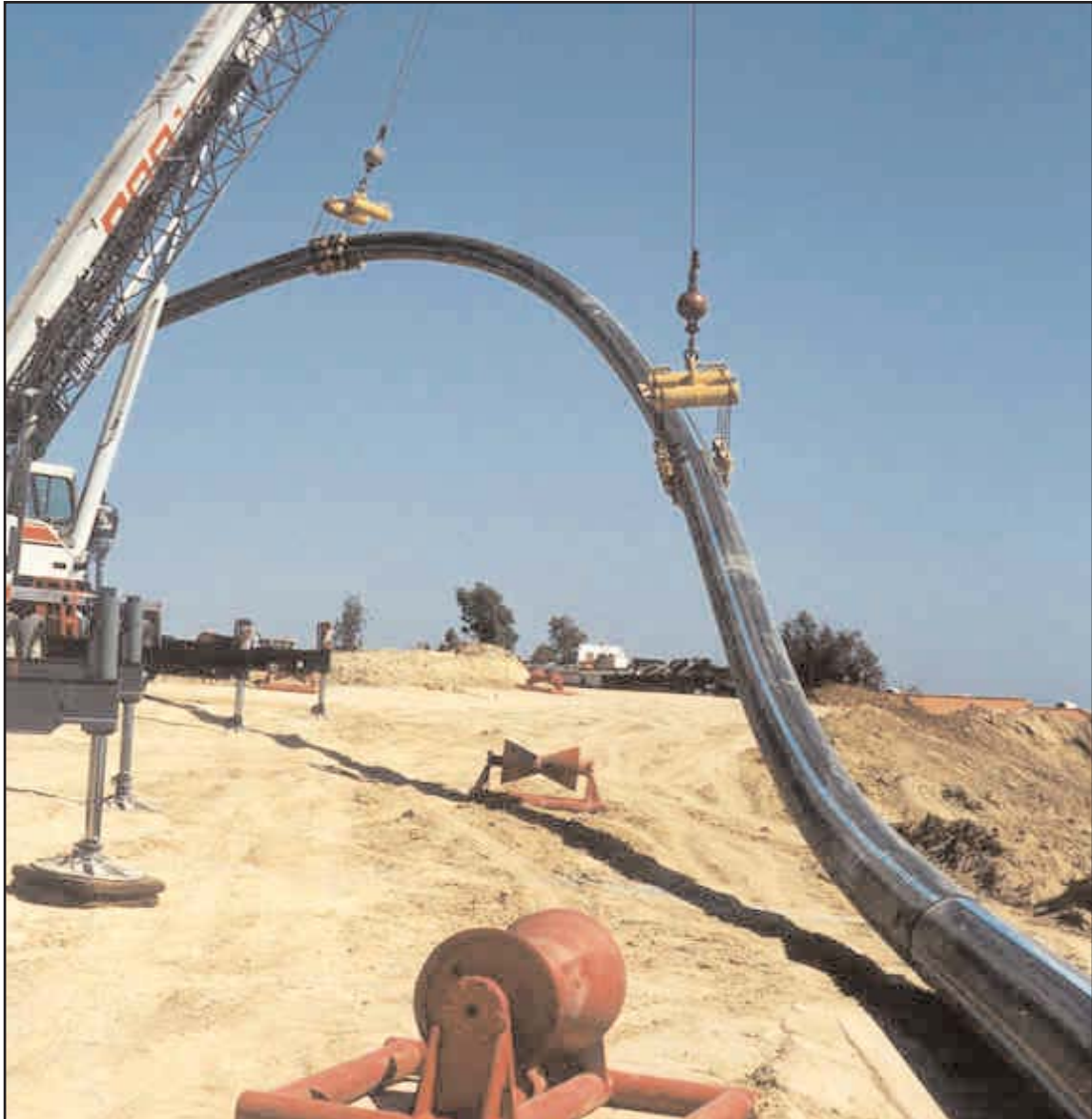




PIPING FOR MUNICIPAL AND INDUSTRIAL APPLICATIONS



Bulletin: PP 503

DRISCOPEX® Series Piping Products for
Municipal Water, Sewer & Landfill
Industrial
Mining

August 2007

DRISCOPEX[®] Series Piping Products for Municipal Water, Sewer & Landfill Industrial Mining

Performance Pipe

PERFORMANCE PIPE is the successor to Plexco¹ and Driscopipe². On July 1, 2000, Chevron Chemical Company and Phillips Chemical Company were joined to form Chevron Phillips Chemical Company LP. Performance Pipe, a division of Chevron Phillips Chemical Company LP, succeeds Plexco and Driscopipe as North America's largest producer of polyethylene piping products for gas, industrial, municipal, mining, oilfield, and utility applications.

