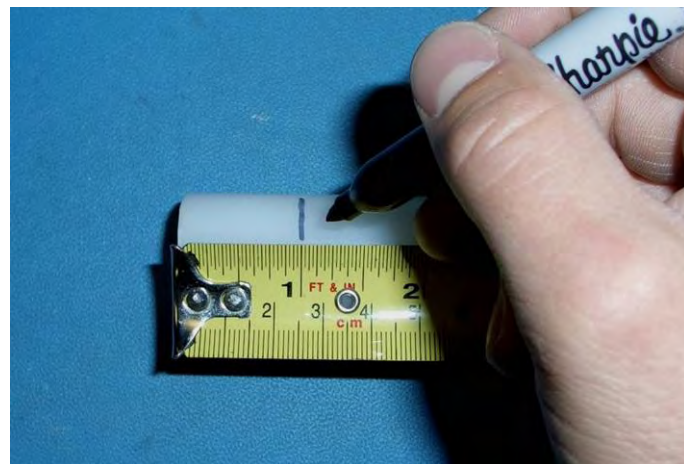
Do not handle the freshly cleaned surfaces before assembling. If the fittings have become excessively dirty due to the atmosphere, coils should be carefully removed and fittings hub and coils cleaned of debris and dirt. Care should be used when removing coils.

* For proper use and safety regulations of IPA, please see supplier's Material Safety Data Sheets

**4.**

Mark socket depth on the pipe.

Fitting	Socket depth
½"	11/16" / 1.8 cm
¾"	25/32" / 1.9 cm
1"	31/32" / 2.4 cm
1½"	1-1/32" / 2.6 cm
2"	1-1/16" / 2.7 cm
3"	1-27/32" / 4.6 cm



Setting up ½" - 3" joints

5.

Insert the pipe end into the fitting socket, while holding the coil wires to one side. The pipe must be fully inserted past the coil to the pipe stop.

Check socket depth mark to be sure the pipe is fully inserted.



6.

Check the continuity of every fusion coil with the continuity tester before fusing.

A green light will indicate a good fusion collar.



MSA250



Electro Plus

Setting up ½" - 3" joints

7.

Connect the factory- supplied fusion cables to the plugs of the fusion coils.

Check how many joints are possible per cycle.

8.

Attach the cable connectors with Velcro self-gripping straps to the pipe, to prevent the fusion wires from pulling out during the fusion process.

Velcro self-gripping straps can be purchased at Home Depot or any other professional vendors.



9.

See the Instructions for the Electro Fusion Machine Trainings.

MSA250-SE or -EX Multi
Training # 236 – MSA250



Electro Plus®
Training # 236 – Electro Plus



End of the Installation

10.

Allow the joint to cool to the touch before disturbing.



End of the Installation

Testing: (see the next slide for detailed information)

Joints may be pressure tested 10 minutes after completion of fusion.

It is a good plumbing practice to test a small section (20 fittings) of the fused piping system first, to ensure proper installation procedures are being performed before continuing with the completion of the system.

Sanitizing:

The basis of any sanitizing procedure would be related to the desired level of system purity. This typically falls within the responsibility of the engineer specifying the system. Please consult the Engineer of Record for requirements.

Pressure Testing of Plastic Piping Systems

Preparation for the Test, Check That:

- ✓ System conforms with installation drawing.
- ✓ Every mechanical connection is checked for proper torquing.
For example: Unions are installed per manufacture recommendations,
Verify bolt torque on all diaphragm valves.
- ✓ Pipe, valves, and fittings are correctly supported and fixed.
- ✓ System is filled with liquid (water) and all air is removed through high point vents. Compressed gas is not allowed!

Pressure Test Suggestion:

Test system to 150% of operational pressure but do not exceed 150 psi @ 68°F or the lowest rated component in the system.

Pressure Loss Due to Elastic Expansion:

It is normal to experience a pressure loss due to elastic expansion generated from the internal pressure and external temperature changes.

In the event of pressure loss, walk the system and look for water on the ground to determine if there is a leak.

Pressure Test Procedure

Pressure Test Procedure of all Georg Fischer Thermoplastic Piping Systems

The following is a general test procedure for Georg Fischer plastic piping. It applies to most applications. Certain applications may require additional consideration. For further questions regarding your application, please contact a Georg Fischer representative.

