PERFORMANCE PIPE
A Division of Chevron Phillips Chemical Company LP

PERFORMANCE PIPE INDUSTRIAL PRODUCTS

Industrial and Mining Piping Systems

- Chemical Piping
- Dewatering
- Dredging
- Dual Containment
- FM Approved Fire Water Piping
- Ice Rink
- Intake & Outfall Lines
- Irrigation
- Landfill
- Leachate Collection
- Mining Applications
- Power Plants
- Process Piping
- Refineries
- Slurry Lines


DriscoPlex® 1000 Pipe


DriscoPlex® 1700 Pipe


DriscoPlex® 4000/4100 Pipe


DriscoPlex® 4000/4100 FM Pipe

When Performance Matters
Rely on Us!

Performance Pipe

Performance Pipe, a division of Chevron Phillips Chemical Company LP, is the largest producer of polyethylene (PE) pressure piping in North America. Performance Pipe was formed with the merger of Plexco and Driscopipe and offers more than 50 years of PE pipe manufacturing experience. All of Performance Pipe's manufacturing facilities are certified in accordance with the latest edition of ISO 9001.

The unmatched quality and performance of Performance Pipe PE piping products are enhanced and strengthened with over five decades of quality polyolefin plastic resin production from Chevron Phillips Chemical Company LP.

As active members of the American Gas Association, ASTM International, American Water Works Association, American Society of Civil Engineers, Plastics Pipe Institute, American Society of Mechanical Engineers, and American Petroleum Institute, we provide technical expertise and service to these organizations on an ongoing basis.

When you select pipe and fitting products from Performance Pipe, you also gain access to our team of experts for technical support and assistance. Topics range from assistance in product applications and capabilities, to installation and handling, to testing and operating procedures.

Performance Pipe is a name you can trust for industrial piping. We specialize in piping products ranging from 1/2" through 54" in diameter. You can count on Performance Pipe when performance really matters.

Products

Industrial applications demand high quality, high performance and durable products to protect the environment, minimize costs, reduce maintenance and provide long-term, trouble-free service. DriscoPlex® PE piping for industrial products are manufactured from engineered polyethylene materials that provide a balance of properties for strength, toughness, flexibility, wear resistance, chemical resistance and durability. Performance Pipe industrial 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.

DriscoPlex® PE piping products 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-free connections that are as strong as the pipe itself. Additional information on heat fusion may be found in the Joining System section of this literature.

Features & Benefits

- ✓ ***Leak Free Joints***
- ✓ ***Corrosion Resistance***
- ✓ ***Exceptional Toughness***
- ✓ ***Abrasion Resistance***
- ✓ ***Superior Fatigue Resistance***
- ✓ ***Environmentally Friendly***
- ✓ ***Unmatched Flexibility***
- ✓ ***Chemical Resistance***
- ✓ ***Easy Installation***
- ✓ ***Low Surge Pressures***
- ✓ ***Excellent Flow***
- ✓ ***Long Term UV Resistance***

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Performance Pipe offers the following industrial piping products:

DriscoPlex® 4100 pipe series – These HDPE PE4710 pipes and fittings are used for industrial, municipal and water distribution applications. The product is a black pipe with available color stripes that complies with the ASTM D3350 Cell Classification of PE445574C. For 4" and larger sizes, the pipe complies with the requirements of ASTM F714 and AWWA C906. Pipes 3" and smaller conform to ASTM D3035 and AWWA C901.

DriscoPlex® 4000/4100 Factory Mutual (FM) pipe series – These HDPE PE4710 pipes and fittings are used for underground fire water protection systems for industrial and municipal applications. The pipe is manufactured with an optional single-color stripe that are permanently extruded onto the pipe OD. The pipe has an ASTM D3350 Cell Classification of PE445574C and is available in pressure class 200, 250, and 335 psi. The pipe conforms to ASTM F714, AWWA C906, ASTM D3035, AWWA C901, NSF 61 and FM 1613.

DriscoPlex® 1700 pipe series – These HDPE PE4710 pipes and fittings are used primarily for mining applications such as gold, copper, sand, silver, coal and phosphate. The pipe is manufactured in compliance with ASTM F714 and ASTM D3035 pipe sizes based on outside diameter. The product is a solid black pipe with available dual stripe marking for color DR identification. The pipe meets ASTM D3350 Cell Classification of PE445574C.

