+GF+ Fuseal

Easy and Reliable Solution for Corrosive Waste Piping Systems

Electrofusion and Mechanical Joining of Pipe and Fittings

+GF+ Fuseal Offers:

- **Electrofusion and Mechanical Joint System**
- **Handles corrosive drainage fluids up to 212°F (100°C) intermittently**
- **High chemical and corrosion resistance**
- **Flame retardant Polypropylene**
- **Highly reliable, multiple fusion technologies that offer the most innovative and advanced in the industry**

Applications

+GF+ Fuseal's excellent chemical and physical properties make the system ideal for handling corrosive chemical waste solutions present in laboratory and industrial DWV applications. +GF+ Fuseal is suitable for use in chemical and industrial plants as well as in hospital and university laboratories where mixtures of acids, bases and solvents are drained.

Excellent Corrosion, Chemical and Environment Resistance

+GF+ Fuseal is resistant to the corrosive action of alkalis, alcohols, acids, solvents and salt solutions. Dilute mineral acids and aqueous solutions of acid salts, which are so destructive to most metals, have no affect on the +GF+ Fuseal system. In general, +GF+ Fuseal is attacked only by strong oxidizing acids and weakened by certain organic solvents and chlorinated hydrocarbons. +GF+ Fuseal will not rust, pit, scale, corrode or be affected by electrolysis.

In above ground installations, the pigmentation protects the system from sunlight. The pigmentation is highly resistant to ultraviolet radiation and is heat-stabilized to provide long life while handling hot reagents.

Flame Retardant Polypropylene

The +GF+ Fuseal flame retardant polypropylene compound yields a combination of high chemical resistance, toughness and high strength at elevated temperatures.

The Perfect Union

An engineer or contractor can combine the benefits of the +GF+ Fuseal electro-fusion joint and the mechanical joint in a single system. +GF+ Fuseal can be used in inaccessible areas and the +GF+ Fuseal mechanical joint works well under bench where speed of installation or future disassembly is needed.

The same MSA 250SE or MSA 250EX machine can be used to fuse the +GF+ PPro-Seal Natural Polypropylene Piping System and the Fuseal 25/50 PVDF System. +GF+ PPro-Seal is a pressure system (up to 150 psi, 10 bar) which can handle basically the same fluids as +GF+ Fuseal.

The +GF+ Fuseal 25/50 PVDF System offers pipe and fittings that can not only handle high temperatures (up to 280° F) and a wide range of chemicals, but is also flame retardant and does not generate smoke.

Improved +GF+ Fuseal Fusion Collar

The +GF+ Fuseal Process has been improved through the development of the +GF+ Fuseal fusion collar. The new fusion collar provides the same joint as the original +GF+ Fuseal coil, however, it can be made in less time. The many improved benefits include:

- Fast positive electrical connection with a duplex clear plug
- Simple insertion of pipe without coil removal
- Elimination of socket sanding
- Elimination of the temporary band clamp — clamps are provided with fusion collars for sizes 1 1/2"–3"
- Rotation of fusion collar allows exact positioning of the duplex plug
- Ability to dry fit an entire system prior to fusion

Mechanical Joint

Make fast, leakproof joints in two easy steps. Slide the nut, grab ring and seal ring on the pipe. Insert the pipe into the socket and tighten 1/2 turn past hand tight. That's it!
As the nut is tightened, the grab ring grips and cuts a retaining groove in the pipe. Further tightening seals the polypropylene ring to ensure a leakproof joint.

This simple method of joining cuts installation time in half and requires no hot water, electricity, or pipe grooving.

MSA 250SE / MSA 250EX

The MSA 250SE and the MSA 250EX represent the most advanced fusion technology in the industry, featuring advanced transformer technology. This unit can be used to join all George Fischer Sloane polypropylene products, including Fuseal II, Fuseal Squared, PPro-Seal, and Fuseal 25/50 PVDF. The MSA 250 can run on both network (110v/60Hz) and generator power sources.

All required fusion parameters are programmed into the MSA 250 by simply scanning a barcode specific to each fitting. Barcodes also provide the capability to perform program updates for new products in the field.

The MSA 250 has multiple joint capability as well as a built-in fail-safe mode.

MSA 250 Fusion Control Unit

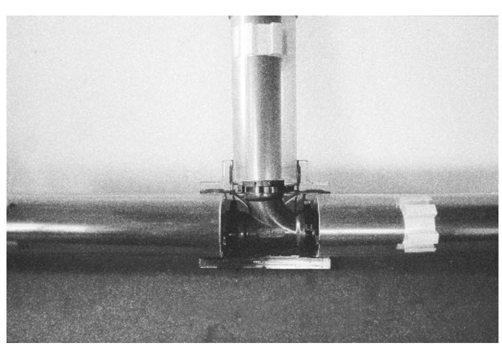
- Developed using proven technology with a global partner, Breutsch Electronics, Inc.
- Advanced transformer technology allows lightweight design
- Fuses on both network and generator power sources
- Easy operation based on scanning barcodes
- Program updates for new products performed in the field
- Operates on 110v/60Hz power source
- Built-in fail-safe mode
- Multiple joint capability
- Digital read-out for all pertinent operating parameters

Product Range

Fittings	Connection	Dimensions	Material
• Fuseal II	New Electrofusion Process	1 1/2" - 6"	Flame Retardant Polypropylene
• Fuseal LD (Large Diameter)	Original Electrofusion Process	8"/10"/12"	Non Flame Retardant Polypropylene
• Fuseal MJ (Mechanical Joint)	Mechanical	1 1/2" - 4"	Flame Retardant Polypropylene
Pipes		**Dimensions**	**Material**
• Schedule 40 (Bluish Color)		1 1/2" - 8"	Flame Retardant Polypropylene
• Schedule 40 (Black Color)		1 1/2" - 12"	Non Flame Retardant Polypropylene
• Schedule 80 (Black Color)		1 1/2" - 12"	Non Flame Retardant Polypropylene

Double Containment System for Optimum Protection

For optimum protection of the environment the +GF+ Fuseal System can be combined with the unique +GF+ Contain-It Double Containment System. Due to its split fittings and pipe, the clear PVC system can be installed even after the +GF+ Fuseal System is tested.