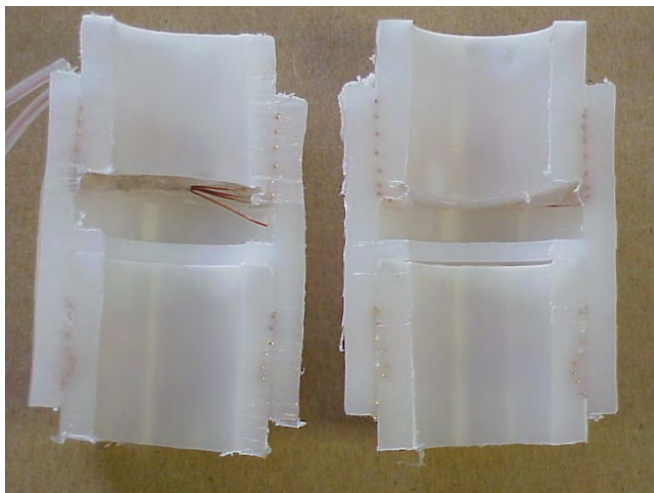
1. All piping systems should be pressure tested prior to being put into operational service.
2. All pressure tests should be conducted in accordance with the appropriate building, plumbing, mechanical, and safety codes for the area where the piping is being installed.
3. When testing plastic piping systems, all tests should be conducted hydrostatically and should not exceed the pressure rating of the lowest rated component in the piping system (often a valve). Test the system at 150% of the designed operational pressure. i.e.: If the system is designed to operate at 80 PSI, then the test will be done at 120 PSI.
4. When hydrostatic pressure is introduced to the system, it should be done gradually through a low point in the piping system with care taken to eliminate any entrapped air by bleeding at high points within the system. This should be done in four stages, waiting ten minutes at each stage (adding $\frac{1}{4}$ the total desired pressure at each stage).
5. Allow one hour for system to stabilize after reaching desired pressure. After the hour, in case of pressure drop, increase pressure back to desired amount and hold for 30 minutes. If pressure drops by more than 6%, check system for leaks.

Note: If ambient temperature changes by more than 10°F during the test, a retest may be necessary.

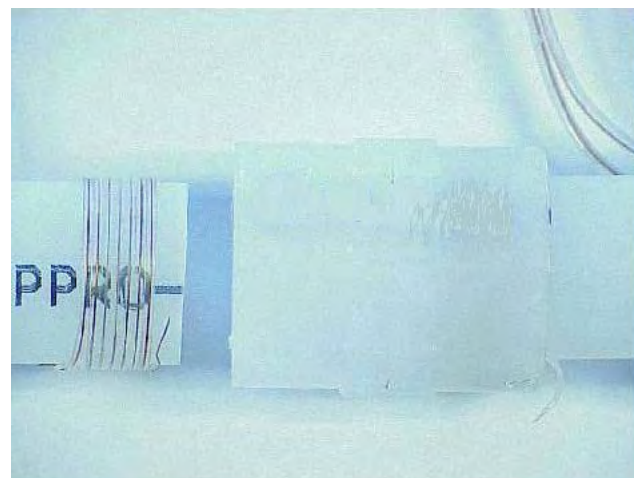


Do not test with gases

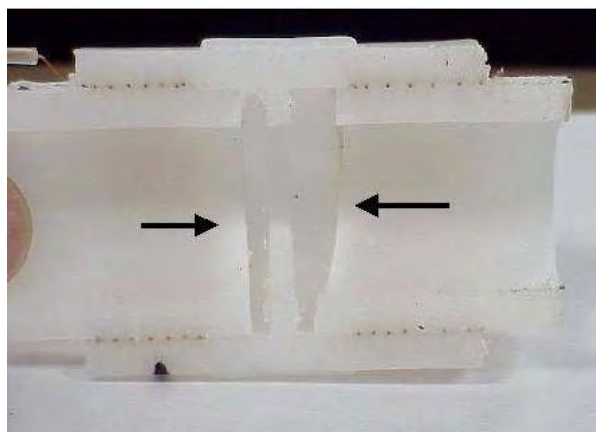
Proper Installations are a must!



Pipe was not fully inserted to the pipe stop!!



Pipe was not cleaned with IPA!



Pipe was not cut square!

To re-fuse a leaking joint...

1. Check the continuity of the fusion coil with the continuity tester to insure coil integrity.
2. Drain the system of water in the area of the leaking joint. Be sure the joint is completely drained & dry.
3. Install & snugly tighten a radiator hose clamp until it has complete contact all the way around the fitting hub.

CAUTION: Do not tighten the clamp past hand tight. There should not be any compression on the joint at this time.

Repeat steps 7 through 10.

4. At the end of the fusion cycle, tighten the clamp drive one full turn.
5. Allow the joint to cool to the touch before removing the clamp.
6. After re-fusing, if the leak is not sealed, cut out the leaking fitting and fuse a new fitting into the system.



Threaded Fittings

In making up threaded joints, care must be taken not to over tighten the joints. Generally, 1/2 to one thread past hand-tight is adequate if the male thread is wrapped with Teflon tape. Further tightening may split female threaded plastic parts.

In general, applications for threaded plastic pipe fittings fall into two categories:

1. Fittings for use in an all plastic system where both the male and female parts are plastic.
2. Fittings for use as transition fittings from plastic to metal.

Theoretically, it is possible to use any combination of threaded parts such as:

Metal male to plastic female
Plastic male to plastic female
Metal female to plastic male

Threaded Fittings

Practical experience suggests that the METAL MALE to PLASTIC FEMALE combination is more susceptible to premature failure than the other two applications.

The reason for this is due to the incompressibility of metal. Standard instructions call for the male part to be run in hand tight and then tightened $\frac{1}{2}$ turn more. It has been our observation, however, that it is very common to find male metal parts screwed in for a total of 7 to 8 threads. This results in excessively high stress levels in the plastic female part.

It is for this reason that GF recommends that its threaded plastic pipe fittings be used only in the following two combinations:

PLASTIC MALE TO PLASTIC FEMALE
PLASTIC MALE TO METAL FEMALE

If it is absolutely necessary to use a plastic female thread for transition to metal nipple, then it is **IMPERATIVE** that the nipple not be turned more than $\frac{1}{2}$ turn past HANDTIGHT ("finger tight" for strong hands).

