

Technical Manual

Fuseal Squared™ Double Containment Corrosive Waste Piping System



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Introduction

Product Summary

Fuseal Squared is a polypropylene double containment corrosive waste piping system. Polypropylene is a material that is known to have wide acceptance as a superior thermoplastic material for handling harsh, corrosive fluids.

Fuseal Squared

Fuseal Squared is available in sizes 1½" x 4" through 8" x 12" in both PPNFR for buried applications and PPFR for above-ground applications.

Fuseal Squared has chemical and physical properties that make the system ideal for handling corrosive, chemical waste solutions up to 212°F intermittently, present in laboratory and industrial DWV applications. Fuseal Squared is capable of handling a variety of mixtures of acids, bases, and solvents.

Fuseal Squared 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 detrimental effect on the Fuseal Squared system. In general, Fuseal Squared is attacked only by strong oxidizing acids and weakened by certain organic solvents and chlorinated hydrocarbons.

Fuseal Squared will not rust, pit, scale, corrode, or be affected by electrolysis.

The following features of Fuseal Squared provide distinct advantages to system design and installation:

- Pipe and fittings are joined with our state of the art fusion technologies.
- Fast electrical connection with duplex plug.
- Fusion coil/collar is rotatable to allow exact positioning of the duplex plug.
- Ability to pressure test primary pipe and containment pipe independently.
- Primary pipe is free-floating, within the containment pipe, allowing for differential expansion.
- Can be electronically leak detected.
- Joins to the standard Fuseal II system without the need for special fittings or tools.
- Added protection with polypropylene for both the primary and containment pipe.
- All standard primary fitting joints are butt-welded and factory tested.

Specifications and Material Properties

Fuseal Squared Suggested Specification Guide

The following specification guide can be used when preparing project orders or inquiries for GF Piping Systems Fuseal Squared Double Containment Corrosive Waste Piping System. Two forms are included:

- 1) a general specification form and
- 2) a specification short form. This system shall be considered for specification in underground applications.

General Specification

Part 1 General

Quality Assurance

The Fuseal Squared 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 1599 – Test Method for Short-Term Hydraulic Failure Pressure of Plastic Pipe, Tube, 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
- UPC 164-2001 – Standard Specification for Dual Containment Piping Systems intended to Convey Acid Waste or other Special Wastes (pending)*

Submittals

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

Part 2 Product

Manufacturer

The corrosive drainage waste and vent system shall be Fuseal Squared (1½" x 4" – 8" x 12") as manufactured by GF Piping Systems.

Materials

The products described in this specification consist of:

- A. Pipe and fittings made of non-flame retardant polypropylene, joined together by electric fusion coils made of conductive-metal wire coated in polypropylene and either molded or independently fit between the fitting and pipe components. Pipe and fittings shall consist of both primary and containment components fabricated by the factory.
- B. Joining Method – The pipe and fittings are joined by use of the electric fusion coils energized by a low voltage power supply. Couplings shall be used as the standard joining connection.
- C. Basic Materials / Compounds - Fittings, pipe, centralizers, and/or other components of the corrosive waste drainage system shall be manufactured in accordance to ASTM D-4101 "Standard Specification for Propylene Plastic Injection and Extrusion Materials" from either Type I, homopolymer polypropylene or Type II, copolymer polypropylene.

Source Quality Control

- A. Pipe Dimensions – Pipe shall be produced to Schedule 40 Iron Pipe Size dimensional standards and meet ASTM F-1412 quality requirements for "Polyolefin Pipe and Fittings for Corrosive waste Drainage Systems."
- B. Fittings Design – Fittings design shall be based upon ASTM D-3311 "DWV Plastic Fitting Patterns."
- C. Electric Fusion Coils – Each coil shall consist of a polypropylene jacketed wire, mandrel wound, and heat fused on the outer surface. The coils shall be either molded into a polypropylene collar or shall be independent and loose fitting pending the size used. Both styles shall have a duplex receptacle for connection to the fusion unit.

