

Industrial Pipe Fittings, LLC

Dual Containment Piping System

Municipal & Industrial Dual Containment for Transporting Environmentally Hazardous Fluids Protection Against Environmental Contamination

Dual Containment Products

Municipal and industrial dual containment applications demand high quality, high performance and durability to protect the environment, minimize costs, reduce maintenance and provide long-term, trouble-free service. I P F DCS piping products are manufactured from engineered polyethylene materials that provide a balance of properties for strength, toughness, flexibility, wear resistance, chemical resistance and durability. I PF DCS products have excellent hydraulics for low resistance to fluid flows even at high flow velocities, and resilience for outstanding tolerance to pressure surge and water hammer. The preferred joining method for I PF DCS is by simultaneous butt fusion, where the carrier and containment pipe are butt fused at the same time. Properly made heat fusion joints provide leak-tight connections that are as strong as the pipe itself.

Municipal and industrial applications require dual containment to protect the environment when transporting hazardous chemicals to protect piping and fluids against contamination when piping must traverse contaminated areas. I P F DCS Dual Containment piping products are manufactured from polyethylene materials that are engineered to provide balanced properties for strength, toughness, flexibility, wear resistance, chemical resistance and durability to protect against contamination, minimize costs, reduce maintenance and provide long-term, trouble-free service.

I P F DCS provides excellent hydraulics, outstanding tolerance to pressure surge and water hammer, and heat fusion joints that provide zero-leak connections that are as strong as the pipe itself.

Performance Characteristics

I P F DCS piping products are manufactured from engineered polyethylene piping materials.

- I P F DCS polyethylene materials are PPI Listed with HDB ratings of 1600 psi at 73°F (11.03 MPa at 23°C) and 800 psi at 140°F (5.52 MPa at 60°C)
- I P F DCS polyethylene materials meet ASTM D 3350 with Cell Classifications 345464C (black) or 345464E (non-black & color).
- I P F DCS polyethylene materials are high-density, extra-high molecular weight

ASTM D 3350 classifies polyethylene pipe material physical properties according to cell values that identify nominal physical property value ranges for density, melt index, flexural modulus, tensile strength at yield, slow crack growth resistance, hydrostatic design basis at 73°F, and color and ultraviolet stabilizer.

ASTM D 3350 Cell Classification Descriptions

<i>D 3350 Cell Classification Number</i>	<i>Property, ASTM Standard, units</i>	<i>Range of Typical Values Allowed per ASTM D 3350 Cell Classification Number</i>	<i>Typical Value for HDPE Material</i>
3	Density, D 1505, gm/cm ³	0.941 – 0.955*	0.955 (black)∇ 0.946 (color)§
4	Melt Index, D 1238, gm/10 min	<0.15	0.1
5	Flexural Modulus, D 790, psi (MPa)	110,000 – 160,000 (758.45 – 1103.20)	133,000 (917.04)

NOTICE – this publication is intended for use as a guide to support the designer of piping systems. It is not intended to be used as installation instructions, and should not be used in place of the advice of a professional engineer. Industrial Pipe Fittings, LLC has made every reasonable effort to ensure the accuracy of this publication, but it may not provide all necessary information, particularly with respect to special or unusual applications. This publication may be changed from time to time without notice. Contact Industrial Pipe Fittings, LLC to determine if you have the most current edition.

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<i>D 3350 Cell Classification Number</i>	<i>Property, ASTM Standard, units</i>	<i>Range of Typical Values Allowed per ASTM D 3350 Cell Classification Number</i>	<i>Typical Value for HDPE Material</i>
4	Tensile Strength at Yield, D 638, psi (MPa)	3,000 – 3,500 (20.68 – 24.13)	3,200 (22.06)
6	Slow Crack Growth Resistance, F 1473 (PENT), hours	6 = >100 h PENT	>100 h PENT
4	Hydrostatic Design Basis, D 3350, psi (MPa)	1600 (11.03)	1600 (11.03)
C E	Color & UV Stabilizer, D 3350	C = Min 2% carbon black; E = Color with UV Stabilizer	C = 2-3% carbon Black E = Color with UV Stabilizer

NOTICE – This chart provides typical physical property information for polyethylene resins used to manufacture IPF polyethylene piping products. It is intended for comparing polyethylene piping resins. It is not a product specification, and it does not establish minimum or maximum values or manufacturing tolerances for resins or for piping products. These typical physical property values were determined using compression-molded plaques prepared from resin. Values obtained from tests of specimens taken from piping products can vary from these typical values. IPF has made every reasonable effort to ensure the accuracy of this chart, but this chart may not provide all necessary information, particularly with respect to special or unusual applications.