DriscoPlex® 1000 pipe series – These high density polyethylene (HDPE) PE4710/PE100 industrial pipes and fittings are produced in compliance with ASTM F714 and ASTM D3035 based on outside diameter pipe sizes. The product is a solid black HDPE pipe that meets ASTM D3350 Cell Classification of PE445574C and is suitable for a variety of industrial applications.

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Fittings

Performance Pipe manufactures HDPE molded butt, socket and saddle fusion fittings produced from high performance high density PE4710 resin. The fittings comply with requirements of ASTM D3261, ASTM D2683, AWWA C901, AWWA C906 and NSF 61. Performance Pipe fittings are produced to Iron Pipe Size (IPS), Ductile Iron Pipe Size (DIPS) and Copper Tubing Size (CTS). Additional information on product size and dimension may be found on Performance Pipe's fittings section at *www.performancepipe.com*.

- ✓ ***90 Elbow***
- ✓ ***45 Elbow***
- ✓ ***Tee***
- ✓ ***Reducer***
- ✓ ***End Cap***
- ✓ ***MJ Adapter***
- ✓ ***Flange Adapter***
- ✓ ***Wall Anchor***
- ✓ ***Branch Saddle***
- ✓ ***Purge Point***
- ✓ ***Purge Cap***
- ✓ ***Tapping Tee***

Quality

Performance Pipe's polyethylene industrial piping products are unmatched in quality and performance. In addition to meeting the manufacturing and quality requirements of ASTM F714, ASTM 3035, AWWA C901, AWWA C906, NSF 61 and FM 1613, Performance Pipe's industrial products also meet our own internal quality assurance (QA) and quality control (QC) requirements. These internal QA/QC requirements meet or exceed those required by industry standards. Each product line is monitored throughout the manufacturing cycle to ensure that the product adheres to all internal quality control specifications and the manufacturing standard. All nine of Performance Pipe's manufacturing facilities are certified in accordance with the latest edition of ISO 9001. Individual plant certificates of conformance to ISO 9001 are available upon request.

Performance Characteristics

Cell Classification

ASTM D3350 "*Standard Specification for Polyethylene Plastics Pipe and Fittings Materials*" standard cell classification covers the identification of polyethylene materials for pipe and fittings according to a cell classification system. DriscoPlex® PE piping for industrial series designation code is listed below.

Table 1: Cell Classifications

Performance Pipe Product Series	Material Designation Code		ASTM D3350 Cell Classification
	Present	Past	
DriscoPlex® PE piping for industrial series HDPE pipe and fitting	PE4710	PE3408	445574C

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Table 2: PE4710 Material Physical Property

DriscoPlex® PE Piping Material Physical Property		
Property	**Standard**	**Typical Value**
Material Designation	ASTM F412/D3350	PE4170
Cell Classification	ASTM D3350	445574C (black)
Density [4]	ASTM D1505	0.960 g/cc (black) >0.947 (colored)
Melt Index [4]	ASTM D1238	0.08 g/10 min
Flexural Modulus [5]	ASTM D790	>120,000 psi
Tensile Strength [5]	ASTM D638 Type IV	>3500 psi
SCG (PENT) [7]	ASTM F1473	>500 hours
HDB at 73°F (23°C) [4]	ASTM D2837	1600 psi
Color; UV stabilizer [C] [E]	ASTM D3350	Black Color

†NOTICE. This typical physical property information is for polyethylene resins used to manufacture some Performance Pipe DriscoPlex® PE piping products. It is not a product specification and 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 information, but it may not provide all necessary information, particularly with respect to special or unusual applications. Some Performance Pipe products are made from materials having typical physical properties different from the values presented in this table.

Pressures Rating

DriscoPlex® PE piping has exceptional tolerance for surge pressures, 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.

Table 3: PE4710 Pipe Pressure Ratings per ASTM F714 at 80°F

PE4710 Pipe Pressure Ratings Per ASTM F714			
Dimension Ratio	**Working Pressure Rating (psi)**	**Allowable Total Pressure During Recurring Surge (psi)**	**Allowable Total Pressure During Occasional Surge (psi)**
9	**250**	**375**	**500**
11	**200**	**300**	**400**
13.5	**160**	**240**	**320**
14.3	**150**	**225**	**300**
17	**125**	**185**	**250**
21	**100**	**150**	**200**
26	**80**	**120**	**160**

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When DriscoPlex® PE piping operates at a temperature above 80°F, the pressure rating (PR) and pressure class (PC) of the pipe are decreased. A PR/PC of temperature above 80°F may be determined by multiplying the PR in Table 3 by the temperature factor from Table 4. The f_T values shown in here are conservative since they are based on the highest temperature within each temperature range and are rounded.