Specification and Material Properties

- D. Pipe Markings – All pipe shall be marked with +GF+ Fuseal, pipe size, Schedule 40, PP110, ASTM F1412, UPC, date stamp, “Made in USA”; and be compatible with the coil fusion method.
- E. Fittings – Primary components shall be molded or fabricated via standard plastic injection molding, butt-fusion or electrofusion. Secondary components shall be molded or fabricated via standard plastic injection molding, butt-fusion, manual hot air welding or electrofusion. Centralizers shall be welded to the primary component of the fitting and/or pipe. Custom fittings shall be allowed per engineering specification as required; however, they shall conform to the requirements of this specification.
- F. Chemical Resistance – Fuseal Squared meets the same chemical resistance values as standard Fuseal polypropylene material. Please consult the chemical resistance chart located in the Fuseal Squared Technical Specification, Section 6.

Part 3 Execution

Installation

Fuseal Squared primary pipe (1½” – 8”) and fittings shall be installed according to current Fuseal Squared installation instructions. The primary piping shall be completely installed, fused, and tested prior to fusing joints on the containment piping.

Testing

Joints, 8” and smaller, may be pressure tested 10 minutes after fusing (or 30 minutes for sizes 10” and larger). Testing and testing times shall be in accordance to local plumbing codes. If local plumbing codes are not established in your area, GF Piping Systems recommends that the primary piping shall be visually inspected during a hydrostatic test of the primary system prior to being permanently covered by the containment piping. Primary piping systems shall be tested to a **maximum** of 30 feet of head. The containment pipe can be tested pneumatically with a **maximum** 5- psi air so not to wet the interstitial space of the system, if used for leak detection purposes. All joints are to be inspected with soapy water to detect for the presence of bubbles, indicating leaks.

Short Form Specification

Product Specification for GF Piping Systems Fuseal Squared Double Containment Corrosive Waste Drainage System

Double containment acid waste drain lines shall be GF Piping Systems’ Fuseal Squared, as manufactured or produced by GF Piping Systems. All Fuseal Squared fittings shall be as manufactured by GF Piping Systems so that they are compatible with Fuseal pipe. All Fuseal Squared pipe shall conform to the dimensional and quality requirements of ASTM F1412 as produced by GF Piping Systems. Pipe shall be specified as Schedule 40 non-flame retardant “black” polypropylene. The Fuseal Squared system shall be joined by the use of couplings with electrically resistant coils energized by a variable low voltage power supply. Pipe and fittings shall be manufactured from either Schedule 40 ASTM D-4101 Type I homopolymer polypropylene material or Type II copolymer polypropylene material. All Fuseal Squared fittings shall be as manufactured by GF Piping Systems so that they are compatible with Fuseal pipe. All Fuseal Squared pipe shall conform to the dimensional and quality requirements of ASTM F1412 as produced by GF Piping Systems. Pipe shall be specified as Schedule 40 non-flame retardant “black” polypropylene. The Fuseal Squared system shall be joined by the use of couplings with electrically resistant coils energized by a variable low voltage power supply. Pipe and fittings shall be manufactured from Schedule 40 ASTM D-4101 Type I homopolymer polypropylene material.

Specification and Material Properties

Material Physical Properties

Material – Group 1 63153 Homopolymer Pipe Grade

Non-flame Retardant – Group 1 Homopolymer ASTM Test No.

D792	Specific Gravity @ 23°C	0.91
D638	Tensile Yield Strength @ 2 in./min., psi	5,000
D256	Izod Impact @ 23°C, ft.lb./in.	2.2
D747	Stiffness-Flexural, 10 ⁸ psi	1.7
D676	Hardness, Rockwell R	95
D648	Heat Distortion Temp. @ 66 psi, °C	176°F, 80°C
C177	Thermal Conductivity, BTU/hr.sq.ft./°F/in.	1.3
D694	Coefficient of Linear Expansion @ -150°F (in./in. °F x 10 ⁻⁵)	5.0
D149	Dielectric Strength, volts/mil; ST	610
	Power Factor @ 60 cps	0.007
D570	Water Absorption in 24 hrs., %	1.9
D1693	Environmental Stress Cracking	None
D4101	Propylene Molding & Extrusion Materials	63153

Fuseal Squared Installation & 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 quantity of waste discharged through waste systems in laboratories and in educational institutions is relatively small (a few gallons at a time), while industrial laboratories and processing systems may discharge larger quantities of hot or cold water and other waste products.