* The ASTM D 3350 density cell classification is for unpigmented base resin.

▽ Black density includes carbon black pigmentation.

§ Color density includes color pigmentation and UV stabilizer.

SCG (ESCR) Resistance

IPF piping materials are engineered to provide exceptional resistance to cracking from long-term stress. In recent years, new tests have been developed to evaluate the resistance to long-term stress cracking. Preeminent among these new tests is ASTM F 1473, the “PENT” test. Research has shown that this stringent test is an excellent indicator of SCG performance, and further, that there may be an empirical correlation between PENT performance and long-term service. IPF pressure piping materials meet or exceed the highest ASTM D 3350 requirements for ASTM F 1473 slow crack growth resistance, and exceed the highest requirements for ASTM D 1693 ESCR.

Color and UV Stabilizer

To resist ultraviolet degradation polyethylene materials are compounded with 2-3% carbon black (black) or sacrificial stabilizers (non-black and colors). Carbon black provides protection for extended unprotected outdoor storage and for long-term surface or above grade applications. Color and non-black products are temporarily protected to allow for up to 18 months of unprotected storage. Color and non-black products are intended for underground service, and should not be used for long-term applications on the surface or above grade.

Chemical Resistance

Very few chemicals will have an effect on IPF DCS piping. Most chemicals, acids, salts and aggressive soils do not attack polyethylene pipe or cause it to degrade. IPF DCS piping does not rust, rot, corrode, or promote or support biological or bacteriological growth. General information on chemical effects is presented with pressure rating information in this bulletin.

Chemicals that may affect the pipe may physically attack and degrade the material (such as strong oxidizers) or may permeate or solvate the pipe wall (such as liquid hydrocarbons). Such chemicals may be unsuitable for transport, or may reduce the pressure rating. Chemical concentration and service temperature may be factors and typically higher concentrations and higher temperatures increase chemical effects.

In some cases, chemically saturated soils may be of concern if the chemicals can permeate the pipe wall and the purity of the fluid in the pipe must be maintained. Liquid hydrocarbon permeation may also reduce pressure rating and may affect future connections to the system.

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I P F DCS Piping Products

The I P F DCS system is a complete system of factory assembled dual-contained pipe and fittings, and components for detecting and monitoring the containment for leakage. System components are intended for field joining using simultaneous butt fusion, where carrier and containment are butt fused in a single joining operation. *I P F DCS is a complete system of dual containment pipe, fittings and components. Compatibility with products from other manufacturers, even when those products are assembled using I P F components, cannot be assured. The user should consult with the product manufacturer to verify that products from other manufacturers are suitable for use and compatible with I P F DCS products.*

Pipe and Fittings

I P F DCS pipe and fittings are factory assembled with the carrier pipe or fitting inside the containment pipe or fitting. Necessary supports are installed on the carrier component before assembly inside the containment, and centralizers are installed and welded in place to ensure that carrier and containment are concentric and locked together for simultaneous butt fusion joining. Supports and centralizers have openings to allow any leakage in the containment to flow to monitoring sites or detection equipment.