If using threaded fittings, we recommend not exceeding 25 psi hydrostatic pressure during testing. However, special conditions may apply.



Further Information



If you have any questions regarding the Fuseal System contact your **+GF+ Area Sales Manager.**

For further information about the fusion units, see the instruction manuals.
The machines need to be calibrated and serviced every year according to the service label on the machine.

Place business card here!!

For specific questions about the fusion units, contact our Machine Service Department.
Address for Machine Service and technical questions:

**George Fischer Inc.
Machine Service Department
2882 Dow Avenue
Tustin, CA 92780**

**Phone: (714) 368-4284
Fax: (714) 731-9056**





Electro Plus®

Fusion Machine Training

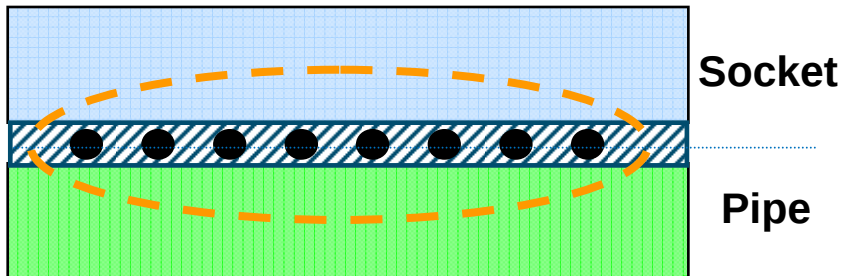
- Machine requirements
- Machine instructions
- Further information
- Written test

236 – Electro Plus



Electrofusion Process

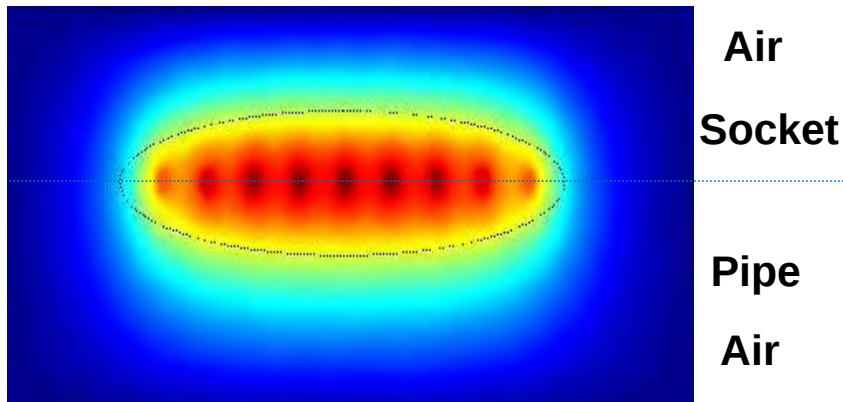
Schematic



The electrofusion process of joining a pipe to a socket uses wires to transfer the heat energy to the plastic material.

The heat energy is sufficient to melt the plastic surrounding the wires. This generates a zone called the “melt zone”.

Computer Simulation



This “melt zone” encapsulates the wires, which are at its origin along the center line.

The picture to the left shows the heat distribution in the “melt zone” region.

Installation Environment

The Electro Plus fusion machine operates within the following temperature range; 14°F (-10°C) to 113°F (45°C). An error will be shown on the hand held display if the ambient temperature is outside of this range.

Material and fusion machine must be the same temperature prior to fusion.

This can be achieved when components and machine are in the same environment for 2 hours.

Please consult your +GF+ Representative if you plan to install product in extreme temperatures (high or low) for proper precautions.





Electro Plus® Fusion Machine

FUSION
POWER UNIT

HAND HELD UNIT
(20' CABLE)

POWER CORD
(5' CABLE)

FUSION CABLE
(15' CABLE w / (4)
3' CONNECTORS)

FOUR DUPLEX
CONNECTORS

Electro Plus® - Specifications

Ensure that the Electro Plus® is positioned on a solid surface.

Connect the Electro Plus® to a wall type receptacle 115 or 230 VAC isolated from heavy power equipment.

If a generator is to be used, be sure it is rated at 3,500 Watts minimum and no other equipment is connected or operated during the fusion cycle.

Also make sure the power cord is not connected when starting the generator.

Parameter	Requirement
Input Voltage	100 - 130 VAC, 60 Hz AC RMS or 200 - 250 VAC, 50 Hz AC RMS
Input Current	15 Amps Max.
Output Voltage	0 to 28.5 VAC galvanically separated
Output Current	0 to 50 Amps
Power Consumption	1,200 Watts Max.
Generator Output Performance	3,500 Watts Min.
Fuse Requirement	(1) 15 amp ceramic slo-blo (2) 7 amp ceramic slo-blo
Extension Cord Requirements	150 ft (46 m) max length 10 gauge / 3 strand min

Electro Plus® - Set Up

1.