System Overview

Fuseal II products are all manufactured of polypropylene, a material that is known to have wide acceptance as a superior thermoplastic material for handling harsh, corrosive fluids.

Because of the chemical resistance, solvent cementing is not an option for this heavy duty material. Thus, George Fischer engineers developed a coil fusion process to easily and effectively join these systems.

Following are brief descriptions of the features of these systems.

Fuseal II

Fuseal II is available in sizes 1$^1/_2$" - 12". It handles temperatures up to 180ºF.

Fuseal II is resistant to the corrosive action of alkalies, alcohols, acids, solvents and salt solutions. Dilute mineral acids and aqueous solutions of acid salts, which are so destructive to most metals, have no effect on the Fuseal II system.

In general, Fuseal II is attacked only by strong oxidizing acids and weakened by certain organic solvents and chlorinated hydrocarbons. Fuseal II will not rust, pit, scale, corrode or be affected by electrolysis.

In above ground installations the pigmentation is highly resistant to ultraviolet radiation and is heat-stabilized to provide long life while handling hot reagents.

The Fuseal II flame retardant polypropylene compound yields a combination of high chemical resistance, toughness and high strength at elevated temperatures.

Fuseal II's excellent chemical and physical properties make the system ideal for use in chemical and industrial plants as well as hospital and university laboratories. In fact, all major pharmaceutical and universities have Fuseal installations currently installed.

The following features make Fuseal II faster and easier to install than our original Fuseal piping system.

- Fast electrical connection with the duplex plug.
- Fusion collar stays on fitting—pipe inserts easily without the extra step of removing the coil and placing it on the pipe.
- Plastic clamps are provided with 1$^1/_2$" through 3" fusion collars. Metal band clamps are available for 4"–12" fittings. Both styles of clamps allow for dry-fitting of the entire system prior to fusing.
- Fusion collar is rotatable to allow exact positioning of the duplex plug.
- Band clamps on each socket allow dry fit of entire system before fusion.

Fuseal LD

Fuseal LD is our large diameter Fuseal piping system. This is available in 8", 10" and 12" sizes and it utilizes our original fusion process. Also made of flame resistant polypropylene, Fuseal LD offers all the basic system benefits of Fuseal II.

Fuseal MJ

Fuseal MJ is our mechanical joint system. It is available in sizes 1$^1/_2$" - 4". This system is also made of the same flame retardant material as our Fuseal II system, however, there is no fusion process. The joints are mechanically joined for a nonpermanent joint in easily accessible locations, such as under sinks.

MSA 250 Electrofusion Unit

Specifications and Materials Properties

Sample Short Form Fuseal II Piping Specification

All Fuseal II fittings shall be as manufactured by George Fischer Sloane, Inc. so that they are compatible with Fuseal pipe. All Fuseal pipe shall conform to the dimensional requirements of ASTM D-1785 for schedule 40/80 pipe as produced by George Fischer Sloane, Inc. The Fuseal II system shall be joined by use of electrical resistance coils energized by a variable low voltage power supply. The Fuseal II fusion collar will have an integral electrical resistance coil which is joined to the power supply via a duplex connector. Each fusion collar will be furnished with a band clamp.

Fuseal II and Fuseal LD Suggested Specification Guide

The following guide specifications can be used when preparing project orders or inquiries for George Fischer, Fuseal II and Fuseal LD, Corrosive Waste Piping System. Two forms are included: a general and a short form specification.

General Specification Part 1 — General

Special Waste Pipe and Fittings
Special Waste and Vent Pipe and Fitting System shall be +GF+ Fuseal polypropylene as manufactured by George Fischer Sloane, Inc. in Little Rock, Arkansas as described below. Piping installed below grade shall be non-flame retardant polypropylene. Pipe and fittings installed above grade shall be flame retardant polypropylene.

Quality Assurance
The Fuseal system shall be manufactured to the following ASTM Standards:

D 4101 - Standard Specification for Propylene Plastic Injection and Extrusion Materials.
D 3311 - Standard Specification for Drain, Waste and Vent (DWV) Plastic Fittings Pattern.
D 1785 - Standard Specification for (PVC) Plastic Pipe, Schedule 40, 80 and 120 (Dimensional requirements only).
D 1599 - Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.
D 2122 Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
F 1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings.
F 1412 - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.

Submittals
Catalog Data: Contractor shall submit___ copies of manufacturer's literature on the Fuseal II and Fuseal LD systems. The literature shall contain complete and current installation instructions.

Part 2 — Product

Manufacturer
The laboratory corrosive drainage waste and vent system shall be Fuseal II ($1^1/_2$"-6") and Fuseal LD (8", 10" & 12") as manufactured by George Fischer Sloane, Inc.

Materials
The products described in this specification consist of:

A. Pipe and fittings made of flame retardant polypropylene joined by electrical fusion coils made of conductive metal wire coated with polypropylene and molded into a flame retardant polypropylene fusion collar.

B. Joining Method — The pipe and fittings are joined by use of the electrical fusion collars energized by a low-voltage power supply.

C. Basic Materials — This specification covers flame retardant polypropylene (PPFR) pipe and fittings made from PPFR plastic, as defined in ASTM D 4101 Propylene Plastic Injection and Extrusion Materials. Flammability requirements are based on ASTM

   D 635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of self supporting plastics in a horizontal position.

D. Compound — The PPFR compound used in the pipe and fittings covered by this specification shall meet the requirements of Class PP110B63153 material as described in ASTM

   D 4101 . As other compounds are shown to be suitable for these products, such compounds will be added to this specification.