Performance Pipe offers more than forty years of polyethylene pipe manufacturing experience with nine ISO certified manufacturing facilities in eight states.

Performance Pipe manufactures 1/2" through 54" outside diameter controlled polyethylene pipe, tubing, and molded fittings for domestic and international markets.

To enhance the outstanding quality and performance of Performance Pipe polyethylene piping, Chevron Phillips Chemical Company LP further strengthens Performance Pipe with over four decades of quality polyolefin plastic resin production.

Performance Pipe Polyethylene Piping Products for M&I

Municipal, mining and industrial applications demand high quality, high performance and durability to protect the environment, minimize costs, reduce maintenance and provide long-term, trouble-free service.

DriscoPlex[®] Series piping products for M & I are manufactured from engineered polyethylene materials that provide a balance of properties for strength, toughness, flexibility, wear resistance, chemical resistance and durability. Performance Pipe products for M & I 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. DriscoPlex[®] piping products for M & I may be joined by many conventional methods, however the preferred joining method for most products is by heat fusion. Properly made heat fusion joints provide leak-tight connections that are as strong as the pipe itself.



¹ Formerly - Plexco, a Division of Chevron Chemical Company, LP

² Formerly - Driscopipe, A Division of Phillips Petroleum Company

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. It does not constitute a guarantee or warranty for piping installations. Performance Pipe 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 Performance Pipe to determine if you have the most current edition.

DRISCOPEX® Products for Municipal and Industrial Applications

Typical Markets for Pipe and Fittings	DRISCOPEX® Series	Typical Features	Previous Designations	
			Former Plexco Product	Former Driscopipe Product
<i>FMR Approved Underground Fire Main</i>	DRISCOPEX® 1500	2, 8, 12	REDSTRIPE FM (IPS)	1000 FM
		2, 8, 23	BLUESTRIPE-FM (IPS)	—
	DRISCOPEX® 1600	6, 12, 24	—	—
		6, 23, 24	—	—
<i>Mining</i>	DRISCOPEX® 1700	1, 3	PLEXSTRIPE	1000 SP
<i>Perforated Pipe</i>	DRISCOPEX® 1900	1, 4	EHMW Perforated Pipe	—
<i>Water Distribution</i>	DRISCOPEX® 4000	5, 6, 7	BLUESTRIPE (DIPS)	4000 BLUESHELL (DIPS)
<i>Municipal & Industrial, Water Distribution</i>	DRISCOPEX® 4100	1, 8, 25, 26	EHMW, BLUESTRIPE (IPS)	1000, 4100 BLUESHELL (IPS)
<i>Water Service Tubing</i>	DRISCOPEX® 5100	9, 19	BLUESTRIPE	5100 ULTRA-LINE
<i>Sanitary Sewer</i>	DRISCOPEX® 4200	8, 10	GREENSTRIPE (IPS)	4200 GREENSHELL (IPS)
	DRISCOPEX® 4300	5, 6, 10	GREENSTRIPE (DIPS)	4300 GREENSHELL (DIPS)
<i>Treated/Reclaimed Water</i>	DRISCOPEX® 4400	8, 13	PURPLESTRIPE (IPS)	4400 LAVENDERSHELL (IPS)
	DRISCOPEX® 4500	5, 6, 13	PURPLESTRIPE (DIPS)	4500 LAVENDERSHELL (DIPS)
<i>Sliplining</i>	DRISCOPEX® 4600	1, 14	PLEXVUE® (IPS)	—
	DRISCOPEX® 4700	5, 6, 14, 20	PLEXVUE® (DIPS)	—
	DRISCOPEX® 1200	1, 15	—	1200 OPTICORE (IPS)
	DRISCOPEX® 1400	5, 15	—	1400 OPTICORE (DIPS)
<i>Irrigation</i>	DRISCOPEX® 4800	16	MDPE	—
<i>Industrial</i>	DRISCOPEX® 8700	1, 19	EHMW	8700
<i>Liner Pipe</i>	DRISCOPEX® 9200	18	EHMW	9200
<i>Industrial & Specialty</i>	DRISCOPEX® 1000	1, 22	EHMW	1000
NOTICE. Capabilities vary from manufacturing plant to manufacturing plant. Contact Performance Pipe to determine the availability of specific products and the availability of particular stripe or shell colors, striping patterns, and IPS or DIPS sizing.				