Table 4: PE4710 Temperature Compensating Multipliers, f_T

Service Temperature Design Factor, f_T							
Average Annual Operating Temperature, °F (°C)	≤80 (27)	≤90 (32)	≤100 (38)	≤110 (43)	≤120 (49)	≤130 (54)	≤140 (60)
	1.0	0.9	0.8	0.8	0.7	0.7	0.6

[1]The average annual temperature is a weighted average of the daily operating temperature, and is not the highest temperature observed in the system. [2]The f_T values are based on PE 4710 compounds with HDB = 1600 psi at 73°F and HDB = 1000 psi at 140°F and are calculated using the temperature equation that is shown in the PPI Handbook, Chapter 3, Appendix A and in PPI TR-3.

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 identifications are in accordance with the APWA/ULCC Uniform Color Code.

One Color Dual Stripe to Identify DR

DriscoPlex® 1700 pipe series has one color dual stripe for quick and easy identification of the pipe dimension ratio (DR). 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 pipe series helps to quickly identify pipe DR for correct placement and installation in the system.

Table 5: DriscoPlex® 1700 Pipe Series One Color Dual Stripe for DR Identification

DriscoPlex® 1700 Pipe Series One Color Dual Stripe for DR Identification										
Stripe Color	Pink	White	Red	Gold	Gray	Orange	Blue	Purple	Green	Brown
DR	6	7	9	11	13.5	15.5	17	21	26	32.5

Sizes

Performance Pipe's DriscoPlex® PE piping series is manufactured to iron pipe sizes (IPS) 2" - 54" and ductile iron pipe sizes (DIPS) 4" - 36" based on outside diameter, with pressure ratings from 60 psi to greater than 300 psi depending on size and series. Specific sizes, dimensions and pressure ratings of pipe and fittings for each product and series can be found on Performance Pipe's website at www.performancepipe.com. Special lengths may be available upon request.

Factory Mutual (FM) Approval

DriscoPlex® 4000/4100 pipe series with FM approval is available. FM approved piping is frequently required for underground fire protection systems at industrial plants and commercial properties insured by FM Global. DriscoPlex® PE piping for FM products are produced in pressure Class 200, Class 250, and Class 335 in 2" - 24" IPS sizing and Class 200 and Class 250 4" - 24" DIPS sizing. Approved products carry the FM marking in the print line on the pipe.

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Table 6: DriscoPlex® 4000/4100 Pipe Series ASTM D3035 and ASTM F714 Outside Diameter Controlled HDPE Pipe (DIPS/IPS/SDR)

Selected Dimension Ratios for DriscoPlex® 4000 DIPS Pipe (Additional Sizes and DR's available. Contact Performance Pipe)

DIPS		DR 17			DR 11		
		PC = 125 psi			PC = 200 psi		
Pipe Size, in.	OD, in.	Min Wall	Avg. ID	Wgt.	Min Wall	Avg. ID	Wgt.
		in.	in.	lbs/ft	in.	in.	lbs/ft
4	4.80	0.282	4.201	1.76	0.436	3.876	2.62
6	6.90	0.406	6.040	3.64	0.627	5.571	5.42
8	9.05	0.532	7.921	6.26	0.823	7.305	9.33
10	11.10	0.653	9.716	9.42	1.009	8.961	14.03
12	13.20	0.776	11.554	13.32	1.200	10.656	19.84
14	15.30	0.900	13.392	17.89	1.391	12.351	26.65
16	17.40	1.024	15.230	23.14	1.582	14.046	34.47
18	19.50	1.147	17.068	29.07	1.773	15.741	43.30
20	21.60	1.271	18.906	35.66	1.964	17.436	53.13
24	25.80	1.518	22.583	50.88	2.345	20.829	75.77
30	32.00	1.882	28.009	78.28	2.909	25.833	116.58
36	38.30	2.253	33.524	112.13	3.482	30.918	167.02
42	44.50	2.618	38.951	151.37			

