

**Yellowstripe® 8300 HDPE Gas Distribution Pipe
PE4710-PE100 / (PE3408)
Typical Physical Property Pipe Data Sheet**

Property	Unit	Test Procedure	Typical Value
Material Designation	--	PPI TR-4	PE4710 PE100
Cell Classification	--	ASTM D3350	445574C 445576C
Pipe Properties			
Density	gms / cm ³	ASTM D1505	0.961 (black)
Melt Index (MI) Condition 190/2.16	gms / 10 minutes	ASTM D1238	0.08
Melt Index (HLMI) Condition 190/21.6	gms / 10 minutes	ASTM D1238	7.5
Hydrostatic Design Basis, (73°F)	psi	ASTM D2837	1,600
Hydrostatic Design Basis, (140°F)	psi	ASTM D2837	1,000
Minimum Required Strength	Mpa (psi)	ISO 9080	>10 (>1450)
Rapid Crack Propagation Critical Pressure (Pc), 0°C (32°F) ⁽¹⁾	Bar (psi)	ISO 13477	>12 bar (>174)
Color; UV Stabilizer [C]	%	ASTM D3350	Min. 2% Carbon Black UV stabilized 10 years
Pipe Test Category	---	ASTM D2513	CEE
Material Properties			
Flexural Modulus @2% strain	psi	ASTM D790	>150,000
Tensile Strength at Yield	psi	ASTM D638 (Type IV)	>3,500
Elongation at Break 2 in/min., Type IV bar	%	ASTM D638	>800
Hardness	Shore D	ASTM D2240	65
PENT	hrs	ASTM F1473	>2,000
Manufactured to ASTM D2513 for pipe. Fittings comply with ASTM D2513 and ASTM D3261.			
Thermal Properties			
Vicat Softening Temperature	°F	ASTM D1525	255
Brittleness Temperature	°F	ASTM D746	-180
Thermal Expansion	in / in / °F	ASTM D696	1.0 x 10 ⁻⁴

(1) Determination made using Small-Scale Steady state. Pc calculated in accordance with ISO 13477

(2) NOTICE: This data sheet 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. Some of these typical physical property values were determined using compression molded plaques. Values obtained from tests of specimens taken from piping products can vary from these typical values. This data sheet may be changed from time to time without notice. Contact Performance Pipe to determine if you have the most recent edition.

**DRISCOPIPE® 8100 HDPE Gas Distribution Pipe
PE4710-PE100 / (PE3408)
Typical Physical Property Pipe Data Sheet**

Property	Unit	Test Procedure	Typical Value
Material Designation	--	PPI TR-4	PE4710 PE100
Cell Classification	--	ASTM D3350	445574C 445576C
Pipe Properties			
Density	gms / cm ³	ASTM D1505	0.961 (black)
Melt Index (MI) Condition 190/2.16	gms / 10 minutes	ASTM D1238	0.08
Melt Index (HLMI) Condition 190/21.6	gms / 10 minutes	ASTM D1238	7.5
Hydrostatic Design Basis, (73°F)	psi	ASTM D2837	1,600
Hydrostatic Design Basis, (140°F)	psi	ASTM D2837	1,000
Minimum Required Strength	Mpa (psi)	ISO 9080	>10 (>1450)
Rapid Crack Propagation Critical Pressure (Pc), 0°C (32°F) ⁽¹⁾	Bar (psi)	ISO 13477	>30 bar (>435)
Color; UV Stabilizer	---	ASTM D3350	Co-extruded yellow shell UV stabilized for 4 years outdoor storage
Pipe Test Category	---	ASTM D2513	CEE
Material Properties			
Flexural Modulus @ 2% strain	psi	ASTM D790	>140,000
Elastic Modulus @ Secant 2% strain (2in/min, Type IV bar)	Psi	ASTM D638	>200,000
Tensile Strength at Yield	psi	ASTM D638 (Type IV)	>3,700
Elongation at Break 2 in/min., Type IV bar	%	ASTM D638	>800
Hardness	Shore D	ASTM D2240	65
PENT	hrs	ASTM F1473	>2000
Pipe is manufactured to ASTM D2513. Fittings comply with ASTM D2513 and ASTM D3261.			
Thermal Properties			
Vicat Softening Temperature	°F	ASTM D1525	255
Brittleness Temperature	°F	ASTM D746	-180
Thermal Expansion	in / in / °F	ASTM D696	1.0 x 10 ⁻⁴