Legend for Table 1 Typical Features :

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|--|---|---|
| <ol style="list-style-type: none"> 1. IPS sizing system. 2. FMR Approved Class 150 or Class 200 in 2" – 24" IPS pipe sizes. 3. A single longitudinal color stripe is extruded into the pipe OD to identify DR. 4. Various perforation patterns are available. 5. DIPS sizing system. 6. The DIPS longitudinal color stripe pattern is three equally spaced pairs of color stripes extruded into the pipe OD. 7. Blue color stripes are standard. A blue color shell is available on special order. 8. The IPS longitudinal color stripe pattern is four equally spaced single color stripes extruded into the pipe OD. | <ol style="list-style-type: none"> 9. NSF Approved. CTS, IPS, and SIDR in 1/2" – 2" sizes. 10. Green color stripes are standard. A green color shell is available on special order. 11. <i>Removed 8-2007</i> 12. Red color stripes standard. 13. Purple color stripes are standard. A lavender color shell is available on special order. 14. Solid light gray color. 15. Light gray color lining extruded into pipe ID. 16. Black PE 2406 material. 17. <i>Removed 8-2007</i> 18. Custom wall thickness and diameters available on special order. | <ol style="list-style-type: none"> 19. PE 3408/PE100 material. 20. Green color stripes are standard. 21. <i>Removed 8-2007</i> 22. 1-1/2" IPS and smaller sizes only. 23. FMR & NSF Approved Class 150 or Class 200. Blue color stripes standard. 24. FMR Approved Class 150 or Class 200 in 4" – 24" DIPS pipe sizes. 25. Black is standard. Blue color stripes or blue color shell available on special order. 26. 2" IPS and 3" IPS made to ASTM D 3035, AWWA C901 and NSF 61. 4" IPS and larger made to ASTM F 714, AWWA C906 and NSF 61. |
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Markets and Typical Applications and Uses for DRISCOPLEX® M & I Piping Products

Market	Typical Applications and Uses
<i>Industrial and Municipal</i>	Industrial Process Piping – Dredging, Slurry and Flyash Lines – Road Drainage and Culverts – Temporary Bypass Pumping – River, Lake and Reservoir Crossings – Force Mains – Odor Control – Sludge Lines – Outfalls and Diffusers – Chemical Mineral Extraction – Chemical and Corrosive Wastes – Leachate Control Systems – Fabricated Fittings and Custom Fabrications – Manholes, Tanks, Structures, Catch Basins – Impoundment Piping – Pipeline Rehabilitation – Chemical and Zebra Mussel Treatment Systems
<i>FM Approved Underground Fire Main</i>	Underground Municipal and Industrial Fire Water Systems
<i>Mining</i>	Acid Mine Drainage – Chemical Mineral Extraction – Process Pipe and Fittings – Decant Systems – Slurry and Tailings Lines – Dewatering – Impoundment Piping
<i>Perforated Pipe</i>	Aeration Systems – Landfill Gas Collection – Leachate Collection – Drainage and Waste Disposal Absorption Fields – Odor Control
<i>Water Distribution</i>	Underground Potable Water Distribution Mains – River, Lake and Reservoir Crossings – Intake Piping – Directional Drilling
<i>Water Service Tubing</i>	Small Diameter Underground Potable Water Distribution Service Lines
<i>Sanitary Sewer</i>	Gravity Sanitary Sewer Mains – Sanitary Sewer Forced Mains – Odor Control – Temporary Bypass Pumping – Dewatering – Storm Drains – Directional Drilling – Chipper Systems
<i>Treated/Reclaimed Water</i>	Raw Water Systems – Outfalls and Diffusers
<i>Sliplining</i>	Pipeline Rehabilitation – Pipe Bursting – Sliplining
<i>Irrigation</i>	Hard-Hose Reel Irrigation – Drag-Line Irrigation – Underground Irrigation Water Supply Mains
<i>Liner Pipe</i>	Pipeline Rehabilitation – Tight-Fitting Liners – Casing for Insulated Pipe

DRISCOPLEX® Piping Products for M & I

OD-controlled polyethylene pipe and tubing are manufactured to applicable ASTM, AWWA, and international standards in sizes from 1/2" through 54" (16 mm through 1400 mm). Depending upon size, fittings are molded, or fabricated. DriscoPlex® 4000 and DriscoPlex® 4100 meet both ASTM F 714 and AWWA C906 and are dual purpose pipes for use in M & I applications as well as water distribution. Performance Pipe DriscoPlex® pipe and fittings are manufactured from engineered polyethylene piping materials.