Selected Dimension Ratios for DriscoPlex® 4100 IPS Pipe (Additional Sizes and DR's available. Contact Performance Pipe)

IPS		DR 17			DR 11		
		PC = 125 psi			PC = 200 psi		
Pipe Size, in.	OD, in.	Min Wall	Avg. ID	Wgt.	Min Wall	Avg. ID	Wgt.
		in.	in.	lbs/ft	in.	in.	lbs/ft
2	2.375	0.140	2.078	0.43	0.216	1.917	0.64
3	3.50	0.206	3.063	0.94	0.318	2.826	1.39
4	4.50	0.265	3.938	1.55	0.409	3.633	2.31
6	6.63	0.390	5.798	3.36	0.602	5.349	5.00
8	8.63	0.507	7.550	5.69	0.784	6.963	8.47
10	10.75	0.632	9.410	8.83	0.977	8.679	13.16
12	12.75	0.750	11.160	12.43	1.159	10.293	18.51
14	14.00	0.824	12.253	14.98	1.273	11.301	22.32
16	16.00	0.941	14.005	19.57	1.455	12.915	29.15
18	18.00	1.059	15.755	24.77	1.636	14.532	36.89
20	20.00	1.176	17.507	30.58	1.818	16.146	45.54
22	22.00	1.294	19.257	37.00	2.000	17.760	55.10
24	24.00	1.412	21.007	44.03	2.182	19.374	65.58
26	26.00	1.529	22.759	51.67	2.364	20.988	76.96
28	28.00	1.647	24.508	59.93	2.545	22.605	89.26
30	30.00	1.765	26.258	68.80	2.727	24.219	102.47
32	32.00	1.882	28.010	78.28	2.909	25.833	116.58
34	34.00	2.000	29.760	88.37	3.091	27.447	131.61
36	36.00	2.118	31.510	99.07	3.273	29.061	147.55
42	42.00	2.471	36.761	134.84	3.818	33.905	200.84
48	48.00	2.824	42.013	176.12			
54	54.00	3.176	47.266	222.90			

This product flyer is intended for reference purposes. It should not be used in place of the advice from a licensed Professional Engineer. Pressure Ratings and Pressure Class are based on operating temperature up to 80°F. Average inside diameter is calculated using Nominal OD and Minimum Wall plus 6% for use in estimating fluid flow. Actual ID will vary. When designing components to fit the pipe ID, refer to pipe dimensions and tolerances in the applicable pipe manufacturing specification. Additional information available at www.performancepipe.com

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Table 7: DriscoPlex® 4000/4100 Pipe FM Series ASTM D3035 and ASTM F714 Outside Diameter Controlled HDPE Pipe (DIPS/IPS/SDR)

Common Dimension Ratio's for DriscoPlex® 4000 FM DIPS Pipe							
DIPS		DR 11			DR 9		
Pressure Class		Class 200 psi			Class 250 psi		
Pipe Size, in.	OD, in.	Min Wall	Avg. ID	Wgt.	Min Wall	Avg. ID	Wgt.
		in.	in.	lbs/ft	in.	in.	lbs/ft
4	4.80	0.436	3.876	2.62	0.533	3.670	3.13
6	6.90	0.627	5.571	5.42	0.767	5.274	6.47
8	9.05	0.823	7.305	9.33	1.006	6.917	11.13
10	11.10	1.009	8.961	14.03	1.233	8.486	16.74
12	13.20	1.200	10.656	19.84	1.467	10.090	23.67
14	15.30	1.391	12.351	26.65	1.700	11.696	31.80
16	17.40	1.582	14.046	34.47	1.933	13.302	41.13
18	19.50	1.773	15.741	43.30	2.167	14.906	51.66
20	21.60	1.964	17.436	53.13	2.400	16.512	63.38
24	25.80	2.345	20.829	75.77	2.867	19.722	90.43