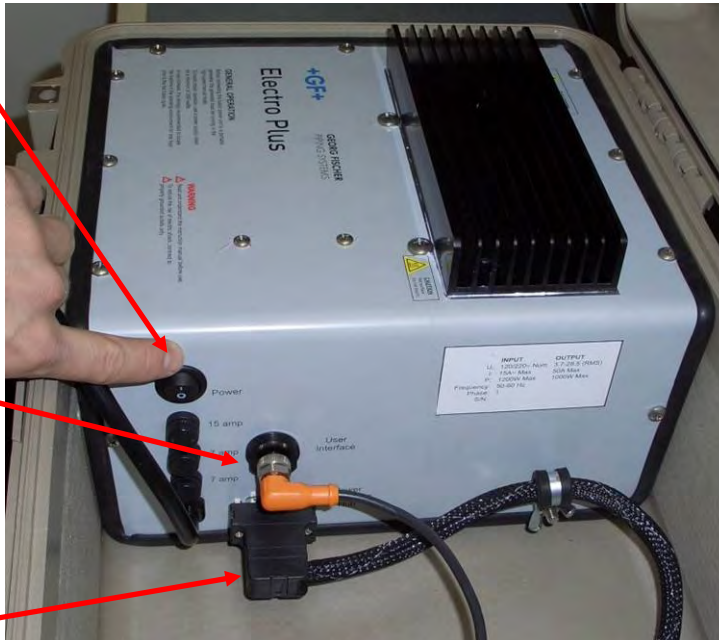
Switch the Electro Plus machine on.

When powered up the LCD will show GEORGE FISCHER followed by information about the firmware. This start up takes about 10 seconds. Afterwards the main menu will be displayed as shown below and the machine is ready to use.

Power
Switch

Hand Held
Unit
Connection

Fusion
Cable
Connection



The Electro Plus® fusion machine runs a system startup check every time when switched on. The machine automatically configures itself for the voltage it is connected to, and adjusts for the ambient temperature.

Electro Plus® - Guide Through the Menu

2.

Choose the product to be fused with
The UP and DOWN arrow.

Select with the arrow to the right.

**3.**

Choose the size to be fused with
The UP and DOWN arrow.

Select with the arrow to the right.

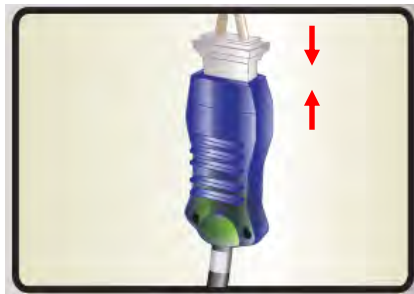
(If at any time you need to move back,
press the arrow to the left.)



Electro Plus® - Preparation for Fusion

4.

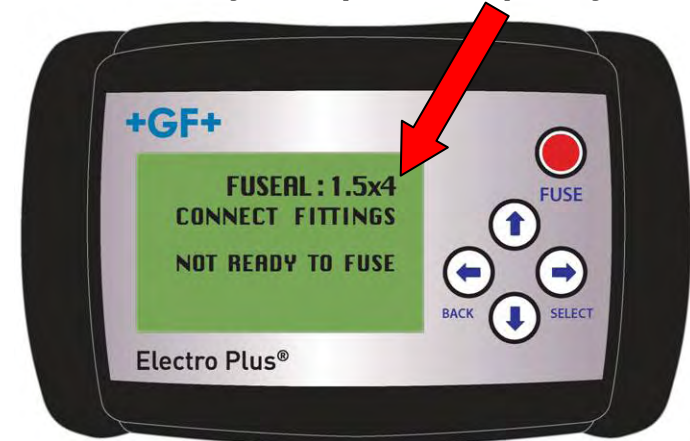
Connect the fusion cables to the duplex connector of the fittings.
(Make sure you note the number of joints allowed per cycle)



A green light in the plug of the fusion cable and a number displayed in the LCD indicates the cable is connected and the fusion coil has continuity.

If a light does not illuminate the coil is possibly damaged and has to be replaced.

Number of joints possible per cycle.



Numbers 1, 2, 3 or 4 in the display indicate which cables are connected.



Electro Plus® - The Fusion Cycle

5.

Once everything is set-up correct, press the red FUSE button to start the fusion.

Red lights in the fusion plugs indicate the fusion is in progress.

The remaining fusion time and the input line voltage is shown on the LCD.



6.

After the fusion time is up, green lights in the fusion plugs will illuminate and "Fusion OK" message on the LCD will appear.



Electro Plus® - End of Fusion Cycle

7.

All fusion cables must be disconnected from the fittings.

(Machine will not accept additional fusion prompts until continuity is broken)

Remember to allow the joint to cool for 10 minutes before disturbing.

You can repeat steps 5 & 6 to fuse the same size and material again or select a new size or material by selecting the arrow to the left as required.