- For long-term service in pressure piping applications, Performance Pipe PE 3608 materials are PPI Listed with HDB ratings of 1600 psi at 73°F (11.03 MPa at 23°C)
- Performance Pipe PE 3608 materials meet ASTM D 3350 Cell Classifications 345464C (black) or 345464E (non-black & color).
- Performance Pipe PE 3608 materials are high-density, extra-high molecular weight.
- Applicable fitting standards include ASTM D 2683, ASTM D 3261, AWWA C906.
- NSF Certification for Potable Water applications.
- FMR Approval for underground Fire Main applications.
- Join by butt fusion, saddle fusion, socket fusion, mechanical connections that are designed for PE pipe and electrofusion.

Color Coding

Color-coding has become the preferred way to identify differences among piping services, sizing systems, and to differentiate multiple DR's (pressure ratings) on the jobsite. For identification that is as permanent as the pipe, striped pipe has color stripes extruded into the pipe outer surface. Color shell pipe has a thin shell of color material extruded into the outer pipe surface. Color identifications are in accordance with the APWA/ULCC Uniform Color Code.

Color Stripes or Color Shell to Identify the Application

<i>Color</i>	<i>Application</i>
Yellow	Natural Gas
Blue	Potable Water
Green	Wastewater
Red	Underground Fire Main
Red	Electric Power Conduit
Purple	Treated Effluent, Reclaimed Water
Orange	Communications Conduit
White – Gray – Brown	Customer Specified

Color Stripe Patterns to Identify the Sizing System

IPS pipe is the same OD as steel pipe. It has four longitudinal color stripes equally spaced around the pipe.

DIPS pipe is the same OD as ductile iron pipe. It has three pairs of longitudinal color stripes equally spaced around the pipe.



One Color Stripe to Identify DR

DriscoPlex® 1700 pipe has one color stripe for quick and easy identification of the pipe DR (dimension ratio). Where a project has multiple DR's - especially when pipes have the same diameter - different colors designate different DR's. Pipes can be readily identified so they can be installed in the correct order for more cost effective installation. DriscoPlex® 1700 helps to quickly identify pipe DR for correct placement and installation in the system.

One Color Stripe for DR Identification

<i>Stripe Color</i>	White	Red	Yellow	Gray	Orange	Blue	Purple	Green	Pink	Brown
<i>DR</i>	7	9	11	13.5	15.5	17	21	26	32.5	41

Solid Color and Color Linings

DriscoPlex® 4100 is solid black with blue color stripes or shell available upon request. DriscoPlex® 4600 is solid gray. DriscoPlex® 4700 is solid gray with green stripes on the OD in the DIPS pattern. DriscoPlex® 1200 and DriscoPlex® 1400 have a black exterior with a soft-white color lining extruded into the ID. These products have a highly reflective inside surface to facilitate video inspection in sewer applications.

Performance

DriscoPlex® piping products for M & I applications meet or exceed performance needs for municipal, mining and industrial applications:

- High strength and stiffness to withstand internal pressure and external loads.
- Chemical resistance to withstand corrosive chemicals (pH from 1 to 14), and aggressive soils.
- Resistance to environmental stress cracking and slow crack growth for long-term resistance to internal pressure, external loads and harsh environments.
- Flexibility, toughness, light weight, and impact resistance for lower cost installation, narrower trenches (reduced excavation), and fewer expensive fittings.
- Heat fusion joining for strong, lifetime leak-tight, fully restrained joints.
- Resilience for enhanced resistance to surge and fatigue.
- Remains flexible at sub-freezing temperatures.
- Retains long-term strength at elevated temperatures.
- Long-term strength for extended life and performance.
- Does not rust, rot or corrode or support biological growth.
- Retains low resistance to liquid flows for reduced pumping and operating costs.

DriscoPlex® is lightweight, flexible, resistant to most chemicals and resistant to abrasion.

DriscoPlex® piping resists ultraviolet and thermal degradation.

Performance Materials

Materials

DriscoPlex® PE 3608 pipe and fittings for M & I applications are made from polyethylene materials that are engineered for high density, extra high molecular weight, and broad molecular weight distribution. ASTM D 3350 identifies polyethylene pipe material physical properties and typical values according to a cell classification system that identifies typical values 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. Polyethylene materials used for DriscoPlex® PE 3608 industrial pipe and fittings are classified under ASTM D 3350 as 345464C or 345464E.