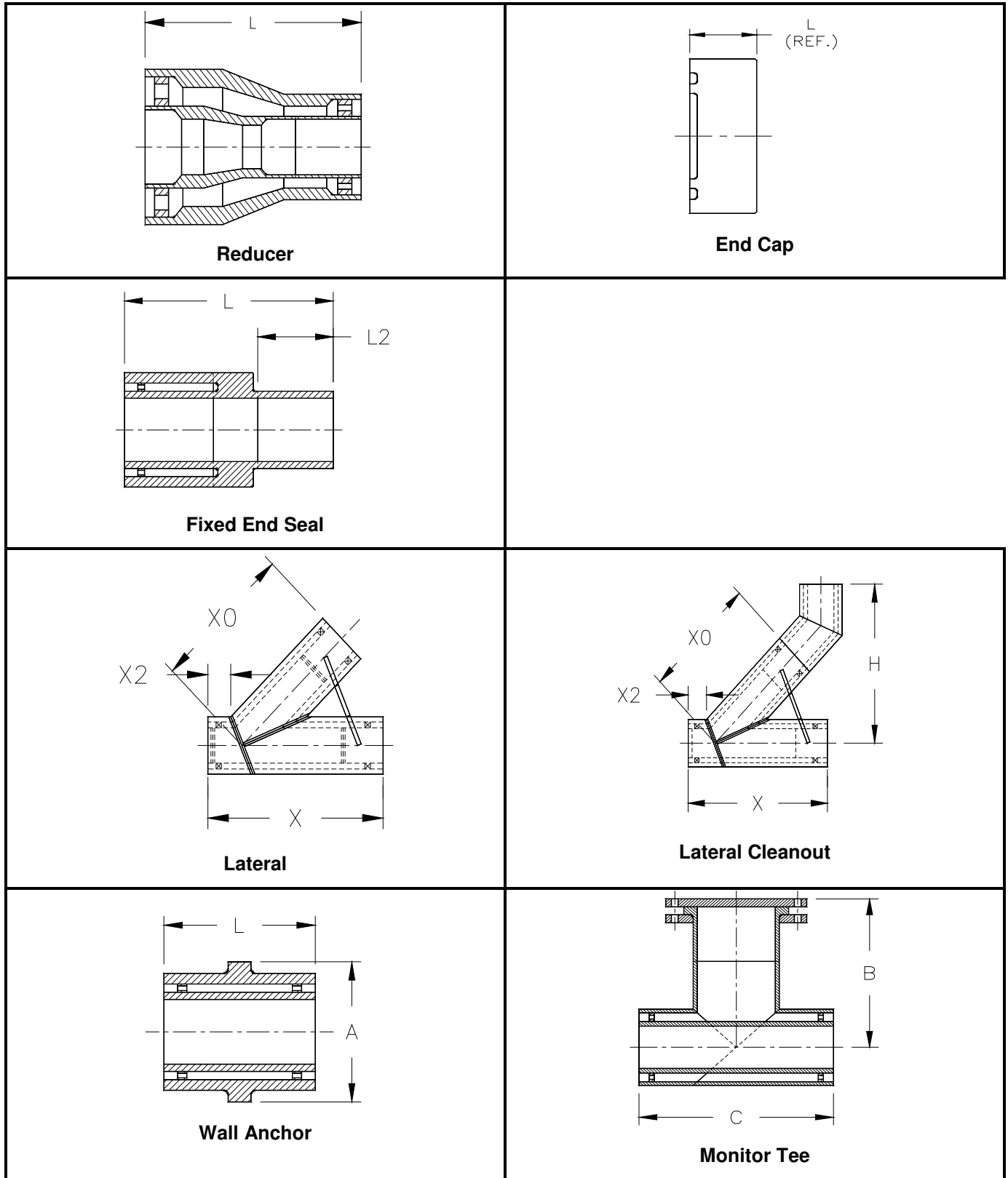
Various combinations of carrier and containment pipe sizes are available as shown in the table. Consult Industrial Pipe Fittings for special sizes and constructions.