Because polypropylene piping is a poor conductor of heat, low volume discharges will not raise the system to the temperature of the waste and therefore, the thermal induced length changes will be limited. High volume of wastes, which take longer to flow through the piping, will bring the system up to, or close, to the waste temperature.

Fuseal Squared, being used for buried applications, is not dramatically affected by thermal expansion for three reasons:

- 1) If the trench is properly backfilled, the system is considered to be totally restrained and not subject to thermally induced changes
- 2) buried pipe is not subject to significant changes in ambient temperatures and
- 3) the primary pipe is free-floating and allows for unhindered thermal expansion.

Polypropylene is not subject to stress cracking. It can be stressed for long periods of time in an unfriendly environment without damage. Polypropylene also exhibits an extremely high fatigue life. Its "self-hinge" characteristic is well documented and the piping material will withstand repeated flexures without harm.

Centralizer (Support) Spacing

Primary Pipe Size	Sch. 40
1½"	4'
2"	4'
3"	5'
4"	5'
6"	5'
8"	5'

Instructions for Buried Installation

Trenching

- 1) The bottom of the trench shall be of stable material. Where ground water is encountered, the bottom shall be stabilized with granular material of ½" maximum particle size. A 4" cushion shall be placed over rock or hardpan.
- 2) The trench width should be sufficient to provide working room if the pipe is to be joined in the trench. Minimum width may be used if the pipe is to be joined before placing in the ditch.
- 3) Trench depth – trenches under building slabs should allow for 12" cover over the pipe. Trenches in exposed locations should permit burial of the pipe at least 12" below the maximum expected frost penetration. A minimum of 24" cover should be provided where the pipe may be exposed to heavy overhead traffic. Applicable plumbing codes may require greater trench depth and cover than technically required.

Fuseal Squared Installation & Engineering Data

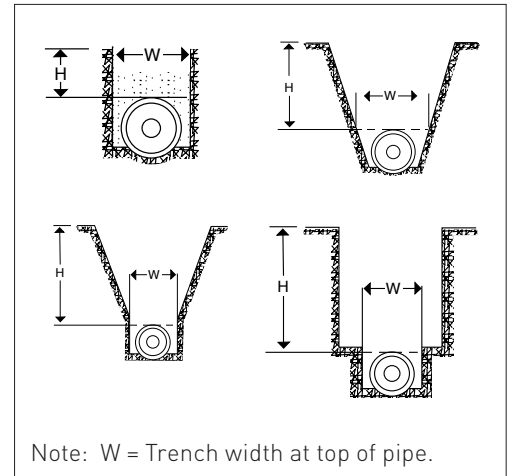
Bedding and Backfill Material

The backfill material surrounding the pipe shall be readily compactible 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 D 2321

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.

Trench Widths For Polypropylene



Fuseal Squared Soil Load and Pipe Resistance

Nom. Size	Wc' = Load Resistance of Pipe (lb./ft.)		H=Height of fill Above Pipe (ft.)	Wc = Soil Loads at Various Trench Widths at Top of Pipe (lb./ft.)		
	Schedule 40 Pipe			2 ft	3 ft.	4 ft.
	E' = 200	E' = 700				
4	564	1055	10	252	297	324
			20	328	432	504
			30	342	493	603
6	573	1313	10	371	437	477
			20	484	636	742
			30	503	725	888
8	638	1612	10	483	569	621
			20	630	828	966
			30	656	945	1156
10	721	1944	10	602	710	774
			20	785	1032	1204
			30	817	1177	1405
12	809	2266	10	714	842	918
			20	931	1225	1429
			30	969	1397	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 10⁵ 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 t³/12

Fuseal Squared Installation & Engineering Data

Installation

The Fuseal electrofusion method is the only practical and reliable way Fuseal polypropylene pipe and fittings can be joined together. The Fuseal system offers consistent and reliable fusion welds on each and every joint.

Entire installations of pipe and fittings can be pre-assembled (i.e. dry fit) prior to the permanent fusion of the joints.

The Fuseal electrofusion process applies precisely the right energy, for a specified duration, to the joint to produce a completely bonded pipe and fitting.