ASTM D 3350 Cell Classification Descriptions

D 3350 Cell Classification Number	Property, ASTM Standard, units	Range of Typical Values Allowed per D 3350 Cell Classification Number	Typical Value for HDPE Material
3	Density, D 1505, gm/cm ³	0.941 – 0.955*	0.955 ± 0.002
4	Melt Index, D 1238, gm/10 min	<0.15	0.08
5	Flexural Modulus, D 790, psi 2% Secant-16:1 Span; depth, 0.5 in/min	110,000 – 160,000	>110,000
4	Tensile Strength at Yield, D 638, psi	3,000 – 3,500	3,200
6	F 1473 (PENT), hours	>100	>100
4	Hydrostatic Design Basis, D 2837, psi	1600	1600
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 Performance Pipe 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. Performance Pipe 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. * Base resin - unpigmented. ±Black = 0.944 g/cc nominal resin density + 0.011 g/cc for 2.5 % carbon black. § Non-black or color = 0.944 g/cc nominal resin density + 0.002 g/cc for color and UV stabilizer.

SCG (ESCR) Resistance

DriscoPlex® piping materials for M & I applications 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. Predominant 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. DriscoPlex® pressure piping materials meet or exceed the highest ASTM D 3350 requirements for slow crack growth resistance under ASTM F 1473.

Color and UV Stabilizer

To resist ultra-violet degradation polyethylene materials are compounded with 2-3% carbon black (black) or sacrificial stabilizers (non-black and colors). Carbon black provides long-term protection for unprotected outdoor storage and for 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 DriscoPlex® piping. Most chemicals, acids, salts and aggressive soils do not attack polyethylene pipe or cause it to degrade. DriscoPlex® piping does not rust, rot, corrode, or promote or support biological or bacteriological growth. Chemicals that may affect the pipe may either be unsuitable for transport, or may reduce the pressure rating - both chemical concentration and service temperature may be factors.

Most piping systems are permeable to chemicals such as liquid hydrocarbons either through the material or through elastomeric gaskets used at joints. In some cases, chemically saturated soils may be of concern if the purity of the fluid in the pipe must be maintained. For pressure M & I applications, hydrocarbon permeation may reduce pressure rating and may affect future connections to the system. See the *Performance Pipe Engineering Manual* for additional information.

Design Performance

Service Pressure, Temperature and Application Ratings

DriscoPlex® PE 3608 pressure service ratings for M & I pipe are dependent upon the pipe dimension ratio (DR), the fluid being transported, the service temperature, and the surrounding environment.

DR	Rating, psi (MPa)	DR	Rating, psi (MPa)
7.3	255 (1.76)	17.0	100 (0.69)
9.0	200 (1.38)	21.0	80 (0.55)
11.0	160 (1.10)	26.0	65 (0.45)
13.5	130 (0.90)	32.5	50 (0.34)

* To determine PE 3408 pressure ratings for applications other than water and temperatures other than 73°F, multiply the Standard PE 3408 Pressure Rating by the appropriate application and temperature multipliers. For special or unusual applications, contact Performance Pipe Technical Services. Fitting pressure ratings may differ from pipe pressure ratings.

Standard PE 3608 Pressure Rating for Water Service at 73°F (23°C)*Service Temperature Multipliers for PE 3608 Pressure Pipe

40°F (4.4°C)	60°F (15.6°C)	73°F (23°C)	100°F (37.8°C)	120°F (48.9°C)	140°F (60°C)
1.20	1.08	1.00	0.78	0.63	0.50

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

Multipliers for Applications Other Than Water

PE 3608 Pressure Pipe Application	Multiplier†
Fluids such as potable and process water, benign chemicals, dry gas (not subject to federal regulations on pressure) *‡, brine, carbon dioxide*, hydrogen sulfide*, wastewater, sewage, glycol/anti-freeze solutions.	1.00
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
†Lower multipliers may be appropriate for some applications at the discretion of the design engineer. * Compressed gas lines must be fully restrained, and protected against mechanical damage by burial or other mechanical means. ‡ Service with compressed air, oxygen and other oxidizing gasses is discouraged because oxidizing gasses reduce service life, particularly at elevated temperature. If used for compressed air or oxygen service, a multiplier of 0.64 or lower should be used.	

Surge Pressures

DriscoPlex® PE 3608 high-density polyethylene piping has exceptional tolerance for surge pressure such as water hammer. For recurrent surge, the surge allowance is 50% of the working pressure rating. For occasional surge, the surge allowance is 100% of the working pressure rating. Surge allowance is applied above the working pressure rating; however, where surge is unlikely, surge allowance cannot be used to increase the working pressure rating of the pipe.