I P F DCS Pipe – Standard Carrier x Containment Configurations

DCS Size	Carrier			Containment Size and Available DR's									
	IPS Size	DR Range	OD In.	IPS Size	OD In.	7.3	9	11	13.5	17	21	26	32.5
1 x 4	1	7.3 - 11	1.315	4	4.500	Y	Y	Y	Y	Y	Y	Y	Y
1-1/4 x 4	1-1/4	7.3 - 13.5	1.660	4	4.500	--	Y	Y	Y	Y	Y	Y	Y
1-1/2 x 4	1-1/2	7.3 - 13.5	1.900	4	4.500	--	--	Y	Y	Y	Y	Y	Y
2 x 4	2	7.3 - 17	2.375	4	4.500	--	--	--	--	Y	Y	Y	Y
2 x 6	2	7.3 - 17	2.375	6	6.625	Y	Y	Y	Y	Y	Y	Y	Y
3 x 6	3	7.3 - 17	3.500	6	6.625	--	--	Y	Y	Y	Y	Y	Y
3 x 8	3	7.3 - 17	3.500	8	8.625	Y	Y	Y	Y	Y	Y	Y	Y
4 x 8	4	7.3 - 21	4.500	8	8.625	--	Y	Y	Y	Y	Y	Y	Y
6 x 10	6	7.3 - 32.5	6.625	10	10.750	--	--	Y	Y	Y	Y	Y	Y
8 x 12	8	7.3 - 32.5	8.625	12	12.750	--	--	--	Y	Y	Y	Y	Y
8 x 14	8	7.3 - 32.5	8.625	14	14.000	--	Y	Y	Y	Y	Y	Y	Y
10 x 16	10	7.3 - 32.5	10.750	16	16.000	--	--	Y	Y	Y	Y	Y	Y
12 x 16	12	7.3 - 32.5	12.750	16	16.000	--	--	--	--	--	--	Y	Y
12 x 18	12	7.3 - 32.5	12.750	18	18.000	--	--	--	Y	Y	Y	Y	Y
14 x 18	14	7.3 - 32.5	14.000	18	18.000	--	--	--	--	--	Y	Y	Y
14 x 20	14	7.3 - 32.5	14.000	20	20.000	--	--	Y	Y	Y	Y	Y	Y
16 x 22	16	7.3 - 32.5	16.000	22	22.000	--	--	--	Y	Y	Y	Y	Y
18 x 24	18	7.3 - 32.5	18.000	24	24.000	--	--	--	Y	Y	Y	Y	Y
20 x 26	20	7.3 - 32.5	20.000	26	26.000	--	--	--	--	Y	Y	Y	Y
22 x 28	22	7.3 - 32.5	22.000	28	28.000	--	--	--	--	Y	Y	Y	Y
24 x 30	24	7.3 - 32.5	24.000	30	30.000	--	--	--	--	Y	Y	Y	Y

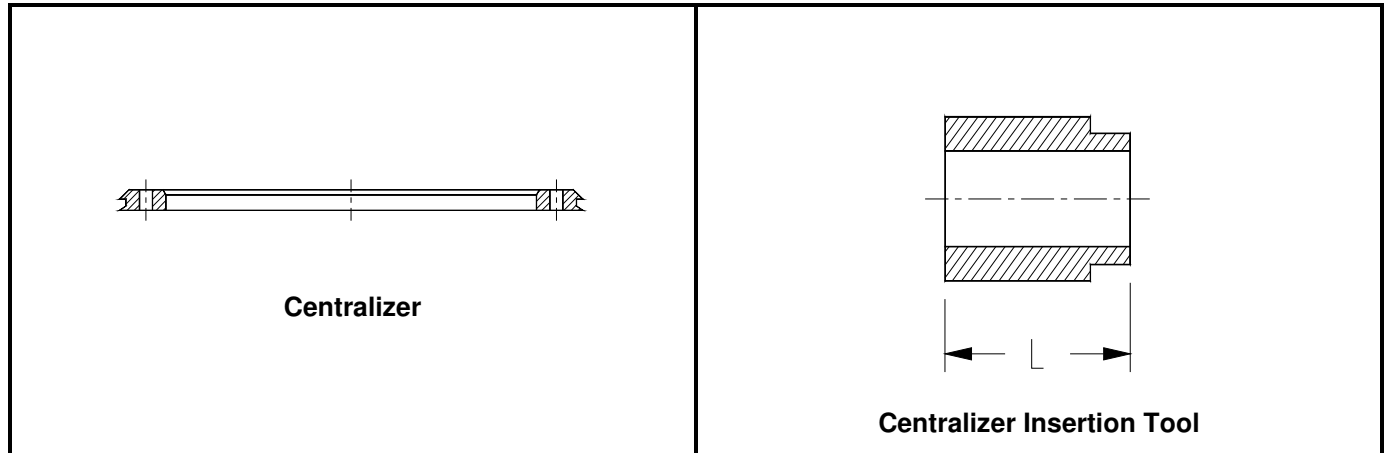
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IPF DCS Design Characteristics

Service Pressure, Temperature and Application Ratings

IPF DCS carrier and containment pressure service ratings are determined according to the dimension ratio (DR), the fluid being transported, the service temperature, and the surrounding environment.

- Carrier and containment pressure ratings are independent of each other.
- **IPF DCS system pressure ratings are limited to the pressure rating of the lowest pressure rated component in the system. In many cases, fitting pressure ratings, especially fitting containment pressure ratings will determine system pressure ratings for carrier and containment.**
- Carrier pipe pressure ratings are based on water service at 80°F (27°C) or lower using a 0.40 design factor for dual containment piping systems.
- Containment pipe pressure ratings are based on water service at 80°F (27°C) or lower using a 0.50 design factor.