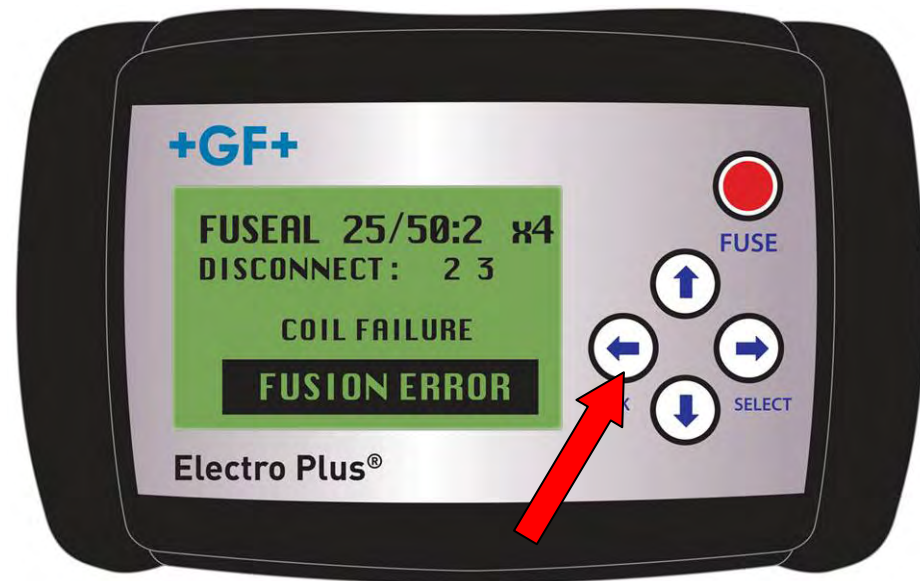
Error Messages – Causes/Remedies

Error Message	Cause / Remedy
Errors that can occur before the fusion	
1. "TOO COLD TO FUSE"	The ambient temperature is below 14°F (-10°C).
2. "TOO HOT TO FUSE"	The ambient temperature is above 113°F (45°C).
3. "TOO MANY FITTINGS"	Disconnect all fittings from fusion cables. Check how many fittings can be connected for this size. Then reconnect the right number of fittings and press FUSE.
4. "SSR TOO HOT"	Solid State Relay too hot. Allow the machine to cool for 5 minutes and try again.
5. "XMFR TOO HOT"	Transformer too hot. Allow the machine to cool for 5 minutes and try again.
6. "FUSION ERROR COIL SHORTED"	Coil in fitting is shorted. Disconnect all fittings from the fusion cables. Replace damaged coils if necessary.
Errors that can occur during the fusion cycle	
1. "HI VOLTS EXCURSION"	Output voltage above the range. Verify the input power supply.
2. "LO VOLTS EXCURSION"	Output voltage below the range. Verify the input power supply.
3. "CAN'T REGULATE"	Unable to maintain output voltage. Verify the input power supply.
4. "FUSION TERMINATED COIL SHORTED"	Coil in fitting shorted during the fusion. Disconnect all fittings from the fusion cables. Replace damaged coils if necessary.
Errors that can occur after the fusion cycle	
1. "COIL FAILURE"	A fusion cable has been disconnected during the fusion cycle or a fusion coil has lost continuity. The cable number (1-4) for the failed coil will blink on the LCD screen.

How to Erase the Displayed ERROR!

After you checked the cause for the Error during the fusion cycle, you need to erase it from the display. If there are multiple fittings fused at the same time, the number of the connectors that failed will blink. All the other fittings were fused properly.

1. Disconnect all the fusion cables
2. Press the back Button



Calibration & Part Numbers

The Fusion Cable requires calibration every year since it is critical to the operation of the machine.

The Fusion Power Unit requires calibration every two years because it only measures the incoming voltage and is not as critical to the operation of the machine.

The unit WARNS the user that calibration is due, but does not prevent the unit from being used.

Electro Plus®



Part Number : 150.000.001

Fusion Power Unit



Part Number : 150.000.002

Hand Held Unit



Part Number : 150.000.003

Fusion Cable



Part Number : 150.000.004



Further Information



If you have any questions regarding the Electro Plus® fusion machine contact your **+GF+ Area Sales Manager.**

For specific questions about the Electro Plus® contact our Machine Service Department.

Place business card here!!

Address for Machine Service and Technical Questions:

**George Fischer LLC
Machine Service Department
2882 Dow Avenue
Tustin, CA 92780**

**Phone: (714) 368-4284
Fax: (714) 731-9056**



MSA250 SE/EX Multi Training



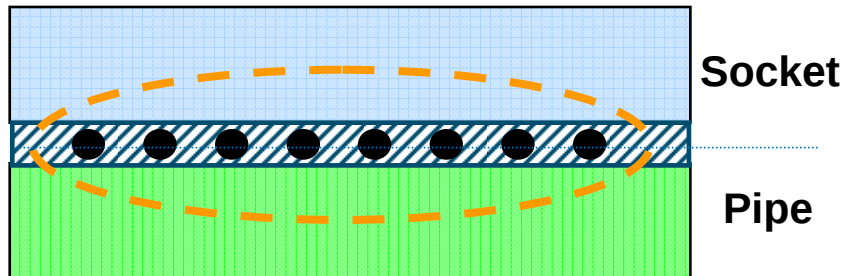
- Machine requirements
- Machine instructions
- Further information
- Written test

236 – MSA250



Electrofusion Process

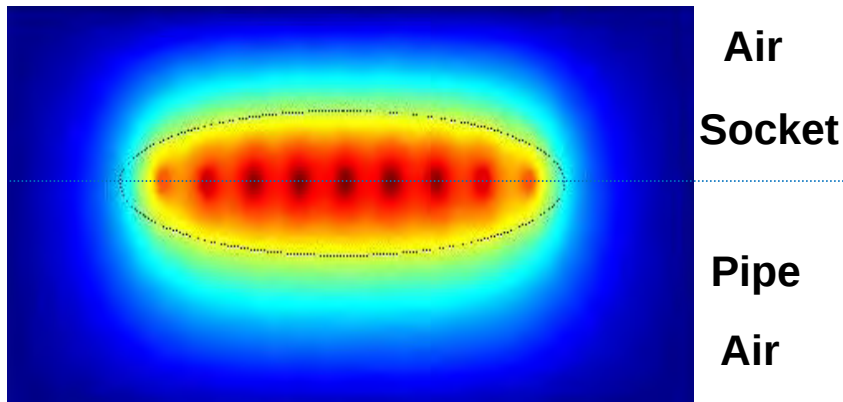
Schematic



The electrofusion process of joining a pipe to a socket uses wires to transfer the heat energy to the plastic material.