The many advantages of the Fuseal process provide the most efficient and cost effective corrosive waste system offered on the market.

Your local GF representative will be pleased to show you how your corrosive waste system problems can be solved by the installation of a Fuseal Squared drainage system.

Note: You must be certified by authorized GF personnel on Fuseal Squared installation or the standard product warranty is void.

The Fuseal bonding process is covered by U.S. Patent Nos. 3,094,452; 3,378,672; 3,506,519 and 3,465,126 and Canadian Patent Nos. 668,419; 811,837; 837,562 and 846,954. Other U.S. and foreign patents pending. **Fusion methods, which apply to Fuseal also, pertain to Fuseal Squared.**



Primary Pipe Preparation – All Sizes

1. Remove all burrs from primary pipe end.
A 10° to 15° chamfer will ease insertion of the pipe into the coupling.



2. Using a clean, dry cloth, wipe all dirt and foreign matter from pipe end.



3. Insert the pipe into the coupling until it hits the pipe stop. Mark the pipe to indicate full socket depth and ensure the pipe is against the stop.



4. Sand the pre-marked area of the primary pipe, with 60 grit sand paper avoiding flat spots. The entire pre-marked area must be sanded.



5. Clean sanded pipe surface with 70% IPA.
6. Do not handle the freshly cleaned surfaces prior to assembly.

Fuseal Squared Installation & Engineering Data

Containment Pipe Preparation – All Sizes



1. Remove all burrs from containment pipe end. A 10° to 15° chamfer will ease insertion of the pipe into the coupling.



2. Using a clean, dry cloth, wipe all dirt and foreign material from pipe end.



3. Slide the closure coupling into place over the exposed primary joint. Center the closure coupling and mark the containment pipe to indicate full socket depth and ensure the pipe is against the stop.



4. Sand the pre-marked area of the containment pipe with 60 grit sand paper, avoiding flat spots.



5. Clean sanded area with 70% IPA.
6. Do not handle the freshly cleaned surfaces prior to assembly.

Fuseal Squared Installation & Engineering Data

Setting Up 1½" – 6" Fuseal Squared Primary Joints



1. The Fuseal II coil is factory assembled in the fitting socket and only requires rotating for electrical access. Rotate the band clamp to orient the ratchet closure to the right or left of the duplex receptacle.
2. Using a clean, dry cloth, wipe all dirt and foreign material from the inside of the coil. Do not remove the coil from the coupling socket.
3. Insert the primary pipe into the coupling and push to the pipe stop. The end of the coupling should align with the socket depth mark made during pipe preparation.



4. Tighten the clamp until a tight mechanical interface is created between the pipe and the coupling. Proper interface will result when the coupling cannot be rotated on the pipe.
5. Connect the fusion cable to the duplex plug on the coupling coil. Make sure the connection is solid. The continuity light should be green indicating a proper connection has been made.



Setting Up Fuseal Squared 8" Primary Joints

1. Place the independent fusion coil on the pipe end, taking care not to touch freshly sanded surface. Leave the coil end flush with the end of the pipe.
2. Insert pipe end into coupling socket. Push in until the pipe end passes the small shoulder and touches the larger shoulder. The coil will slide up the pipe the distance between the small and large shoulders. Note: If the coil is loose on the pipe, place the coil into the socket and insert the pipe carefully so as not to displace the coil.
3. Fit the steel band clamp to the joint, allowing the clamp to seat flush with the socket entrance. Tighten the band clamp until the pipe will not rotate in the socket.
4. Connect the fusion cable to the duplex plug on the coupling coil. Make sure the connection is solid. The continuity light should be green, indicating a proper connection has been made.

Fuseal Squared Installation & Engineering Data

Containment Pipe (Closure Coupling) Installation

Note: On Fuseal Squared joints with loose coils, the coil should be visible with the top of the socket.

No closure coupling has a pipe stop.

1. When joining 2 sections of spigot end pipe or fittings, a closure coupling must be installed first and moved away from the joint until the primary joint is fused and tested.
2. Ensure that the coupling is fitted with a coil on each side.
 - It is recommended that for 8" – 12" closure couplings, a back-up loose Fuseal coil is used when installing.
 - If the original closure coil is damaged, this coil is discarded and the back-up is moved into position.
 - Prior to installing the closure coupling, slide the back-up coil on the containment pipe first, and then the closure coupling.