To determine pressure ratings for temperatures above 80°F (27°C) and for applications other than water, multiply the carrier or containment pressure rating from Table A by the appropriate Service Temperature Multiplier from Table B and Service Application Multiplier from Table C. For special or unusual applications, contact Industrial Pipe Fittings. Fitting pressure ratings may differ from pipe pressure ratings.

Table A – IPF DCS Carrier and Containment Pipe Pressure Ratings* for Water Service at 80°F (27°C)

<i>Carrier</i>		<i>Containment</i>	
<i>DR</i>	<i>Rating, psi (MPa)</i>	<i>DR</i>	<i>Rating, psi (MPa)</i>
7.3	200 (1.38)	7.3	255 (1.76)
9.0	160 (1.10)	9.0	200 (1.38)
11.0	130 (0.90)	11.0	160 (1.10)
13.5	100 (0.69)	13.5	130 (0.90)
17.0	80 (0.55)	17.0	100 (0.69)
21.0	65 (0.45)	21.0	80 (0.55)
26.0	50 (0.34)	26.0	65 (0.45)
32.5	40 (0.28)	32.5	50 (0.34)

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*** The carrier and containment pressure ratings in this table are for I P F DCS pipe as a component of a dual containment system. System pressure ratings for carrier and containment may be less where pressure ratings for other components in the system are lower.**

Table B – I P F DCS Carrier and Containment Pipe Service Temperature Multipliers

80 °F (27 °C)	90 °F (32 °C)	100 °F (38 °C)	110 °F (43 °C)	120 °F (49 °C)	130 °F (54 °C)	140 °F (60 °C)†
1.00	0.90	0.78	0.75	0.63	0.60	0.50

†For suitable pressure applications, the maximum carrier pipe service temperature is 140 °F (60 °C). For suitable non-pressure and gravity flow applications, service temperatures up to 180°F (82°C) are permissible.

Table C – I P F DCS Carrier and Containment Pipe Service Application Multipliers for Applications Other Than Water

Service Application	Multiplier†
Fluids such as potable and process water, benign chemicals, dry gas (that is not subject to federal regulations for pressure)*◇, brine, carbon dioxide*, hydrogen sulfide*, wastewater, sewage, glycol/anti-freeze solutions.	1.00
Compressed air, oxygen or other oxidizing gases at 73 °F (23 °C) or lower temperature◇	0.64
Fluids such as solvating or permeating chemicals in pipe or soil (typically liquid hydrocarbons) in 2% or greater concentrations, natural or other fuel-gas liquid condensates, crude oil, fuel oil, gasoline, diesel, kerosene, hydrocarbon fuels.	0.50

† At the discretion of the design engineer, lower multipliers may be appropriate for some applications.

* Compressed gas lines must be fully restrained, and protected against mechanical damage by burial or other mechanical means.

◇ For compressed air, oxygen and other oxidizing gasses, service life may be reduced and service above 73 °F (23 °C) is not recommended.

Pipe Surge Pressures

I P F DCS high-density polyethylene piping has exceptional tolerance for surge pressures such as water hammer. When there is a sudden increase or decrease in water system flow velocity, a pressure surge will occur. Recurrent pressure surges, P_{RS} , are repetitive surge events that occur frequently such as during pump start-stop operation. Occasional pressure surges, P_{OS} , are irregularly occurring surges such as a sudden flow change due to firefighting or check valve operation. Surge pressure magnitude corresponds directly to velocity change; greater velocity change produces greater surge pressure. Under all steady pressure conditions, Table A pressure ratings apply. When a surge event occurs, the maximum permissible internal pressure during the surge event is the Table A pressure rating plus the appropriate recurring or occasional surge allowance.