Common Dimension Ratio's for DriscoPlex® 4100 FM IPS Pipe										
IPS		DR 11			DR 9			DR 7		
Pressure Class		Class 200 psi			Class 250 psi			Class 335 psi		
Pipe Size, in.	OD, in.	Min Wall	Avg. ID	Wgt.	Min Wall	Avg. ID	Wgt.	Min Wall	Avg. ID	Wgt.
		in.	in.	lbs/ft	in.	in.	lbs/ft	in.	in.	lbs/ft
2	2.375	0.216	1.917	0.64	0.264	1.815	0.77	0.339	1.656	0.95
3	3.50	0.318	2.826	1.39	0.389	2.675	1.66	0.500	2.440	2.06
4	4.50	0.409	3.633	2.31	0.500	3.440	2.75	0.643	3.137	3.40
6	6.625	0.602	5.349	5.00	0.736	5.065	5.96	0.946	4.619	7.37
8	8.625	0.784	6.963	8.47	0.958	6.594	10.11	1.232	6.013	12.50
10	10.75	0.977	8.679	13.16	1.194	8.219	15.70	1.536	7.494	19.42
12	12.75	1.159	10.293	18.51	1.417	9.746	22.08	1.821	8.889	27.31
14	14.00	1.273	11.301	22.32	1.556	10.701	26.63	2.000	9.760	32.93
16	16.00	1.455	12.915	29.15	1.778	12.231	34.78	2.286	11.154	43.01
18	18.00	1.636	14.532	36.89	2.000	13.760	44.02	2.571	12.549	54.43
20	20.00	1.818	16.146	45.54	2.222	15.289	54.34	2.857	13.943	67.20
22	22.00	2.000	17.760	55.10	2.444	16.819	65.75	3.143	15.337	81.32
24	24.00	2.182	19.374	65.58	2.667	18.346	78.25	3.429	16.731	96.77

This product flyer is intended for reference purposes. It should not be used in place of the advice from a licensed Professional Engineer. The listed Pressure Class are based on operating temperature up to 80°F and a 0.63 Design Factor for water application per PPI TR-41 and FM1613. Average inside diameter is calculated using Nominal OD and Minimum Wall plus 6% for use in estimating fluid flow. Actual ID will vary. When designing components to fit the pipe ID, refer to pipe dimensions and tolerances in the applicable pipe manufacturing specification. Elevated temperature use considerations may require additional compensating factors. Additional information available at www.performancepipe.com.

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Table 8: DriscoPlex® 1000/1700 Pipe Series ASTM D3035 and ASTM F714 Outside Diameter Controlled HDPE Pipe (IPS/SDR)

Common Dimension Ratio's for DriscoPlex® 1000/1700 IPS Pipe (Custom DR's available. Contact Performance Pipe)																
IPS		DR 21			DR 17			DR 13.5			DR 11			DR 9		
ASTM F714 PR		PR = 100 psi			PR = 125 psi			PR = 160 psi			PR = 200 psi			PR = 250 psi		
Pipe Size	OD, in.	Min Wall	Avg. ID	Wgt.	Min Wall	Avg. ID	Wgt.	Min Wall	Avg. ID	Wgt.	Min Wall	Avg. ID	Wgt.	Min Wall	Avg. ID	Wgt.
in.		in.	in.	lbs/ft	in.	in.	lbs/ft	in.	in.	lbs/ft	in.	in.	lbs/ft	in.	in.	lbs/ft
2	2.375				0.140	2.078	0.43	0.176	2.002	0.53	0.216	1.917	0.64	0.264	1.815	0.77
3	3.50				0.206	3.063	0.94	0.259	2.951	1.16	0.318	2.826	1.39	0.389	2.675	1.66
4	4.50	0.214	4.046	1.27	0.265	3.938	1.55	0.333	3.794	1.92	0.409	3.633	2.31	0.500	3.440	2.75
6	6.63	0.315	5.957	2.75	0.390	5.798	3.36	0.491	5.584	4.15	0.602	5.349	5.00	0.736	5.065	5.96
8	8.63	0.411	7.754	4.66	0.507	7.550	5.69	0.639	7.270	7.04	0.784	6.963	8.47	0.958	6.594	10.11
10	10.75	0.512	9.665	7.24	0.632	9.410	8.83	0.796	9.062	10.93	0.977	8.679	13.16	1.194	8.219	15.70
12	12.75	0.607	11.463	10.19	0.750	11.160	12.43	0.944	10.749	15.38	1.159	10.293	18.51	1.417	9.746	22.08
14	14.00	0.667	12.586	12.28	0.824	12.253	14.98	1.037	11.802	18.54	1.273	11.301	22.32	1.556	10.701	26.63
16	16.00	0.762	14.385	16.04	0.941	14.005	19.57	1.185	13.488	24.22	1.455	12.915	29.15	1.778	12.231	34.78
18	18.00	0.857	16.183	20.30	1.059	15.755	24.77	1.333	15.174	30.65	1.636	14.532	36.89	2.000	13.760	44.02
20	20.00	0.952	17.982	25.07	1.176	17.507	30.58	1.481	16.860	37.84	1.818	16.146	45.54	2.222	15.289	54.34
22	22.00	1.048	19.778	30.33	1.294	19.257	37.00	1.630	18.544	45.79	2.000	17.760	55.10	2.444	16.819	65.75
24	24.00	1.143	21.577	36.10	1.412	21.007	44.03	1.778	20.231	54.49	2.182	19.374	65.58	2.667	18.346	78.25
26	26.00	1.238	23.375	42.36	1.529	22.759	51.67	1.926	21.917	63.95	2.364	20.988	76.96	2.889	19.875	91.84
28	28.00	1.333	25.174	49.13	1.647	24.508	59.93	2.074	23.603	74.17	2.545	22.605	89.26	3.111	21.405	106.51
30	30.00	1.429	26.971	56.40	1.765	26.258	68.80	2.222	25.289	85.14	2.727	24.219	102.47	3.333	22.934	122.27
32	32.00	1.524	28.769	64.17	1.882	28.010	78.28	2.370	26.976	96.87	2.909	25.833	116.58	3.556	24.462	139.12
34	34.00	1.619	30.568	72.44	2.000	29.760	88.37	2.519	28.660	109.36	3.091	27.447	131.61			
36	36.00	1.714	32.366	81.21	2.118	31.510	99.07	2.667	30.346	122.60	3.273	29.061	147.55			
42	42.00	2.000	37.760	110.54	2.471	36.761	134.84	3.111	35.405	166.88	3.818	33.905	200.84			
48	48.00	2.286	43.154	144.38	2.824	42.013	176.12									
54	54.00	2.571	48.549	182.73	3.176	47.266	222.90									