Source Quality Control

A. Pipe Dimensions — Requirement, pipe shall be produced to Schedule 40 and Schedule 80 Iron Pipe Sizes dimensional standards and shall meet the dimension and tolerances for outside diameter.

B. Fittings, Design and Dimensions — Requirements, fittings design shall be based upon the laying length dimensions in ASTM D 3311 DWV Plastic Fitting Patterns.

C. Electrical Fusion Collars ($1^1/_2$"- 6") — Each coil shall consist of polypropylene jacketed wire, mandrel wound and heat fused on the outer surface and molded into a self-supporting fusion collar with an integral duplex receptacle. Each collar shall be provided with a ratchet style plastic clamp for sizes up to 3". 4" and 6" fittings will require the use of the steel band clamps that must be ordered separately.

D. Electrical Fusion Coils (8"-12") — Each coil shall consist of polypropylene jacketed wire, mandrel wound and heat fused on the outer surface. These coils shall be inserted and taped in place within the fusion sockets of all LD fitings at the factory. Properly sized steel band clamps (ordered separately) will be required for proper fusion of fittings to pipe during installation.

E. Pipe Markings — Schedule 40 PPFR, Flame Retardant, shall be bluish in color, Group 1-63153, manufactured in 10-foot lengths. Schedule 40 PPRO, Non-Flame Retardant, shall be black in color, Group 1-53653 manufactured in 20-foot lengths. Schedule 80 PPRO, Non-Flame Retardant shall be black in color, Group 2-53653 manufactured in 20-foot lengths.

All previously listed lengths of pipe shall be marked with +GF+, Fuseal, NSF-CW-SE, Pipe Size, Schedule, Type, Quality Control Mark and be compatible with the coil fusion method.

F. Fittings — Shall be legibly marked with molded-on letters showing manufacturer's trademark, pipe size of each socket, manufacturer's part number, NSF-CW-SE and symbol PPFR indicating the material.

Part 3 — Execution

Installation

A. Fuseal II, Fuseal MJ and Fuseal LD pipe and fittings shall be installed according to the current installation instructions as published by the manufacturer.

B. A manufacturer's representative, who has been certified as a training instructor, shall be at the site prior to the day the piping system installation is to commence. A manufacturer's rep. will perform a complete training session on the proper method of installation for the piping system. Upon completion of the training, the installers will be given a test on the items covered in the session. Persons successfully completing the test shall be given a laminated card which certifies them for one year as installers of the Fuseal piping system.

Testing

Joints may be pressure tested 10 minutes after fusing, (30 minutes for 10" and 12"). Test in accordance with local plumbing codes. All sections of the system shall be tested with a maximum of 30-foot head of water.

Sample Short Form Fuseal, Mechanical Joint in Accessible Locations Specification

The system shall be made of flame retardant polypropylene pipe and fittings and in concealed locations shall be joined by the George Fischer Fuseal method. In exposed or easily accessible location, George Fischer Fuseal Mechanical joint fittings may be used. All flame retardant polypropylene pipe and fittings shall conform to George Fischer, Inc. specifications. Installation and test shall be in accordance with the manufacturer's recommendations and the governing local code.

Fuseal MJ Suggested Specification Guide

The following guide specifications can be used when preparing project orders or inquiries for George Fischer, Fuseal Mechanical Joint (MJ) Piping System. Two forms are included:
a general and a short form specification.

General Specification

Part 1 — General

Special Waste Pipe and Fittings

Special Waste and Vent Pipe and Fitting System shall be +GF+ Fuseal polypropylene as manufactured by George Fischer Sloane, Inc. in Little Rock, Arkansas as described below. Pipe and fittings installed above grade shall be flame retardant polypropylene.

Quality Assurance

The Fuseal systems shall be manufactured to the following ASTM Standards:

D 4101 - Standard Specification for Propylene Plastic Injection and Extrusion Materials.

D 3311 - Standard Specification for Drain, Waste and Vent (DWV) Plastic Fittings Pattern.

D 1785 - Standard Specification for (PVC) Plastic Pipe, Schedule 40, 80 and 120 (Dimensional requirements only).

D 1599 - Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.

D 2122 Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings.

F 1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings.

F 1412 - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.

Submittals

Catalog Data: Contractor shall submit___ copies of manufacturer's literature on the Fuseal MJ system. The literature shall contain complete and current installation instructions.

Part 2 — Product

Manufacturer

Pipe and Fittings in exposed or easily accessible locations may be joined with the George Fischer Sloane Mechanical Joint System.

Materials

The products described in this specification consist of:

A. Pipe and fittings made of flame retardant polypropylene. The fittings include a seal ring made of polypropylene based material and a grab ring made of Ryton® (trademark of Phillips Petroleum).

B. Joining Method — The pipe and fittings shall be installed according to the current MJ installation instructions.

C. Basic Materials — This specification covers flame retardant polypropylene (PPFR) pipe and fittings made from PPFR plastic, as defined in ASTM D 4101 Propylene Plastic Injection and Extrusion Materials. Flammability requirements are based on ASTM D 635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of self supporting plastics in a horizontal position.

D. Compound — The PPFR compound used in the pipe and fittings covered by this specification shall meet the requirements of Class PP110B63153 material as described in ASTM D 4101. As other compounds are shown to be suitable for these products, such compounds will be added to this specification.

Part 3 — Execution

Installation

A. Fuseal Mechanical Joint fittings shall be installed according to current Fuseal Mechanical Joint installation Instructions.

B. A manufacturer's representative, who has been certified as a training instructor, shall be at the site prior to the day the piping system installation is to commence. A manufacturer's rep. will perform a complete training session on the proper method of installation for the piping system. Upon completion of the training, the installers will be given a test on the items covered in the session. Persons successfully completing the test shall be given a laminated card which certifies them for one year as installers of the Fuseal piping system.