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 back and forth to allow for thermal length change. Restraining anchors may be necessary to maintain the pipeline in the right-of-way.

Flow Resistance

DriscoPlex® piping for M & I applications 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. DriscoPlex® piping does not rust, rot, corrode, or tuberculate. When combined with outstanding abrasion resistance, DriscoPlex® 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, and for gravity flows, an "n" factor of 0.009 is typically used with the Manning formula. See the *Performance Pipe Engineering Manual* for additional information.

Joining

DriscoPlex® pipe and fittings are joined using heat fusion, flanges, mechanical connections that are designed for PE pipe, and electrofusion. Heat fusion is a simple procedure that utilizes controlled temperature and pressure to melt and fuse PE pipe materials together. Butt fusion is used to join components end to end; saddle fusion to attach a branch outlet to a main pipe, and socket fusion to join smaller pipes to socket fittings. When properly made, heat fusion joints are reliable, leak-free, fully restrained, and as strong as the pipe itself. Contact Performance Pipe for recommended joining procedures.

A leakage allowance common to gasketed-bell-and-spigot joined pressure pipes is unnecessary with the DriscoPlex® pressure piping system. With heat fusion, there are no gaskets to leak, joint restraints are not required, and thrust blocks are necessary only under unusual circumstances. Long lengths - 40 feet or more - mean fewer joints.



DriscoPlex® pipe and fittings may also be joined together or transitioned to other materials with flanges, mechanical connections that are designed for PE pipe, or electrofusion. These connections must be made in accordance with the connection manufacturer's instructions. Some connections such as mechanical OD compression couplings may require a stiffener in the pipe bore.

DriscoPlex® piping products cannot be joined with adhesive or solvent cement. Threaded joining, and joining by hot air (hot gas), or extrusion welding techniques are not recommended for pressure service.

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.

DriscoPlex® piping products for M & I applications may be directly buried, planted, directionally drilled, pulled-in, submerged, laid on the surface, or suspended. DriscoPlex® pipes may also be used for rehabilitation by sliplining and various proprietary rehabilitation techniques. Pull-in type installations (such as directional drilling, pull-in, sliplining, and various renewal techniques) are limited to butt-fused DriscoPlex® PE 3608 pipes and the pulling force on the pipe should not be allowed to exceed the allowable tensile load (ATL) for the pipe (a weak link or break-away device at the pulling head is recommended). During the pull, both ends of the pull should be monitored for constant motion.



Direct Burial

For subsurface installations, DriscoPlex® pipe is installed using flexible pipe/soil system design practices. Flexible DriscoPlex® 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 normal burial depths, installation and embedment in accordance with ASTM D 2321 for non-pressure pipes, and ASTM D 2774 for pressure pipes is recommended. Special burial design may be required for greater depths and in special or unusual soil conditions. Burial design information may be found in the *Plastics Pipe Institute Handbook of Polyethylene Pipe*. Pipes may be buried to depths exceeding 100 feet.

DriscoPlex® OD controlled pipes can be butt fused on the surface into long lengths, thus narrow trench widths and minimal open trench length can be used to save on installation costs. Lightweight DriscoPlex® pipe may be readily placed in the trench with common construction lifting equipment.

Depending upon DR and where fittings are not present in the bend, DriscoPlex® OD controlled pipe may be cold-bent as tight as 20-40 times the pipe diameter, thus reducing or even eliminating the need for elbows at bends. If adequate space is not available for the bending radius, a fitting of the desired angle may be fused into the piping system to obtain the necessary change in direction. *Larger fabricated fittings require special care during handling and installation.*

Plowing, Planting and Pull-In

Plowing and planting generally involve opening or cutting a narrow trench with a plow or a wheel or chain type trencher and feeding PE pipe directly over the trenching machine into the trench. When the pipe is fed into the trench through a plow, the bending radius of the pipe through the plow should not be less than half the long-term minimum bending radius for DR of the pipe. In pull-in, a narrow trench is opened and then a pipe string is pulled into the trench from one end. Plowing planting and pull-in are limited to suitable soils and open, unobstructed areas, but can be very cost effective.

Directional Drilling

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. Additional information is available in *Plastics Pipe Institute Handbook of Polyethylene Pipe*.