The heat energy is sufficient to melt the plastic surrounding the wires. This generates a zone called the “melt” zone.

Computer Simulation



This “melt” zone encapsulates the wires, which are at its origin along the center line.

The picture to the left shows the heat distribution and the “melt” zone region.

Power requirements MSA250 SE / EX Multi

1.

Ensure that the MSA250 is standing firmly and the cooling fan is unobstructed.

Plug the power cord into a suitable AC power source.

If the MSA250 is used on a power generator, make sure the MSA250 is not plugged in when starting up the generator due to power peaks during the start up.

MSA250 SE

Input Voltage	110-120 VAC
Frequency	60 Hz
Input Current	15 Amps
Length of power cord	150' max. (10 gauge / 3 strand)

MSA250 EX / EX Multi

Input Voltage	210-240 VAC
Frequency	50 Hz
Input Current	15 Amps
Length of power cord	150' max. (10 gauge / 3 strand)

After plugging in the MSA250, the display shows 4 dashes (----) indicating the machine has started up and is ready to fuse.

The MSA250 Fusion Machines operate in the following temperature range: **+14°F (-10°C) to +113°F (+45°C)**. If it is out of this range, E5 or E6 is shown on the display.



Joint fusion with MSA250 SE / EX Multi

2.

Select the appropriate barcode (i.e. correct material and size) and scan the barcode with the barcode reader.



Number of joints possible per cycle.

The barcode reader operates best when held at an angle of 10°-30° from the vertical position and is run across the barcode strip in one continuous movement. **Treat the barcode reader pen with care!**

The fusion unit screen will display the time required for the fusion.

After the appropriate barcode is read and the fusion cables are connected to the fittings, the green light will illuminate on the display of the MSA250.



Joint fusion with MSA250 SE / EX Multi

3.

If everything is set up correctly **press the start/stop key on the MSA250 fusion unit.**



Once the fusion cycle is started the time will count down until zero is reached. To interrupt the fusion cycle press the start/stop key again.

The fusion time read on the display can be a few seconds different from the time on the barcode card, depending on the ambient temperature. This is an adjustment that the machine does automatically.

Joint fusion with MSA250 SE / EX Multi

4.

The audible horn sounds when the fusion cycle is finished.

You will see the following information alternately on the display after a successful fusion.



E0 indicates no errors.

You will find a list of error codes with the barcodes cards, in the instruction manual of the MSA250 and in this training documentation.



10' indicates a cooling time of 10 minutes.

Depending on the dimension and material.



7.9 indicates the energy which was used for the fusion cycle in KJ (Kilojoules).

Depending on the dimension, material and how many fusion cables are connected.

The fusion cables can be removed from the fittings if E0 is shown on the display. **If an error code comes up, check what this code indicates and solve the problem before you do the next fusion. It might be necessary to re-fuse this joint.**

End of the Fusion

5.

Allow the joint to cool to the touch before disturbing,
at least for the cooling time indicated on the machine display.



End of the Fusion

See the installation instructions for the next steps!

Manual Input of Fusion Time and Voltage

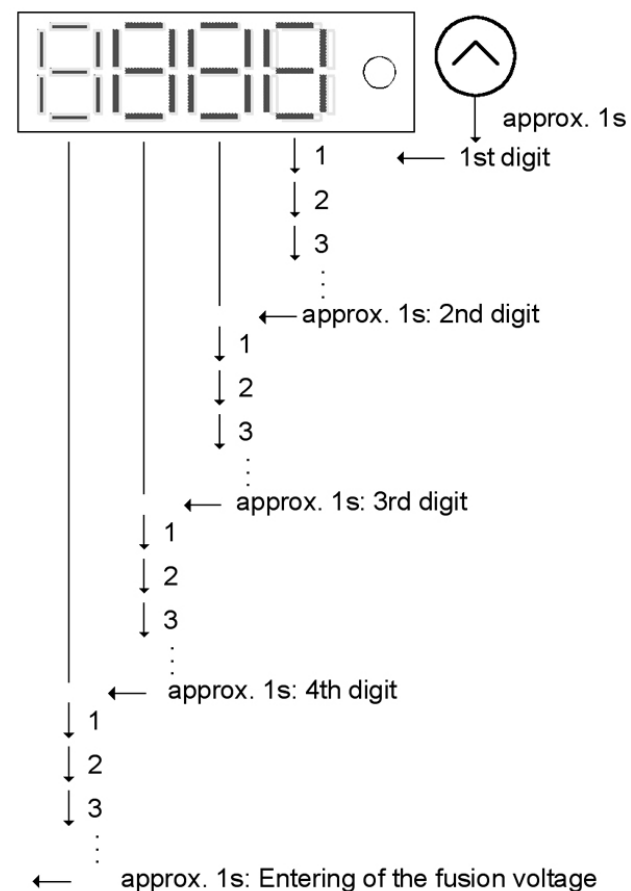
If the barcode reader pen breaks, it is possible to enter the fusion voltage and time manually.