Testing
Joints may be pressure tested after assembly. Test in accordance with local plumbing codes. All sections of the system shall be tested with a minimum ten foot head of water up to a maximum thirty foot head of water.

Material Physical Properties

Material — Group 1 63153
Homopolymer Pipe Grade
George Fischer Sloane flame retardant polypropylene, when tested per ASTM D 635 shows an average time of burning of under 5 seconds (actual 2.72 seconds) and an average extent of burning of under 5 millimeters (actual 1.8 mm). It is recognized that small scale laboratory combustibility tests do not necessarily indicate the burning characteristics of the material in an actual building fire. This material ceases to burn when the igniting flame source is removed. It is not non-combustible.

Schedule 40 (Blue)
Flame Retardant — Group 1
Homopolymer ASTM Test No.

D 792	Specific Gravity @ 23°C	0.94
D 638	Tensile Yield Strength @ 2 in./min., psi	4500
D 256	Izod Impact 23°C, (73°F) ft.lb./in.	1.0
D 790	Flexural Modulus Proc. B - 1 % Secant, psi	200,000
D 785	Hardness, Rockwell R	80
D 648	Heat Distortion Temp. @ 264 psi	167°F, 75°C
D 635	Flammability: Average time of burning - less than 5mm, actual 2.7 seconds Average extent of burning - less than 5mm, actual 1.8mm	
D 2843	Smoke Density: Maximum Smoke Density Rating, %	88.7 67.8
D 694	Coefficient of Linear Expansion @ 0-150°F, (in. /in.°F x 10^{-5}) (-17°C - 62°C)	6.1
C 177	Thermal Conductivity BTU/hr. sq. ft./°F/in.	1.3
D 570	Water Absorption, %	0.03
D 1238	Melt Flow Rate, g/10min. @ 230°C	0.05
D 638	Elongation at Break, %	200
D 4101	Polypropylene Molding & Extrusion Material	B63153

Schedule 40 (Black)
Non-Flame Retardant — Group 1
Homopolymer ASTM Test No.

D 792	Specific Gravity @ 23°C (73°C) (g/cm^3)	0.91
D 638	Tensile Yield Strength @ 2 in./min.,psi	5,000
D 256	Izod Impact @ 23°C, (73°F) ft.lb./in.	2.2
D 747	Stiffness-Flexural, 108 psi	1.7
D 676	Hardness, Rockwell R	95
D 648	Heat Distortion Temp. @ 66 psi	176°F, 80°C
C 177	Thermal Conductivity, BTU/hr. sq.ft./°F/in.	1.3
D 694	Coefficient of Linear Expansion @150°F, (62°C) (in./in.°F x 10^{-5})	5.0
D 149	Dielectric Strength, volts/mil;ST Power Factor @ 60 cps	610 0.007
D 570	Water Absorption in 24 hrs., %	1.9
D 1693	Environmental Stress Cracking	None
D 4101	Propylene Molding & Extrusion Materials	B63153

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Schedule 80 (Black)
Non-Flame Retardant — Group 2
Copolymer ASTM Test No.

D 792	Specific Gravity @ 23°C	0.91
D 638	Tensile Yield Strength @ 2 in./min.,psi	3900
D 256	Izod Impact @ 23°C	8
D 676	Hardness, Rockwell R	87
D 648	Heat Distortion Temp. @ 66 psi	212°F, 100°C
C 177	Thermal Conductivity, BTU/hr. sq. ft./°F/in.	1.15
D 694	Coefficient of Linear Expansion @ 68°F (in. / in. °F x 10^{-5})	6.1
D 570	Water Absorption in 24 hrs., %	0.03
D 1694	Environmental Stress Cracking	None
D 4101	Propylene molding & Extrusion Materials	B53653

Fuseal Installation and Engineering Data

Thermal Expansion Compensation

Temperature changes in waste systems depend on the quantity and temperature of the liquid waste discharged into the system. In general, the quantities of wastes discharged through waste systems in laboratories in educational institutions will be relatively small (a few gallons at a time), while industrial laboratories and processing systems may discharge large quantities of very hot or very cold water.

Because polypropylene piping is not the best conductor of heat, low volume discharges will not raise the piping to the temperature of the wastes, hence, the thermal induced length changes in general will be less than expected. High volumes of wastes which take longer to flow through the piping will bring the system up to or close to the temperature of the wastes.

Waste pipe also is subject to ambient temperature changes. These changes will be more pronounced during the construction period and generally will be negligible after the laboratory is occupied due to control of building

enclosed within wall and ceiling spaces.

Buried piping or piping in the crawl spaces under a building is subject to less than ambient temperatures and to the piping being enclosed within wall and ceiling spaces.

There are three methods of controlling or compensating for thermal expansion of Fuseal corrosive waste systems:
1 .) taking advantage of offsets and changes of direction in the piping;
2.) vertical expansion joint assemblies;
3.) restraint of the system.

Offsets

Most waste systems have many short runs of pipe with frequent changes in direction. Advantage may be taken of the changes in direction by allowing thermally induced length changes to be taken up in movement of the pipe beyond the bends.

Expansion loop and offset lengths, which are dependent on pipe diameter, may be obtained from the charts in two pages.

In areas of the system where this method is used, support but do not rigidly restrain the piping at branches or changes of direction. Do not anchor the pipe rigidly in walls. Holes through the structure must allow for free movement. Figure A indicates the recommended expansion loop and offset configuration to be used with the charts on page 7.15 dimensions.

Linear expansion may be determined from the chart on page 7.14, which is independent of pipe diameter.