Sliplining

In sliplining, a new DriscoPlex® pipe is installed within an existing host pipe, thus rehabilitating the existing system at greatly reduced costs. Sliplining rehabilitation has proved to be very cost effective for systems where the host pipe retains sufficient structural integrity, but fails to adequately contain fluids within the pipe, or exclude groundwater outside the pipe. Although the rehabilitated system has a smaller diameter than the original pipe, the exceptional flow characteristics of DriscoPlex® pipe typically provide comparable, and occasionally even greater flow capacity. See *ASTM F 585* and the *Performance Pipe Engineering Manual* for more information.

Proprietary Trenchless Rehabilitation Techniques

A number of proprietary techniques use polyethylene pipe to rehabilitate a deteriorated or partially deteriorated host pipe. Tight-fitting liner techniques generally employ a mechanical means to temporarily reduce the diameter of the liner by swaging, rolling-down, or deforming. The liner is pulled into the host pipe, and then expanded to fit closely to the host pipe inside diameter. The liner restores leak tightness, but the condition of the host pipe determines the structural integrity of the rehabilitated pipeline.

In pipe bursting, a bursting head is attached to a polyethylene pipe string. When pulled into the host pipe, the bursting head breaks the host pipe into pieces, enlarges the hole and installs the new pipe. Pipe bursting can provide increased capacity where the host pipe can be used as a guide path to install a larger pipe. Since the original host pipe is destroyed during installation, the new pipe must be structurally designed for the necessary static and dynamic loads. Pipe bursting is limited to host pipes that can be fractured and appropriate soil conditions.

Submerged

Submerged installations such as river and lake crossings, or outfalls require weights to keep the pipe submerged. DriscoPlex® piping materials are about 4-1/2% lighter than water and will float even when the pipe is water filled. Anchors may be required if significant crosscurrents are encountered.



Surface

Surface installations will be affected by thermal length changes. Snaking the pipe back and forth can allow extra pipe length so that cold weather contraction may be controlled. Restraining anchors may be necessary to maintain the pipeline within the right-of-way. Pipelines exposed to the sun may be heated enough to affect system pressure ratings. Large diameter fabricated fittings may require external mechanical reinforcement to withstand bending and tensile forces from thermal length changes.

Suspended

Suspended installations will be subject to the same thermal length change and resultant forces as a surface pipeline. Pipeline supports should be at least 1/2 pipe diameter wide and cradle the bottom 1/3 of the pipe. Supports that hang the pipe from above allow the pipe to deflect sideways with thermal expansion and contraction. Supports will need to be spaced according to the pipe diameter, DR, and the weight of the fluid in the pipe. The recommended maximum deflection between supports is 1 in.

Slurry Transport

DriscoPlex® piping has demonstrated superiority to other types of piping where corrosion and erosion problems exist. In liquid slurry piping, DriscoPlex® HDPE piping shows exceptional wear resistance, in some cases, as much as 3 to 5 times better than steel. Design information on slurry piping design, velocity and particle size can be found in the *Performance Pipe Engineering Manual*.

CAUTIONS

OBSERVE ALL LOCAL, STATE AND FEDERAL CODES AND REGULATIONS, AND GENERAL HANDLING, INSTALLATION, CONSTRUCTION AND OPERATING SAFETY PRECAUTIONS. THE FOLLOWING ARE SOME ADDITIONAL PRECAUTIONS THAT SHOULD BE OBSERVED WHEN USING PERFORMANCE PIPE POLYETHYLENE PIPING PRODUCTS.

FUSION AND JOINING

DURING HEAT FUSION, EQUIPMENT AND PRODUCTS CAN EXCEED 400°F (204°C). TAKE CARE 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.

PERFORMANCE PIPE POLYETHYLENE PIPING PRODUCTS CANNOT BE JOINED WITH ADHESIVE OR SOLVENT CEMENT. PIPE-THREAD JOINING AND JOINING BY HOT AIR (GAS) WELDING OR EXTRUSION WELDING TECHNIQUES ARE NOT RECOMMENDED FOR PRESSURE SERVICE.

LIQUID HYDROCARBON PERMEATION MAY OCCUR WHEN LIQUID HYDROCARBONS ARE PRESENT IN THE PIPE, OR WHERE SOIL SURROUNDING THE PIPE IS CONTAMINATED WITH LIQUID HYDROCARBONS. PERMEATED POLYETHYLENE PIPE SHOULD BE JOINED USING SUITABLE MECHANICAL CONNECTIONS BECAUSE FUSION JOINING TO LIQUID HYDROCARBON PERMEATED PIPES MAY RESULT IN A LOW STRENGTH JOINT. MECHANICAL FITTINGS MUST BE INSTALLED IN ACCORDANCE WITH THE FITTING MANUFACTURER'S INSTRUCTIONS. OBTAIN THESE INSTRUCTIONS FROM THE FITTING MANUFACTURER. SEE PERFORMANCE PIPE BULLETIN PP 750 AND THE PERFORMANCE PIPE ENGINEERING MANUAL.