Entering the fusion time

1. Press the UP key approximately 1 second. The unit is now in the programming mode. The digit to be programmed will blink.
2. Press the UP key several times until the desired number appears on the display. With every push of the key, the active display moves up one position. 0,1,2,3...9,0.
3. The next digit is reached by pressing the UP key for approximately 1 second.
4. Repeat steps 2 and 3 until all 4 digits are inserted.
5. By pressing and holding on the last digit, the input is confirmed and the process continues with the input of the fusion voltage.

Entering the fusion voltage

Entering the fusion voltage works the same as entering the fusion time. The fusion voltage is displayed in volts. It can be programmed to an accuracy of 0.1 volts. By pressing and holding on the last digit, the input is confirmed and the MSA250 SE ready for fusion.



Description of Error Codes

No	Description	Comments
E2	MAINS VOLTAGE TOO HIGH	Check generator, 110V AC Nominal
E5	AMBIENT TEMP. TOO LOW	Must be between +14°F / +113°F
E6	AMBIENT TEMP. TOO HIGH	Must be between +14°F / +113°F
E7	INTERNAL TEMP. TOO LOW	Allow MSA 250 to warm up in a heated room
E8	INTERNAL TEMP. TOO HIGH	Allow MSA 250 to cool off
E9	FITTING RESISTANCE TOO LOW	Check fitting. (Display switches between error code and measured resistance)
E10	FITTING RESISTANCE TOO HIGH	Check fitting. (Display switches between error code and measured resistance)
E11	FUSION VOLTAGE TOO LOW	Check generator output / extension cable
E12	FUSION VOLTAGE TOO HIGH	If this occurs frequently, send MSA 250 in for servicing
E13	FUSION CIRCUIT INTERRUPTED	Check the power cable To dismiss this error message, switch off MSA 250
E14	FUSION CURRENT TOO HIGH	Damaged coil. If this occurs frequently, return MSA for servicing.
E15	POWER SUPPLY TEMP. TOO LOW	Allow MSA250 to warm up in a heated room
E16	POWER SUPPLY TEMP. TOO HIGH	Allow MSA 250 to cool off
E21	OUTAGE DURING LAST FUSION	Check the last fusion operation
E22	FUSION INTERRUPTED WITH STOP	Check the last fusion operation
E28	UNIT RANGE EXCEEDED	Use a fitting which can be joined with the MSA 250
E71	SYS.-ER. MEASUR. AMBIENT TEMP.	Send MSA 250 in for servicing
E74	FUSION POWER TOO LOW	Check the generator output / extension cable
E75	FUSION POWER TOO HIGH	Allowed fusion-power exceeded. Use MSA250 SE with less fittings in parallel.
E78	POWER SUPPLY ERROR	Send MSA 250 in for servicing
E100	FUSION PROGRAM INCORRECT	Use a barcode from the standard ISO/TR 13950
E101	WRONG BARCODE TYPE	Use a barcode from the standard ISO/TR 13950
E102	CONFIGURATION ERROR	Send MSA 250 in for servicing
E103	RESISTANCE MEASUREMENT ERROR	Disconnect MSA 250 and fitting from the generator, check the connection
E104	VENTILATOR ERROR	Check ventilator opening. If unobstructed, send MSA 250 for servicing



Further Information



If you have any questions regarding the Fuseal System contact your **+GF+ Area Sales Manager.**

For further information about the fusion units, see the instruction manuals.
The machines need to be calibrated and serviced every year according to the service label on the machine.

Place business card here!!

For specific questions about the fusion units, contact our Machine Service Department.
Address for Machine Service and technical questions:

**George Fischer Inc.
Machine Service Department
2882 Dow Avenue
Tustin, CA 92780**

**Phone: (714) 368-4284
Fax: (714) 731-9056**



Warranty Statement

Always check for the most current General Terms and Conditions and Warranty Statement at www.gfpiping.com under "Price Lists."

GENERAL WARRANTY

Seller's Products are carefully inspected for manufacturing defects; however, it is not always possible to detect hidden defects.

Said Products are warranted to the extent that Seller will repair or replace without charge or issue a credit, should this be the most practical resolution to a validated warranty claim. Engineered Piping Products, Valves and Actuation Products (excluding the Type 546 manual valve), Waste and Containment Products, and Vinyl Piping Products proved to have manufacturing defects within twelve (12) months, Signet products twenty-four (24) months, from the date of shipment per invoice and provided Seller has been given an opportunity to inspect the Product alleged to be defective and the installation and/or use thereof. The Type 546 manual valve has a Limited Lifetime Warranty. Details of this Limited Lifetime Warranty can be found below. Seller does not warrant any Products obtained through an unauthorized Distributor, Dealer or Agent.

For Signet Products moving parts, such as meter movements, are warranted from manufacturing defects for twelve (12) months from date of shipment per invoice. Signet pH and ORP electrodes are warranted out of box but not warranted against any post calibration damage, due to process or application failures (e.g. high temperature, chemical poisoning, dry-out) or mishandling (e.g. broken glass, freezing temperatures).