Vertical Expansion Joint Assemblies

Fuseal vertical expansion joint assemblies are designed to absorb expansion and contraction in vertical piping runs in multi-story buildings. The expansion joints are factory assembled and consist of two components: 1) O-ring fitting with pre-lubricated EPDM O-Ring gasket joint; 2) piston spigot. They are available in $1^1/_2$", 2", 3" and 4" sizes. Vertical expansion joint assemblies are quickly and easily installed by means of our standard Fuseal joining process.

Thermal Expansion — Fuseal

Length (Feet)	Temperature Change — Δ T in °F						
	40°F	**50°F**	**60°F**	**70°F**	**80°F**	**90°F**	**100°F**
	Schedule 40 (black) Non-Flame Retardant Homopolymer 1½ – 10"						
20	.48	.60	.72	.84	.96	1.08	1.20
40	.96	1.20	1.44	1.68	1.92	2.16	2.60
60	1.44	1.80	2.16	2.52	2.88	3.24	3.60
80	1.92	2.40	2.88	3.36	3.84	4.32	4.80
100	2.40	3.00	3.60	4.20	4.80	5.40	6.00
	Schedule 80 (black) Non-Flame Retardant Copolymer 1½ – 12" and Schedule 40 (blue) Flame Retardant Homopolymer 1½ – 8"						
20	.59	.73	.88	1.02	1.17	1.32	1.96
40	1.17	1.46	1.76	2.05	2.34	2.69	2.93
60	1.76	2.20	2.64	3.07	3.51	3.95	4.39
80	2.34	2.93	3.51	4.10	4.68	5.27	5.86
100	2.93	3.66	4.39	5.12	5.86	6.59	7.32

Note: Table based on: $\Delta L = 12\ eL\ \Delta T$

Example:

Highest Temperature Expected	120°F
Lowest Temperature Expected	50°F
Total Change ΔT	70°F

Length of Run — 40 ft.
From 70°F column, read 1.68 inches length change, ΔL

Where:

*e = Coefficient of Thermal Expansion = 5×10^{-5} in./in.°F
**e = Coefficient of Thermal Expansion = 6.1×10^{-5} in./in.°F
L = Length of Run, ft.
ΔT = Temperature Change, °F

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Fuseal Polypropylene Expansion Loops

Polypropylene Fuseal		Length of Run (feet)									
		10	20	30	40	50	60	70	80	90	100
Pipe Size (in.)	O.D. of Pipe (in.)	Minimum Deflected Pipe Length (inches)									
1/2	0.840	17	25	30	35	39	43	46	49	52	55
3/4	1.050	19	27	34	39	43	48	51	55	58	61
1	1.315	22	31	38	43	49	53	57	61	65	69
1 1/4	1.660	24	35	42	49	55	60	65	69	73	77
1 1/2	1.900	26	37	45	52	58	64	69	74	78	83
2	2.375	29	41	51	58	65	72	77	83	88	92
3	3.500	35	50	61	71	79	87	94	100	106	112
4	4.500	40	57	70	80	90	98	106	114	121	127
6	6.625	49	69	84	98	109	119	129	138	146	154
8	8.625	56	79	96	111	124	136	147	157	167	176
10	10.750	62	88	108	124	139	152	164	176	186	196
12	12.750	68	96	117	135	151	166	179	191	203	214

Fuseal Polypropylene Offsets and Change of Directions

Polypropylene Fuseal		Length of Run (feet)									
		10	20	30	40	50	60	70	80	90	100
Pipe Size (in.)	O.D. of Pip (in.)	Minimum Deflected Pipe Length (inches)									
1/2	0.840	25	35	43	49	55	60	65	69	74	78
3/4	1.050	27	39	48	55	61	67	73	78	82	87
1	1.315	31	43	53	61	69	75	81	87	92	97
1 1/4	1.660	35	49	60	69	77	85	91	98	104	109
1 1/2	1.900	37	52	64	74	83	90	98	104	111	117
2	2.375	41	58	72	83	92	101	109	117	124	131
3	3.500	50	71	87	100	112	123	133	142	150	159
4	4.500	57	80	98	114	127	139	150	161	171	180
6	6.625	69	98	119	138	154	169	183	195	207	218
8	8.625	79	111	136	157	176	193	208	223	236	249
10	10.750	88	124	152	176	196	215	232	249	264	278
12	12.750	96	135	166	191	214	234	253	271	287	303

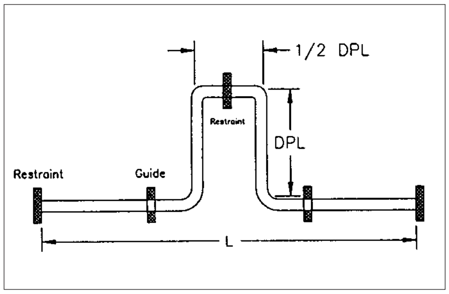
Restraint

Restraint is rigidly anchoring the pipe runs to the building structure at appropriate places so that thermally induced dimension changes will be replaced by thermally induced stresses. This can be accomplished by use of adequately strong clamps or supports to hold the pipe in place. The appended Table 4 shows the forces to be resisted. For horizontal runs, braced clamp type hangers may be used. For floor penetrations, extension riser clamps may be used.

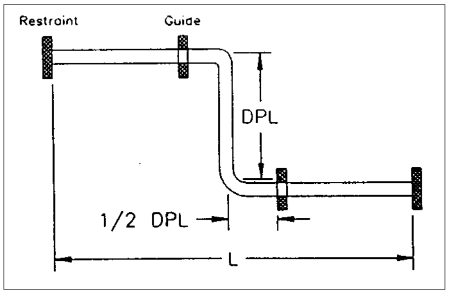
Underground installation in properly backfilled trenches may be considered to be a restrained system and not subject to thermally induced dimensional changes.

It should be noted that two unusual properties of polypropylene make for the success of these methods of handling thermal expansion. Polypropylene is not subject to stress cracking. It can be stressed for long periods of time in what might be considered unfriendly environments without harm. In addition, nolypropylene has an extremely high fatigue life. Its "self-hinge" characteristics are well known and the piping materials will stand repeated drastic flexures without harm.