Please visit www.performancepipe.com for additional size and dimension. Pressure Ratings are based on operating temperature up to 80°F. Pressure Rating is based on a 0.63 Design Factor per PPI TR-41. Temperature, Chemical and Environmental use considerations may require additional design factors.

Average inside diameter is calculated using Nominal OD and Minimum Wall plus 6% for use in estimating fluid flow. Actual ID will vary. When designing components to fit the pipe ID, refer to pipe dimensions and tolerances in the applicable pipe manufacturing specification.

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Joining System

A piping system is only as good as its joints. PE can be melted, re-formed and cooled while maintaining its original physical properties. A significant advantage of PE pipe is that it can be joined by heat fusion. During heat fusion, the two surfaces are heated to a designated temperature and then forced together. The force causes the molten surfaces to flow and mix together, that when cooled, result in a joint as strong as the pipe itself. Properly made fusion joints are completely leak-tight. The fusion joint allows for rigorous pull in trenchless installations such as horizontal directional drilling, slip lining and pipe bursting.

Performance Pipe products can also be connected mechanically when fusion cannot be done due to constructability limitations. Please refer to Performance Pipe's *Field Handbook* for more information. Flange adapters with metal back-up rings, mechanical joint adapters, compression couplings and other means are available for joining PE pipe. More information can be found on *PE Flange Adapter* PP 811-TN and *MJ Adapter Connections* PP 812-TN online at *www.performancepipe.com.*

Performance Pipe recommends using Performance Pipe's Fusion Joining Procedures Bulletin PP 751-TN *Heat Fusion Joining Procedures and Qualification Guide* and ASTM F2620 *Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings* when making heat fusion joints with our industrial piping products.

Another qualified guideline used for butt and saddle fusion of polyethylene piping products is the Plastic Pipe Institute's PPI TR-33/2006 *Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe*.

Chemical Resistance

DriscoPlex® PE piping for industrial series pipes are resistant to a wide range of chemicals, making it a product of choice to transport chemicals or to install in soils where chemicals are present. Naturally occurring chemicals in the soil will not degrade the pipe. Many chemicals, acids, salts and hot soils will not attack the pipe or cause it to degrade. It does not rust, rot or corrode. It does not promote or support algae or bacterial growth.

A few strong oxidizing agents and mineral acids can react with polyethylene when present in high concentrations and/or elevated temperatures. A summary of chemical resistance testing is available from the Plastic Pipe Institute (PPI) at *www.plasticpipe.org* in TR-19 *Thermoplastics Piping for the Transport of Chemicals*. Consult with Performance Pipe for additional details.