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**Driscoplex® 6500 MDPE Gas Distribution Pipe
PE2708/2406
Typical Physical Property Pipe Data Sheet**

Property	Unit	Test Procedure	Typical Value
Material Designation	--	PPI TR-4	PE2708/2406
Cell Classification	--	ASTM D3350	234373E
Pipe Properties			
Density	gms / cm ³	ASTM D1505	0.939
Melt Index (MI) Condition 190/2.16	gms / 10 minutes	ASTM D1238	0.18
Melt Index (HLM1) Condition 190/21.6	gms / 10 minutes	ASTM D1238	---
Hydrostatic Design Basis, (73°F)	psi	ASTM D2837	1,250
Hydrostatic Design Basis, (140°F)	psi	ASTM D2837	1,000
Minimum Required Strength	Mpa (psi)	ISO 9080	>8.0 (>1160)
Rapid Crack Propagation Critical Pressure (Pc), 0°C (32°F) ⁽¹⁾	Bar (psi)	ISO 13477	>8.5 bar (>123)
Color; UV Stabilizer	---	ASTM D3350	Yellow UV stabilized for 4 years outdoor storage
Pipe Test Category	---	ASTM D2513	CEE
Material Properties			
Flexural Modulus @2% strain	psi	ASTM D790	>100,000
Elastic Modulus @ Secant 2% strain (2in/min, Type IV bar)	Psi	ASTM D638	>86,000
Tensile Strength at Yield	psi	ASTM D638 (Type IV)	>2,800
Elongation at Break 2 in/min., Type IV bar	%	ASTM D638	>800
Hardness	Shore D	ASTM D2240	63
PENT	hrs	ASTM F1473	>2000
Thermal Properties			
Vicat Softening Temperature	°F	ASTM D1525	227
Brittleness Temperature	°F	ASTM D746	-180
Thermal Expansion	in / in / °F	ASTM D696	1.0 x 10 ⁻⁴
Manufactured to ASTM D2513 for pipe. Fittings comply with ASTM D2513 and ASTM D3261.			

- (1) Determination made using Small-Scale Steady state. Pc calculated in accordance with ISO 13477
- (2) NOTICE: This data sheet 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. Some of these typical physical property values were determined using compression molded plaques. Values obtained from tests of specimens taken from piping products can vary from these typical values. This data sheet may be changed from time to time without notice. Contact Performance Pipe to determine if you have the most recent edition.

Permeability and Permeation

Plastics are permeable to gases to varying degrees. Although the constituents of natural gas can permeate through polyethylene, the volume of gas lost through permeation is generally so low as to have an insignificant effect on the handling of natural gas in a piping system. The American Gas Association (AGA) *Plastic Pipe Manual for Gas Service* lists the permeability of PE 2406 polyethylene pipe to methane, the primary constituent of natural gas, as 4.2×10^{-3} . Using the AGA factor, one mile of 2" SDR 11 PE2708/2406 pipe carrying 100% methane at 60 psi would lose less than 0.27 ft³ per day.