Pressure Rating, Surge Allowance and Corresponding Sudden Velocity Change for Water at 80 °F (27 °C) or Lower

Pressure Rating, psi	Recurring Surge Events – P_{RS}		Occasional Surge Events – P_{OS}	
	Surge Allowance, P_{RS} , lb/in ²	Corresponding Sudden Velocity Change, ft/s	Surge Allowance, P_{OS} , lb/in ²	Corresponding Sudden Velocity Change, ft/s
80	40	4.0	80	8.0
100	50	4.4	100	8.9
130	65	5.0	130	10.0
160	80	5.6	160	11.1
200	100	6.2	200	12.4

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Subfreezing Temperatures

Water can be frozen solid in polyethylene pipe without damaging the pipe, but an ice plug in the pipe will stop flow. *Do not apply pressure to a frozen line that has an ice plug. Allow ice plugging to thaw before applying pressure to the line. Severe water hammer (such as from an ice plug stopping suddenly at an obstruction) in a frozen, surface or above grade pipeline can shatter the pipeline and flying fragments can cause death, injury or property damage.*

Thermal Expansion and Contraction

When subjected to a temperature change, unrestrained (not buried) polyethylene pipe will expand or contract. A rule-of-thumb is 1/10/100 – allow about 1” for a 10°F change for each 100 feet of pipe.

Allow piping to stabilize to trench bottom or casing temperature before final tie-in or backfilling. Surface or aboveground installations should be snaked side to side to allow for thermal length change. Restraining anchors may be necessary to maintain the pipeline in the right-of-way.

Flow Resistance

I P F DCS piping has a hydraulically smooth, non-wetting inside surface. Higher flow capacity and reduced friction loss can result in lower operating costs from reduced pumping costs and reduced maintenance. I P F DCS piping does not rust, rot, corrode, or tuberculate. When combined with outstanding abrasion resistance, I P F DCS piping provides excellent flow properties throughout its service life. For pressure water and wastewater flows, a Hazen-Williams “C” factor of 150-155 is typically used. For gravity flows, a Manning “n” factor of 0.009 is typically used. See the *Industrial Pipe Fittings Engineering Manual* for additional information.

Joining

I P F DCS pipe and fittings are joined using simultaneous butt fusion and flange connections. Simultaneous butt fusion joins carrier to carrier and containment to containment in a single operation. When properly made, heat fusion joints are reliable, leak-free, and fully restrained. See PPI TR-33 for recommended butt fusion joining procedures. PPI Bulletin TR-33 is available on their website at www.plasticpipe.org.

When determining fusion joining pressure for hydraulic butt fusion equipment, use the equipment manufacturer’s recommended procedure to determine fusion joining pressure for the carrier, and then for the containment, and then add the two pressures together.

Installation

Observe safe handling and construction practices at all times. Observe all applicable local, state, and federal codes and regulations, and all safety requirements specified by the owner, owner’s representative or project engineer.

I P F DCS piping products for M & I applications may be directly buried, directionally drilled, pulled-in, submerged, laid on the surface, or suspended. *Pull-in type installations (such as directional drilling) are limited to butt-fused I P F DCS pipes and the pulling force on the pipe should not be allowed to exceed the allowable tensile load (ATL) for the containment pipe. A weak link or break-away device at the pulling head is necessary whenever pulling equipment can generate pulling forces that exceed the ATL for the containment pipe. During the pull, both ends of the pull should be monitored for constant motion. For ATL information, see ASTM F 1804 Standard Practice for Determining Allowable Tensile Load for Polyethylene (PE) Gas Pipe During Pull-In Installation. Pulling heads should be designed for the type of pull-in installation. I P F does not offer pulling head products.*

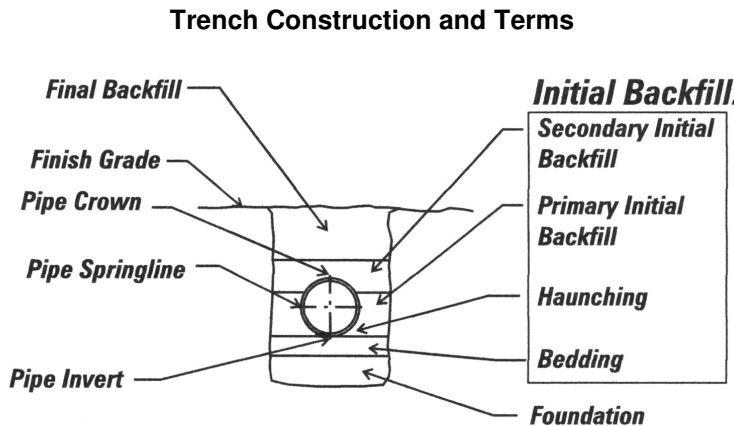
Direct Burial

For subsurface installations, I P F DCS piping is installed using flexible pipe/soil system design practices. Flexible I P F pipe acts together with the embedment and the surrounding soil to support earthloads and live loads above the pipe, thus the selection of embedment soils and their placement around the pipe are very important. At

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normal burial depths, installation and embedment for non-pressure containment should be in accordance with ASTM D 2321, *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity Flow Applications*, and in accordance with ASTM D 2774, *Standard Practice for Underground Installation of Thermoplastic Pressure Piping*, for pressure containment. Special burial design may be required for greater depths and in special or unusual soil conditions.