3. When moving the closure coupling away from and back toward the exposed primary joint, **it is recommended to slide the coils and coupling body separately to ensure coil integrity**; slide the coil away from the joint, followed by the coupling body.



4. After the primary joint has been fused and tested, move the coupling body back toward the exposed primary joint, and gently slide the coil back into the coupling body so that the coil is flush with the top of the coupling.
 - **Care must be taken to ensure that there is equal coupling length on either side of the joint. It is recommended that the exposed primary joint area is measured and compared with the length of the closure coupling.**



5. For each joint, install (4) band clamps (two on each side) with handles offset at 90°.



6. Connect the fusion cable to the duplex plug on the coupling coil. Make sure the connection is solid. The continuity light should be green indicating a proper connection has been made.

Fuseal Squared Installation & Engineering Data



Field Modifications of Pipe

1. Determine and mark the cutting length* on the entire circumference of the containment pipe.

*Refer to Centralizer Support Table on page 8.



2. Cut squarely, with axis of pipe, through both the containment and primary pipe. Use a miter box, fine tooth handsaw, power cutoff saw, or plastic tubing cutter.



3. Place a mark, on the entire circumference of the containment pipe, approximately 2" from the end.

4. Cut squarely, with axis of pipe, through the containment pipe only. Use a miter box, fine tooth handsaw, power cutoff saw, or plastic tubing cutter.

Testing

Joints 8" and smaller may be pressure tested 10 minutes after fusing (or 30 minutes for sizes 10" and larger). Testing and testing times shall be in accordance to local plumbing codes. If local plumbing codes are not established in your area, GF recommends that the primary piping shall be visually inspected during a hydrostatic test of the primary system prior to being permanently covered by the containment piping. Primary piping systems shall be tested to a **maximum** of 30 feet of head. The containment pipe can be tested pneumatically with a **maximum** 5- psi air so not to wet the interstitial space of the system, if used for leak detection purposes. All joints are to be inspected with soapy water to detect for the presence of bubbles, indicating leaks.

Re-fusing of Leaking Joints

1. Drain any liquid from the area surrounding the joint.
2. Replace plastic band clamp with a new clamp (1½" – 4") or retighten metal band clamp (6" – 12").

Warning: Releasing of the plastic clamp can be dangerous. Do not release with your face near the clamp. It is recommended to wear a glove when releasing the clamp.

3. Repeat the fusion process.
4. Tighten the **plastic band clamp** 1 to 2 additional clicks and the **metal band clamp** an additional 1½ – 2 turns after the fusion cycle is completed.

Fusion Technologies

Follow the GF Piping Systems operating guidelines for the fusion unit being used. It is recommended to use one of the following:

1. MSA 250SE
2. Electro Plus

Fuseal Squared Installation & Engineering Data

General Product Notes

- All containment elbows, tees, wyes, p-traps, and pipe are designed with spigot ends, with the primary extending 2" beyond the containment portion of the fitting or pipe. This allows for a minimum of 4" of primary spigot to be exposed for the joining area.

Note: This allows the closure coupling to completely contain a primary joint.

- All centralizers are heat welded to the primary pipe and are difficult to remove. When cutting the pipe to length, care must be taken to avoid these centralizers (refer to Centralizer Support Spacing Table).
- Loose centralizers are available as needed for field modifications. Loose centralizers will require field welding to the primary pipe.
- If the system is to be cable leak-detected, rotate the primary pipe so that the centralizer opening is positioned on the bottom of the pipe, to allow for pulling of the cable.
- Increases are a two-part, loose assembly without spacers; molded Fuseal primary increasers are used where available.
- **For accurate installation, it is extremely important to dry fit the primary joint first and carefully mark the pipe end and/or fitting spigot. This will indicate the correct position of the coupling and will ensure that the pipe is inserted to the required socket depth.**
- **Prior to fusing permanent joints, it is strongly recommended that the next joint be considered (i.e. careful measurement, alignment, dry fit, markings etc.).**

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