Other constituents of natural gas are typically heavier than methane, thus less permeable through polyethylene. Hydrogen is the exception; however, the concentration of hydrogen in most natural gas is so low that the actual amount of hydrogen permeation would be insignificant. At low temperatures and higher pressures, heavier hydrocarbon gases such as propane or butane may condense and liquefy in the pipe. Such condensates are known to permeate polyethylene pipe. All types of hydrocarbons (aromatic, paraffinic, etc.) have a similar effect, and the relative effect on different polyethylene pipe resins is essentially the same. Liquid hydrocarbon permeation will affect joining. **See *Cautions on Liquid Hydrocarbon Permeation, page 5.***

Design Pressure

The following formula is used to compute the design pressures for polyethylene piping systems for natural gas service at operating temperatures up to but not over 140°F (60°C). For operating temperatures below 73°F (23°C), use 73°F (23°C) Design Pressures.

$$P = \frac{2S}{(SDR - 1)} \times f$$

Where:

P = Design Pressure in pounds per square inch gauge (psig);

S = Long Term Hydrostatic Strength (Hydrostatic Design Basis) psi, at pipeline operating temperature; See Table 5.

f = Design factor (specified in CFR 192.121); See Table 6.

SDR = Standard Dimension Ratio

$$SDR = \frac{\text{Pipe Nominal Outside Diameter}}{\text{Pipe Minimum Wall Thickness}}$$

Table 5: Hydrostatic Design Basis

Hydrostatic Design Basis or Long Term Hydrostatic Strength, S				
Performance Pipe Product Series	73.4F Data	100F Interpolated	120F Interpolated	140F Data
Driscoplex [®] 6500 Pipe (MDPE)	1250	1250	1000	1000
Driscopipe [®] 8100 Pipe (HDPE)	1600	1250	1000	1000
Yellowstripe [®] 8300 Pipe (HDPE)	1600	1250	1000	1000

Table 6: Design Service Factor

Application	Design (service) Factor, f
Gas distribution and transmission per CFR 49 Part 192, §192.121	0.32
Gas distribution and transmission in Canada per CSA Z662-96	0.40
Gas distribution or transmission piping that is permeated by solvating chemicals such as liquid hydrocarbons or liquefied gas condensate	0.25

Operating Pressures (psig)

The following tables provide **maximum allowable operating pressures (MAOP)** and recommended maximum design pressure rating (PR) for PE2708 (PE2406) pipes and PE4710/PE100 (PE3408) pipes for gas distribution service at the indicated operating temperatures. PE pipes of the same DR and Material Designation Code but different outside diameters have the same Design (Working) Pressure Ratings. Pipe minimum wall thickness is determined by dividing the pipe average outside diameter (O.D.) by the DR number.

Pressure ratings are calculated in accordance with applicable federal codes. A check should be made to determine if these pressures apply under the state and/or local codes governing the specific application. Use 73°F (23°C) pressure ratings for operating temperatures below 73°F (23°C).

Table 7: MAOP Driscoplex® 6500 MDPE Gas Distribution Pipe (PE2708)

MAOP & Maximum Design Pressure Rating (PR) for Dry Natural Gas Service --				
PE2708 (PE2406)	Driscoplex® 6500 Pipe PE2708 (PE2406) (Class 1, 2, 3, and 4 location per U.S. federal regulations CFR 192.121 – Design (Service) Factor 0.32‡)			
SDR	73°F (23°C) (PSIG)	100°F (38°C) (PSIG)	120°F (48°C) (PSIG)	140°F (60°C) (PSIG)
7.0	125†	125†	107	107
7.3	125†	125†	102	102
9.0	100	100	80	80
9.3	96	96	77	77
10.0	89	89	71	71
11.0	80	80	64	64
11.5	76	76	61	61
12.5	70	70	56	56
13.5	64	64	51	51

‡ Class 1, 2, 3, & 4 locations per U.S. federal regulations.
† 49 CFR Part 192.123(e) allows and limits design pressure to 125psig, provided the pressure is calculated in accordance with 49CFR 192.121.