Minimum Trench Width

Nominal Pipe OD, in	Minimum Trench Width, in	Clearance Between Parallel Pipes, in
< 3	12	4
3 – 16	Pipe OD + 12	6
> 16 – 34	Pipe OD + 18	9
> 34 – 63	Pipe OD + 24	12
> 63	Pipe OD + 36	18

I P F DCS pipes can be simultaneously butt fused on the surface into long lengths, thus narrow trench widths and minimal open trench length can be used to reduce installation costs.

The recommended cold bending radius for field installations is 100 times the containment pipe OD or greater. If adequate space is not available for the minimum bending radius, a fitting of the desired angle may be fused into the system to obtain the necessary change in direction. When the containment is 16" IPS and larger, I P F DCS fabricated fittings require special care during handling and installation to prevent breakage and damage.

Directional Drilling

I P F DCS polyethylene piping is a material of choice for trenchless installation such as horizontal directional drilling. Flexibility, fused joints that are as strong as the pipe and excellent tensile strength make it well suited for HDD applications where it is necessary to install piping under obstacles such as rivers, lakes or highways.

Horizontal directional drilling is a subsurface installation technique that involves pulling the pipe into a prepared borehole. Horizontal directional drilling uses a surface-mounted rig, first to drill a guided hole along a shallow arc bore path, then to pull a string of pipe back into the borehole. Pullback is facilitated by a back-reamer that enlarges the hole. A drilling fluid (drilling mud) is injected into the borehole to stabilize the borehole and to lubricate the drill string and the pipe. Tracking equipment is used to guide and direct drilling. Horizontal directional drilling can be very cost effective for river, lake and reservoir crossings and where existing subsurface utilities and obstructions raise the cost of open-cut trenching. Existing subsurface obstructions must be accurately located before installation.

As the hole is bored, a steel drill string is extended behind a cutting head. Drilling mud is used to cool the cutter, to flush excavated soil from the borehole and to lubricate the borehole. At the end of the borepath, the drill string is angled upwards and through the surface. The cutting head is removed and a backreamer attached. The pipe string is attached to the backreamer. As the drill string is withdrawn to the drilling rig, the backreamer enlarges the borehole and the pipe string is drawn in. As with any pipe pulling technique, the movement of the drill string and the pipe string must be monitored, and the pulling load on the polyethylene pipe must not exceed the allowable tensile load, or safe pull strength, of the containment pipe. A weak-link device is necessary between the pipe and the pull string when pulling equipment can exceed the allowable tensile load (ATL) of the containment pipe.

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Horizontal directional drilling is most often used where open cut installations are not feasible such as road and river crossings. For road or driveway crossings, this method can often be more economical than open cut because surface restoration is reduced and there is less traffic disruption.

Submerged

I P F DCS piping can be installed as a submerged line. Its flexibility, butt-fused joints and corrosion resistance make it an excellent choice for submerged installations. I P F piping is lightweight and requires anti-flotation ballast, weights or anchors. Submerged crossings with I P F piping can often be an economical alternative to traditional pipe materials or other installation methods.

Fluid Flows

The inside surface of I P F DCS polyethylene pipe is both hydraulically smooth and non-wetting. To estimate gravity flows using the Manning equation, a Manning roughness coefficient of 0.009 is used.

Pressure flows of water and water-like fluids may be estimated with the Hazen-Williams formula. Values of the Hazen-Williams C-factor range from 150 to 160 for I P F polyethylene pipe with values from 150 to 155 being used for conservative flow estimates. For fluid flow estimates using Darcy-Weisbach, Colebrook and Moody methods, an absolute roughness of 7×10^{-5} ft is recommended.

Cautions and Notices

Polyethylene piping has been safely used in thousands of applications. In addition to the general handling, installation, construction and operating safety precautions that should be observed when using any product including piping products, below are some precautions that should be observed when using I P F piping products. Local, state and federal codes and regulations may also apply.