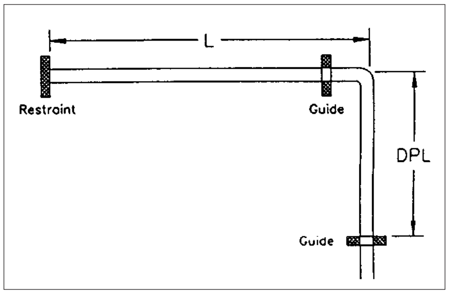
Expansion Loop and Offset Configuration for Polypropylene



Expansion Loop



Expansion Offset



Change of Direction

Restraint Force, (lbs.)

Nominal Size (in.)	Schedule 40			*Schedule 80		
	A(in.^{2})	ΔT=50°F S=500 psi	ΔT=100°F S=1000 psi	A(in.^{2})	ΔT=50°F S=500 psi	ΔT=100°F S=1000 psi
1 1/2	.799	400	800	1.068	534	1070
2	1.075	538	1080	1.477	739	1478
3	2.228	1110	2220	3.016	1510	3020
4	3.173	1590	3180	4.407	2200	4400
6	5.584	2790	5580	8.405	4200	8400
8*	8.399	4610	4220	12.763	7020	14040
10*	11.908	6536	13070	18.922	10405	20810
12*	15.745	8645	17290	16.035	14320	28640

NOTE: Table based on: S=eΔTE, F=A x S
*Indicates copolymer polypropylene.

Where:

S = Thermal Stress, psi
F = Restraint Force Necessary, lbs.
A = Cross Sectional Area of Pipe Wall, in.^{2}
ΔT = Temperature Difference, °F
e = Coefficient Thermal Expansion = 5 x 10^{-5} in./in.°F
E = Modulus of Elasticity = 2.0 x 10^5 psi
*e = Coefficient Thermal Expansion = 6.1 x 10^{-5} in./in.°F
*E = Modulus of Elasticity = 1.8 x 10^5 psi

Instructions for Above Ground

The physical properties of polypropylene are such that it is excellent piping material and may be handled and installed in much the same manner as other materials.

Vertical Risers

1. Piping may penetrate floors or slabs through sheet metal or steel pipe sleeves with normal clearances.

2. Risers should be supported with standard riser clamp or wall bracket at each floor or ten feet.

Horizontal Piping

1. Piping should be installed in hangers so that the system will be free moving, or clamped where necessary to control thermal expansion.

2. Conventional split ring or clevis type band hangers may be used. No special padding or isolation is required.

3. Horizontal piping hangers must be spaced in accordance with the following chart.

Fuseal Support Spacing (feet)

Pipe Size (in.)	Temperature (°F)						
	73°F	120°F	140°F	160°F	180°F	200°F	210°F
$1^1/_2$	$4^3/_4$	$4^1/_2$	$4^1/_2$	$4^1/_2$	$4^1/_4$	4	$3^3/_4$
2	$5^1/_4$	5	5	$4^3/_4$	$4^1/_2$	$4^1/_4$	4
3	$6^1/_4$	6	$5^3/_4$	$5^3/_4$	$5^1/_2$	$5^1/_4$	5
4	$6^3/_4$	$6^1/_2$	$6^1/_2$	$6^1/_4$	6	$5^3/_4$	$5^1/_2$
6	8	$7^1/_2$	$7^1/_2$	$7^1/_4$	7	$6^1/_2$	6
8	$8^1/_2$	8	$7^1/_2$	$6^3/_4$	$6^1/_2$	$6^1/_4$	6
10	$9^1/_2$	$8^3/_4$	8	$7^1/_2$	7	$6^3/_4$	$6^1/_2$
12	10	$9^1/_2$	$8^1/_2$	8	$7^1/_2$	$7^1/_4$	7

Instructions for Underground

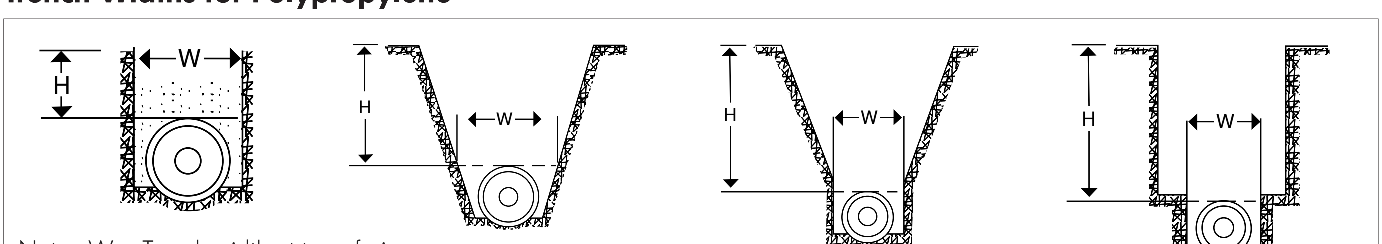
Trenching

1. The bottom of the trench shall be of stable material. Where ground water is encountered, the bottom shall be stabalized with granular material of $^1/_2$″ maximum particle size. A 4″ cushion shall be placed over rock or hardpan.

2. Trench width—should be sufficient to provide working room if pipe is to be jointed in the trench. Minimum width may be used if pipe is to be joined before placing in ditch.

3. Trench depth—trenches under building slabs should allow for 12″ cover over the pipe. Trenches in exposed locations should permit burial of pipe at least 12″ below maximum expected frost penetration. A minimum of 24″ cover should be provided where pipe may be exposed to heavy overhead traffic. Applicable plumbing codes may require greater trench depth and cover than technically required.

Trench Widths for Polypropylene



Note: W = Trench width at top of pipe.