Limitations of Remedy

Damages, warranties, and liability in the event of any breach of warranty by the Seller, the exclusive remedy of the customer shall be the REPAIR OR REPLACEMENT of the non-conforming goods in the manner and for the period of time as provided in the "warranty" section above. No warranty is included against any expense for removal, reinstallation, or consequential damages of any nature arising from any defect. Seller shall not be liable for special, incidental or consequential damages, such as (but not limited to) damage or loss of other property of equipment, business interruption, or loss of profits or revenue. The warranties set out above are the only warranties made by Seller and are expressly in lieu of all other warranties, expressed or implied, including the warranties or merchantability and fitness for a particular purpose. Any and all warranties implied by any course of dealing or usage of trade between the parties are expressly excluded. Any action for breach of any contract made by seller for the sale of goods must be commenced within twelve (12) months (Signet Instrumentation products twenty-four months) of Seller's tender of delivery of the subject goods.

TYPE 546 MANUAL VALVE LIMITED LIFETIME WARRANTY

What This Warranty Covers

This Limited Lifetime Warranty is provided only to the original user of the Type 546 Manual Valve, or a Type 546 Manual Valve distributor authorized by Georg Fischer Piping Systems Americas (hereinafter "Seller"). Seller warrants to the original user or to the authorized distributor that the Type 546 Manual Valve, if used in accordance with these instructions, will be free of defects in material and workmanship. This limited lifetime warranty is not applicable to any other Georg Fischer Piping products, or to any products not manufactured by Georg Fischer Piping.

How Long This Warranty Lasts

This Limited Lifetime Warranty lasts as long as the original user or authorized distributor owns the Type 546 Manual Valve.

What Georg Fischer Piping Systems Americas Will Do

At Seller's option, Seller will repair, replace, or substitute a defective Type 546 Manual Valve with a Type 546 Manual Valve of equal value. Repair or replacement as provided under this Limited Lifetime Warranty is the EXCLUSIVE remedy under this Limited Lifetime Warranty.

What This Warranty Does Not Cover

This Limited Lifetime Warranty does not apply to Type 546 Manual Valves characterized by one or more of the following:

1. Valves that have been subject to abuse, misuse, neglect, accident, fire, improper installation, storage, handling or adjustment, or corrosion.
2. Acts of God, including, but not limited to fire, flood, hurricane, tornado, earthquake, electro-static or any other similar natural cause beyond the control of Seller.
3. Valves that have been modified or altered outside of or beyond Seller specifications.
4. Valves used in application other than those recommended by Seller, either in its most recent catalog or in the instructions accompanying the Type 546 Manual Valve.
5. Freight charges, installation cost, labor cost, damage to related components, and cost incurred due to down time, from normal wear and tear of the valve.

What To Do To Make A Claim

To make a claim under this Limited Lifetime Warranty, product must be returned to Seller for evaluation and disposition. Please contact Seller for a Return Material Authorization (RMA) number prior to sending product back. When returning the product, please include (i) written proof of purchase, which includes the date, amount, and place of purchase; (ii) a written description of the claimed defect(s) using the GF Material Evaluation Form with a photo of the application if practical; and (iii) completed GF Material Safety Disclosure Form. Seller shall have 48 hours following receipt of any Type 546 valve returned for warranty claim to investigate the claimed defects, and the original user or authorized distributor shall give Seller (or its agents) reasonable access to the application of the valve for inspection purposes. Seller's address for warranty services is:

Returns Department

2882 Dow Ave
Tustin, CA 92780

Each of the above mentioned terms must be met in order to qualify for Limited Lifetime Warranty coverage.

Application of Additional Warranties

GEORG FISCHER PIPING SYSTEMS AMERICAS LIMITED LIFETIME WARRANTY AND REMEDIES SET FORTH HEREIN ARE THE ORIGINAL USER'S, AND AUTHORIZED DISTRIBUTOR'S, SOLE AND EXCLUSIVE REMEDIES, AND ARE OFFERED BY SELLER IN LIEU OF ALL OTHER WARRANTIES, GUARANTEES, AND/OR REMEDIES WHATSOEVER, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE, OR OTHER WARRANTIES OR GUARANTEES ARISING BY OPERATION OF LAW, WHICH ARE HEREBY EXPRESSLY DISCLAIMED.

In no event shall Seller be liable to the original user or authorized distributor or third parties for lost profits, consequential, incidental, punitive, exemplary or other similar damages.

This Limited Lifetime Warranty may not be modified except in a written instrument signed by an officer of Georg Fischer Piping Systems Americas. Seller shall not be bound by, and the original user or authorized distributor shall not rely upon, representations made by individuals or agents of Seller (including, without limitation, authorized distributors of GF Type 546 Manual Valve) in regards to GF Type 546 Manual Valves, except as contained in this Limited Lifetime Warranty. This Limited Lifetime Warranty is only valid in the United States of America. This Limited Lifetime Warranty gives the original user and authorized distributor certain specific legal rights, and the original user or authorized distributor may also have other rights that vary from state to state. Some states' laws do not allow the limitation/exclusion of incidental or consequential damages, or otherwise restrict the limitations contained herein, so some of the exclusions above may not apply to you.