WEIGHT, UNLOADING AND HANDLING

ALTHOUGH POLYETHYLENE PIPING IS LIGHTWEIGHT COMPARED TO SOME OTHER PIPING PRODUCTS, SIGNIFICANT WEIGHT MAY BE INVOLVED. MOVE POLYETHYLENE PIPING WITH PROPER HANDLING AND LIFTING EQUIPMENT. USE FABRIC SLINGS. DO NOT USE CHAINS OR WIRE ROPES. DO NOT ROLL OR DROP PIPE OFF THE TRUCK, OR DRAG PIPING OVER SHARP ROCKS OR OTHER ABRASIVE OBJECTS. IMPROPER HANDLING OR ABUSE CAN DAMAGE PIPING AND COMPROMISE SYSTEM PERFORMANCE OR CAUSE INJURY OR PROPERTY DAMAGE. OBTAIN AND OBSERVE THE HANDLING INSTRUCTIONS PROVIDED BY THE DELIVERY DRIVER.

STRIKING THE PIPE WITH AN INSTRUMENT SUCH AS A HAMMER MAY RESULT IN UNCONTROLLED REBOUND. STORE DRISCOPLEX® PRODUCTS SO THAT THE POTENTIAL FOR DAMAGE OR INJURY IS MINIMIZED. SEE THE PERFORMANCE PIPE ENGINEERING MANUAL.

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 REPAIRS. SEE PERFORMANCE PIPE TECHNICAL NOTE PP-802 LEAK TESTING PE PIPING SYSTEMS.

PROTECTION AGAINST SHEAR AND BENDING LOADS

WHERE A POLYETHYLENE BRANCH OR SERVICE PIPE IS JOINED TO A BRANCH FITTING AND WHERE PIPES ENTER OR EXIT CASINGS OR WALLS, STRUCTURAL SUPPORT SUCH AS PROPERLY PLACED, COMPACTED BACKFILL AND A PROTECTIVE SLEEVE SHOULD BE USED. WHETHER OR NOT A PROTECTIVE SLEEVE IS INSTALLED, THE AREA SURROUNDING THE CONNECTION MUST BE STRUCTURALLY SUPPORTED BY EMBEDMENT IN PROPERLY PLACED COMPACTED BACKFILL OR OTHER MEANS TO PROTECT THE POLYETHYLENE PIPE AGAINST SHEAR AND BENDING LOADS. SEE THE PERFORMANCE PIPE ENGINEERING MANUAL AND ASTM D 2774.

Associations

ASTM - American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 USA. Tel - 610-832-9500, Fax - 610-832-9555, e-mail - service@astm.org; website - www.astm.org.
AWWA - American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235 USA.
PPI - Plastics Pipe Institute, Inc., 1825 Connecticut Avenue NW, Suite 680, Washington, DC 20009.
APWA/ULCC - American Public Works Association/Utility Location and Coordination Council

Standards ASTM

Materials

D 3350 *Polyethylene Plastic Pipe and Fittings Materials*

Products

D 2239 *Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter*
D 2683 *Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing*
D 2737 *Polyethylene (PE) Plastic Tubing*
D 3035 *Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter*
D 3261 *Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing*
F 714 *Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter*
F 810 *Smoothwall Polyethylene (PE) Pipe for Use in Drainage and Waste Disposal Absorption Fields*

Installation

D 2321 *Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications*
D 2774 *Underground Installation of Thermoplastic Pressure Piping*
F 585 *Insertion of Flexible Polyethylene Pipe Into Existing Sewers*
F 1804 *Determining allowable Tensile Load for Polyethylene (PE) Gas Pipe During Pull-In Installation*
F 1962 *Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings*

AWWA Standards

C901 *Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. (13 mm) through 3 in. (76 mm) for Water Service*
C906 *Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 63 in. (1,575 mm), for Water Distribution and Transmission*

Publications

Plastics Pipe Institute Handbook of Polyethylene Pipe.
Performance Pipe Engineering Manual

CONTACT INFORMATION:

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or technical assistance:

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Fax: 972-599-7348

Visit us at www.performancepipe.com for the latest complete literature.

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