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Toughness & Flexibility

PE pipe is flexible. PE can be field bent to a radius as tight as 20 times the pipe's outside diameter depending on wall thickness and installation method.

This flexibility allows the pipe to follow rolling terrain and minimize the need for fittings. All of the major trenchless installation methods rely on the pipe's flexibility for avoiding obstacles and handling curvature in the bore path. The flexibility combined with fusion joints make HDPE considerably less susceptible to damage from ground movement due to freeze/thaw cycles, shrinking or swelling of expansive soils and even earthquakes. Refer to Performance Pipe Tech Note PP 819-TN *Field Bending of DriscoPlex® PE piping systems is* available at *www.performancepipe.com* for additional information.

Cold Bending Radius

The allowable cold bending radius for DriscoPlex® PE piping is dependent upon the pipe outside diameter (OD), DR and the presence of fittings in the bend. For additional information and special consideration for horizontal directional drilling, see Performance Pipe's Technical Note PP 819-TN *Field Bending of DriscoPlex® PE Piping*.

Table 9: Allowable Cold Bending Radius

Pipe Dimension Ratio	Allowable Cold Bending Radius
9 or less	20 times the pipe OD
>9 to 13.5	25 times the pipe OD
13.5 – 21	27 times the pipe OD
26	34 times the pipe OD
32.5	42 times the pipe OD
41	52 times the pipe OD
Fitting or flange present in the bend	**100 times the pipe OD**

Special Installation Techniques

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 it and to lubricate the drill string and 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 and calculation on

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horizontal directional drilling is covered in detail in Chapter 12 of the PPI Handbook of Polyethylene Pipe and the BoreAid™ calculator available at *www.plasticpipe.org*. Additional information can also be found in ASTM F1962 *Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings* and PPI TR-46 *Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe*.

Sliplining

PE pipe can be installed within an existing host pipe by a technique called sliplining, 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® PE piping typically provide comparable and occasionally even greater flow capacity. More information can be found online in Performance Pipe's Technical Note PP 803-TN on Pull-In-Applications, ASTM F585 *Insertion of Flexible Polyethylene Pipe Into Existing Sewers* and Chapter 11 of the PPI *Handbook of Polyethylene Pipe*.

Pipe Bursting

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. Additional information on pipe bursting is covered in detail in Chapter 16 of the PPI *Handbook of Polyethylene Pipe* available at *www.plasticpipe.org*.

Special Considerations for Plowing and Planting

Plowing and planting involve cutting a narrow trench and feeding the pipe into the trench through a shoe or chute fitted just behind the trench cutting equipment. The shoe or chute feeds the pipe into the bottom of the cut. The minimum bend radius of the pipe through the shoe may be tighter than the minimum bend radius of the pipe used for a permanent long-term installation, but it must not be so tight that the pipe kinks. Table 11 presents the minimum short-term bend ratio for applications such as plowing and planting. The pipe's path through the shoe or chute should be as friction free as practical to reduce additional outer fiber tensile stresses. Generally plowing and planting is limited to 12" and smaller pipes.

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Table 10: Minimum Short-term Cold Bending Radius

Pipe Dimension Ratio	Minimum Short-Term Bending Radius
9	10
>9 to 13.5	13
>13.5 to 17	17

Fluid Hydraulics

DriscoPlex® PE piping series for industrial pipes are characterized as hydraulically smooth and typically have an absolute surface roughness (ε) of 0.000005 ft. The Hazen Williams C-Factor equals 150 to 155 for PE pipes. For gravity flow, the n-factor in the Manning equation is typically taken as 0.009 for clear water and 0.010 for sanitary sewer. Even though the inside diameter of PE pipe may be smaller for the same nominal size as metallic or concrete pipes, flow is often equal or greater through PE pipe due to the smooth ID.

Above Ground Applications

DriscoPlex® PE piping series for industrial pipes are suitable for applications where there is long-term, direct exposure to UV. This includes all surface and above grade applications. DriscoPlex® PE piping series for industrial pipes include a minimum 2% carbon black in the material providing long-term UV protection. The carbon black particles prevent UV degradation by blocking UV energy penetration.