Fusion

During the heat fusion process the equipment and products can reach temperatures in excess of 450°F (231°C). Caution should be taken to prevent burns.

Do not bend pipes into alignment against open butt fusion machine clamps. The pipe may spring out and cause injury or damage.

Weight, Unloading and Handling

Although polyethylene pipe is not as heavy as some other piping products, significant weight may be involved. Exercise care when handling and working around polyethylene pipe.

Polyethylene piping is a tough, robust material, but it is not immune to damage. Improper handling or abuse can damage piping and compromise system quality or performance or cause injury or damage.

WARNING – Obtain and observe the pipe unloading instructions provided by the delivery driver.

I P F DCS piping should be handled only with proper handling and lifting equipment that has been checked before use to ensure adequate capacity and safe condition. Use lifting equipment with spreader bars having fabric slings spaced 15-20 feet apart, or fork lift forks should be of sufficient depth, padded and spread 15-20 feet apart. Do not use chains or wire rope. Do not push, roll or drop pipe off the truck, or drag piping. Unload and store I P F DCS products on level terrain and so that the potential for mechanical damage is minimized. See the unloading instructions provided by the delivery driver.

While polyethylene piping has excellent impact resistance, striking the pipe with an instrument such as a hammer may result in uncontrolled rebound. Do not stand or walk on polyethylene pipe, especially when the pipe is damp.

Testing

When testing is required, observe all safety measures, restrain pipe against movement in the event of catastrophic failure, and observe limitations of temperature, test pressure, test duration and making repair.

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The carrier pipe must be pressurized when testing the containment, and the containment test pressure must not exceed the internal pressure applied to the carrier or the containment pressure rating of the lowest pressure rated component containment, whichever is less.

Protection Against Shear and Bending Loads

Measures such as properly placed, compacted backfill, protective sleeves and structural supports are necessary to protect plastic pipe against shear and bending loads. Connections should be protected where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle or tapping tee on a main pipe, and where pipes enter or exit casings or walls. Properly placed, compacted backfill and a protective sleeve or a structural support are generally used together, but whether or not a protective sleeve or a structural support is installed, the area surrounding the connection must be embedded in properly placed, compacted backfill to protect the polyethylene pipe against shear and bending loads.

Information about protecting against shear and bending loads at service or branch connections and where PE pipe penetrates a structure or enters or exits a casing can be found in the PPI Handbook of Polyethylene Pipe and ASTM D 2774 *Underground Installation of Thermoplastic Pressure Piping*.

Liquid Hydrocarbon Permeation

When present, liquid hydrocarbons may permeate (solvate) polyethylene pipe. Liquid hydrocarbon permeation may occur when liquid hydrocarbons are present in the pipe, or where soil surrounding the pipe is contaminated with liquid hydrocarbons. All types of liquid hydrocarbons (aromatic, paraffinic, etc.) have a similar effect, and the relative effect on different polyethylene pipe resins is essentially the same. Heat fusion joining to liquid hydrocarbon permeated pipes may result in a low strength joint.

CAUTION — Once polyethylene pipe has been permeated with liquid hydrocarbons, heat fusion or electrofusion joining is not recommended because liquid hydrocarbons can leach out during heating and contaminate the joint. Liquid hydrocarbon permeated polyethylene pipe should be joined using suitable mechanical connection methods.

Liquid hydrocarbon contamination is indicated by a rough, sandpaper-like, bubbly, or pockmarked surface when a fusion heating iron is removed from the pipe surface, and may be indicated by discoloration or by a hydrocarbon fuel odor.

Mechanical fittings must be installed in accordance with the fitting manufacturer's instructions. Obtain these instructions from the fitting manufacturer.

Locating

Most polyethylene materials are not detectable with standard magnetic locating equipment. To aid in the detection of underground PE piping, measures such as tracer wires, identification and detection tapes, line markers, electronic marker systems, acoustic pipe tracing, and "call before you dig" line location measures may be used. When installing PE piping, the method or methods for future pipeline detection should be considered. Where posted signs are used, the signs should indicate that the pipeline is polyethylene to alert locating personnel that the pipeline may not be detectable with standard locating equipment. Utilities in the area should always be contacted before the start of any underground installation work such as excavation, trenching, directional boring, etc.