Bedding and Backfill Material

The backfill material surrounding the pipe shall be readily compactable and shall consist of coarse sand, sand with gravel or clay, sand that is free from frozen lumps, stone larger than 1/2" and excessive fines, silt or clay. The material shall fall within the Highway Research Board Classification Group A-1, A-2 (Plasticity Index less than 10) or A-3.

Bedding and Backfilling - ASTM D2321

1. Bedding — Install in 6" maximum layers. Level final grade by hand. Minimum depth 4" (6" in rock cuts).
2. Haunching — Install in 6" maximum layers. Work around pipe by hand to provide uniform support.
3. Initial Backfill — Install to a minimum of 6" above pipe crown.
4. Embedment Compaction — Minimum density 95% Standard Proctor per ASTM D 698. Use hand tampers or vibratory compactors.
5. Final Backfill — Compact as required by the engineer.

Note 1: Figures are calculated from minimum soil resistance values (E' = 200 psi for uncompacted sandy clay loam) and compacted soil (E' = 700 for side-fill soil that is compacted to 90% or more of Proctor Density for a distance of two pipe diameters on each side of the pipe). If Wc' is less than Wc at a given trench depth and width, then soil compaction will be necessary.

Note 2: These are soil loads only and do not include live loads.

Fuseal Soil Load and Pipe Resistance

Nom. Size	Wc' = Load Resistance of Pipe (lb./ft.)				H=Height of fill Above Pipe	Wc = Soil Loads at Various Trench Widths at Top of Pipe (lb./ft.)		
	Schedule 40 Pipe		Schedule 80 Pipe					
	E' = 200	E' = 700	E' = 200	E' = 700	(ft.)	2 ft	3 ft.	4 ft.
$1^1/_2$	556	764	1375	1561	10 20 30	106 138 144	125 182 207	136 212 254
2	466	718	1161	1400	10 20 30	132 172 180	156 227 259	170 265 317
$2^1/_2$	701	1005	1593	1879	10 20 30	160 204 216	191 273 306	210 321 377
3	614	988	1416	1772	10 20 30	196 256 266	231 336 384	252 392 469
$3^1/_2$	578	1011	1318	1731	10 20 30	223 284 300	266 380 426	293 466 524
4	564	1055	1266	1735	10 20 30	252 328 342	297 432 493	324 504 603
5	555	1170	1206	1796	10 20 30	310 395 417	370 529 592	407 621 730
6	573	1313	1323	2028	10 20 30	371 484 503	437 636 725	477 742 888
8	638	1612	1319	2250	10 20 30	483 630 656	569 828 945	621 966 1156
10	721	1944	1481	2649	10 20 30	602 785 817	710 1032 1177	774 1204 1405
12	809	2266	1676	3067	10 20 30	714 931 969	842 1225 1397	918 1429 1709

$$Wc' = \frac{\Delta x(EI + 0.061\,E'r^3)80}{r^3}$$

Wc' = Load Resistance of the Pipe, lb./ft.
Δx = Deflection in Inches @ 5% (.05 x I.D.)
E = Modulus of Elasticity = 2.0 x 10^5 psi
t = Pipe Wall Thickness, in.
r = Mean Radius of Pipe (O.D. - t)/2
E' = Modulus of Passive Soil Resistance, psi
H = Height of Fill Above Top of Pipe, ft.
I = Moment of Inertia $t^3/12$

Specification for the MSA 250SE

Part number	MSA 250SE
Input Voltage	90-130 VAC Nominal Voltage: 110 V / Generator: 110-120 VAC Nominal Voltage
Input Current	15 Amps
Output Voltage	0 to 45 VAC
Output Current	0 to 30 Amps
Power Consumption	max. 1200 W nominal output
Generator Output Performance	2 KVA Sinusoidal (unipolar operation) depending on the fitting diameter
Back-up Fuse	10–16 AT depending on the fitting size
Fusion Voltage	3,7 -32 VAC galvanically separated
Protection Type	Protection class 1/IP 65
Operating Temperature	–10°C (14°F) to + 45°C (113°F)
Duty Cycle	100%
Dimensions	Width: 280 mm (.91 ft.) Depth: 200 mm (.66 ft.) Height: 350 mm (1.15 ft.) (measured inc. carrying handle)
Weight	11.5 kg (24 lbs.) (with cables)
Power Cable	Length 3 m (10 ft.)
Extension Cord Requirement	150’ (10 gauge/3 strand)

Specification for the MSA 250EX

Part number	MSA 250EX
Input Voltage	200-250 VAC Nominal Voltage: 230 V / Generator: 210-230 VAC Nominal Voltage
Input Current	15 Amps
Output Voltage	0 to 45 VAC
Output Current	0 to 30 Amps
Power Consumption	max. 1200 W nominal output
Generator Output Performance	2 KVA Sinusoidal (unipolar operation) depending on the fitting diameter
Back-up Fuse	10–16 AT depending on the fitting size
Fusion Voltage	3,7 -32 VAC galvanically separated
Protection Type	Protection class 1/IP 65
Operating Temperature	–10°C (14°F) to + 45°C (113°F)
Duty Cycle	100%
Dimensions	Width: 280 mm (.91 ft.) Depth: 200 mm (.66 ft.) Height: 350 mm (1.15 ft.) (measured inc. carrying handle)
Weight	11.5 kg (24 lbs.) (with cables)
Power Cable	Length 3 m (10 ft.)
Extension Cord Requirement	150’ (10 gauge/3 strand)

Plastic Piping and Fire

Increasingly, fire protection officials and code officials are becoming sensitive to the fire characteristics of plastic materials used in building construction and plastic piping is naturally included in these concerns. To satisfy the fire safety requirements set out by the authorities, the engineer and the architect must have a better understanding of the plastics used in piping, appropriate test methods and means of protection against fire danger attributable to plastic piping.