Above ground installations expose a pipeline to wide temperature variations requiring installation considerations to accommodate thermal expansion and contraction. See Performance Pipe Technical Note PP 814-TN *Engineering Considerations for Temperature Change* for additional information. Above grade pipelines require the pipe to be properly supported. Performance Pipe Technical Note PP 815-TN discusses this topic in further detail. In addition, refer to Chapter 8 of the PPI *Handbook of Polyethylene Pipe* at *www.plasticpipe.org*.

Abrasion Resistance/Mining & Slurry Applications

HDPE Pipe is a product of choice for transporting liquid slurries in dredging, fly-ash and mine tailing applications. One of the key reasons is HDPE's superior abrasion resistance. HDPE pipe frequently outwears harder piping materials when conveying many types of abrasive solids in liquid slurries. Turbulent flow is recommended because particles suspended in the carrier liquid will bounce off the pipe's inside surface, using the pipe's elasticity and high molecular weight toughness to absorb the particle's energy. Particle size and fluid velocity are important considerations for slurry piping design. This topic is covered in detail in Chapter 6 of the PPI *Handbook of Polyethylene Pipe* available at *www.plasticpipe.org*.

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Deep Burial and Landfill Applications

PE pipe is widely used in landfill applications for methane gas recovery and leachate collection systems. This is largely due to the chemical resistance of PE pipe, as well as its flexibility and tolerance for shifting soils. Burial design of PE pipe utilizes flexible pipe/soil system design practices. The pipe actually gains strength from the surrounding soil allowing it to support additional loads. PE pipe has a high strain limit which allows it to deflect to a relatively high degree compared to other materials and the leak-tightness of fusion joints is not affected by pipe deflection. For deep burials such as landfill leachate collection systems where depths can exceed 100 ft, the ability for the pipe to deflect without damage is an important engineering property. As the pipe deflects under loads from deep burial, generally there is arching in the soil that results in lower loads on the pipe. Burial design concepts for polyethylene pipe for standard installations, shallow cover and deep fills is covered in detail in Chapter 6 of PPI's *Handbook of Polyethylene Pipe*.

Marine Installation

PE is well-suited for use in various marine installations such as river and lake crossings, outfalls, intake piping, etc. The specific gravity of PE is less than water and thus the pipe will float. Concrete ballast blocks are added to the pipe to sink and hold it in the intended location. Due to the pipe's buoyancy combined with fusion joints, a typical installation involves attaching the ballast blocks, towing the pipe to its intended location and filling the pipeline with water to sink; thus very little work takes place underwater. More information pertaining to marine installation of polyethylene pipe is covered in detail in Chapter 10 of PPI's *Handbook of Polyethylene Pipe*.

Cautions

Polyethylene piping has been safely used in thousands of applications. However, there are general precautions that should be observed when using any product. In this respect, polyethylene piping is no different. Below is a list of some of the precautions that should be observed when using Performance Pipe's pipe and fittings.

Fusion

During the heat fusion process, 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.

Performance Pipe polyethylene piping products cannot be joined with adhesives or solvent cement. Pipe-thread joining and joining by hot air (gas) welding or extrusion welding techniques are not recommended for pressure service.

Weight, Unloading and Handling

Although polyethylene pipe is not as heavy as some other piping products, significant weight may be involved. Care should be used when handling and working around polyethylene pipe. Improper handling or abuse may cause damage to piping, compromise system quality or performance, or cause personal injury. Observe the safe handling instructions provided by the delivery driver. *Pipe Loading and Unloading-Truck Driver Safety* and *Improved Packaging = Easier Installation* videos can be found on Performance Pipe's website under the Video Gallery Section.

Coils

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Coiled PE pipe is restrained with strapping to contain the spring-like energy retained within the coil. Cutting or breaking strapping can result in an uncontrolled release. Take all necessary safety precautions and use appropriate equipment. Observe the safe handling instructions provided by the delivery driver.

Leak Testing

Observe all safety measures, restrain pipe against movement in the event of catastrophic failure, and observe limitations of temperature, test pressure, test duration and procedures for making repairs. Additional information pertaining to leak testing can be found in the Performance Pipe's Technical Note PP 815-TN at *www.performancepipe.com*.

Protection against Shear and Bending Loads

Measures such as properly placed compacted backfill, protective sleeves and structural support are sometimes necessary to protect plastic pipe against shear and bending loads. For additional installation information see ASTM D-2774 *Underground Installation of Thermoplastic Pressure Piping*.

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