To put this into the proper perspective, the architect, engineer and administrative authority must realize that, in the vast majority of cases, fires start in occupied areas of a building, not within the walls.

Testing Methods

The following are common laboratory tests conducted on small samples of plastic material and are useful in characterizing and comparing different plastics. However, these tests are of only limited use in predicting the behavior of the materials in real fire situations.

A. ASTM D 635 - Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position.

One half inch wide by five inch long horizontal specimens are exposed to a bunsen burner flame. The time of burning and distance burned are recorded. The results are reported as measured, except that the minimum time of burning is reported as "less than five seconds" and the minimum extent of burning is reported as "less than five millimeters."

B. UL 94 - One half inch wide by five inch long vertical specimens are exposed repeatedly to a bunsen burner flame. Time of burning, possible dripping of burning particles and after glow are observed. Results are reported as V-0, V-1 or V-2, depending on test results.

C. ASTM D 2843 - Density of Smoke from the Burning or Decomposition of Plastics.

A one quarter inch by one inch by one inch sample is exposed propane burner flame and light transmission through the smo} generated by the burning plastic is measured with a standard lamp and photocell for four minutes. Results are reported as light absorption and smoke density.

D. ASTM D 2863 - Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index).

A one eighth inch by one quarter inch by three to six inch long specimen is burned in a variable oxygen-nitrogen mixture to determine the percentage oxygen required to maintain combustion.

2. Large Scale Tests - These tests are run on full sized wall or floor (floor-ceiling) assemblies or on large material specimens. They are intended to determine the response of varying construction methods and materials to actual fire conditions.

A. ASTM E 119 - Fire Tests of Building Construction and Materials.
NFPA 251
UL 263
UBC 43-1

Wall sections of at least 100 square feet in size are attached as the front wall of a furnace and exposed to a flaming environment, the temperature of which rises according to a standard time temperature curve. The test specimen may or may not be expos to vertical or horizontal loads. The specimen, after exposure ma be subjected to a high pressure hose stream to determine its integrity after exposure.

This test is universally accepted as the method of rating wall assemblies for fire resistance as related to time of exposure. Ratings may be 1, 2, 3 or 4 hours, depending on the time for the temperature to rise to not more than 250°F above its initial temperature on the non-exposed face. Floor and floor-ceiling assemblies of at least 180 square feet in size are also tested per E 119 as the roofs of a floor-ceiling furnace, and rated on the basis of the time for the temperature to rise 250°F above the initial

7

temperature on the unexposed face, as for walls.

B. ASTM E 814 - Fire Tests of Through-Penetration Fire Stops.

This test method (published Spring 1982) is essentially identica] the E 119 test except that it is intended to determine the ability fire stopping methods and devices to maintain the fire rating (integrity) of rated fire resistive walls, floors or floor-ceiling assemblies which are penetrated by pipe, conduits or cables. 0, the years, plastic piping has shown to be both a durable material and capable of playing its part in fire containment.

C. ASTM E 84 - Surface Burning Characteristics of Building Materials.
NFPA 255
UL 723
UBC 42-1

As stated, this test is intended for testing of surface finish materials which are capable of supporting themselves or of being supported other than by support on the underside of the test specimen. Samples are 20 inches (min.) wide by 24 feet long and are attached to the roof of an 18 inch by 30 foot furnace.

Burning characteristics of the samples are stated as percentage of the rate of burning of red oak.

This test, being specifically aimed at testing surface finish materials, is recognized as not applying to plastic pipe by those who understand the test method. The National Fire Protection Association has stated that the test is not to be applied to plastic pipe and that the pipe should be tested as a component of a wall or floor assembly in the E 119 test.

Protection Methods

Fuseal Waste and Vent Piping

1. For through the wall penetration, three methods have been used.

A. A thin, close fitting sheet metal sleeve covering the pipe continuously for a 10 inch to 18 inch projection of each side of the wall.
B. A 36 inch length of glass or high silicon iron pipe through the wall.

C. A one inch thick high temperature magnesia pipe insulation for five feet of developed length on each side of the wall or floor penetration.

Method "A" has been tested in both Canada and Sweden, but not by ASTM E 119. This method has been approved by some states. Methods "B" and "C" have not been tested but have been assumed to work and have been approved by some states.

2. For piping contained in one hour wood stud, gypsum wall boarr covered walls and with trap arms penetrating the wall facing, tests at the University of California and the Ohio State University have shown three ways of maintaining the fire integrity of the walls.

A. The stud space is packed with mineral wool insulation from floor level to four feet above the floor. This method furnishes protection for walls containing PVC-DWV and flame retardant polypropylene (FRPP) corrosive waste piping.

B. A galvanized iron plate measuring 16 inches by 26 inches with a tight fitting hole 4 inches from the bottom edge is placed around the trap arm on the studs on both sides of the wall. This method furnishes protection for ABS, PVC and Fuseal DWV.

C. Completely backpacking the space around the penetrating pipe through the gypsum wall board. This method was shown to work in ABS and PVC-DWV installations where the penetrations were in the stud spacing next to the one containing the vertical piping.

In addition to these test-proven methods, penetrations by well supported non-combustible pipe connected to the plastic pipe in the wall has been accepted by some jurisdictions without test.

3. For extended fire ratings, exposed piping should be enclosed with 5/8" type X gypsum wall board.

4. In plenum spaces between a floor and a suspended ceiling, protection can be provided by 3M FireMaster PlenumWrap. This PlenumWrap is a non-combustible insulation material encapsulated with aluminum foil. It is classified by Omega Point Laboratories for use on PVC, CPVC, PB, PE, PP, PVDF and ABS pipe in return air plenums. Tested to the UL 910 flammability test. The 3M FireMaster PlenumWrap provides protection from external flame-propagation and smoke. It protects plastic pipes that are to be installed in ducts, plenums and other spaces used for environmental air.