Table 8: MAOP Driscopipe® 8100 Pipe & Yellowstripe® 8300 Pipe (PE4710)

MAOP & Maximum Design Pressure Rating (PR) for Dry Natural Gas Service --				
PE4710/PE100 (PE3408)	Driscopipe® 8100 pipe and Yellowstripe® Pipe PE4710-PE100 (Class 1, 2, 3, and 4 location per U.S. federal regulations CFR 192.121 – Design (Service) Factor 0.32‡)			
SDR	73°F (23°C) (PSIG)	100°F (38°C) (PSIG)	120°F (48°C) (PSIG)	140°F (60°C) (PSIG)
7.0	125†	125†	107	107
7.3	125†	125†	102	100†
9.0	125†	100	80	80
9.3	123†	96	77	77
11.0	102	80	64	64
12.5	89	70	56	56
13.5	82	64	51	51

‡ Class 1, 2, 3, & 4 locations per U.S. federal regulations.
† 49 CFR Part 192.123(e) allows and limits design pressure to 125psig, provided the pressure is calculated in accordance with 49CFR 192.121.

Cold Bending Radius

The allowable cold bending radius for DriscoPlex[®] 6500 pipe 2406 is dependent upon the pipe OD, DR and the presence of fittings in the bend. 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 or greater	27 times the pipe OD
Fitting or flange present in the bend	100 times the pipe OD

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 10 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 practicable to reduce additional outerfiber tensile stresses. Generally plowing and planting is limited to 12" and smaller pipes.

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

Propane (LPG) Gas Service

The Office of Pipeline Safety Advisory Bulletin No. 73-4, dated April 1973, states, "It is the operator's responsibility to assure the integrity of the plastic pipe selected for use in the piping system, and this should be based on a favorable recommendation from the manufacturer. Therefore, the Federal minimum safety standards do permit the use of plastic in a properly engineered underground system of LPG distribution conforming to the limitations of these regulations." DriscoPlex[®] 6500 pipe (PE2708), Driscopipe[®] 8100 pipe (PE4710) and Yellowstripe[®] 8300 pipe (PE4710) series products meet the requirements of ANSI/NFPA 58 *Standard for the Storage and Handling of Liquefied Petroleum Gases*.

The Plastics Pipe Institute has made the following "Use Recommendation" for polyethylene piping systems for commercial propane systems:

PPI Use Recommendation (Technical Report TR-22)

The information collected indicates that polyethylene plastic piping is satisfactory for transporting LPG and its major component, propane gas. This information also indicates that pressure design parameters based on propane gas should be adequate and reasonable. However, until more information is available, these use recommendations cover only commercial propane vapor in detail.

1. The polyethylene plastic pipe, tubing and fittings should be only those specific types designated as PE 2708 or PE 4710 and meeting the appropriate requirements of ASTM D 2513.
2. A Hydrostatic Design Basis of 1000 psi should be used in the design of polyethylene pipe systems for propane gas distribution at pipe temperatures of 73°F or lower. The long-term hydro static strength measurements should be made in accordance with ASTM D 2837.
3. Polyethylene should be used only in underground propane gas distribution systems designed to operate at internal pressures and temperatures such that condensation will not occur.

It is also recommended that operating pressures be limited to 30 psig or less.

In cases where condensation does occur in a propane system or propane enriched system and the presence of condensation is of relatively short duration, there is no indication of loss of physical integrity or observable change in polyethylene pipe. Under actual operating conditions, in a properly designed system, the pressures and temperatures are such that revaporization of any propane condensates will usually occur. Experience with propane liquids in polyethylene shows that there is no cumulative effect of intermittent, short duration exposure of propane condensate in polyethylene. For additional information, see PPI Technical Report TR-22. Exposure to liquefied propane condensates for extended periods may affect joining.

Mercaptans

Mercaptans are a group of organic compounds containing a Sulfur-Hydrogen bond that have a distinct odor in small concentrations. Natural gas is an odorless hydrocarbon. Natural gas carriers and distributors add mercaptans to natural gas to warn of leaks and to alert the presence of natural gas atmospheres. New plastic pipes have the tendency to absorb mercaptans, causing the odor to fade or become faint. The effect is not long term and after a period of time the distinctive odor of mercaptan is readily detected when released.

Mercaptan enriched natural gas has the possibility of inducing a phenomenon known as “odor fatigue.” The condition can cause nasal passages to become saturated with the smell of gas over time, making it difficult to continue to detect the mercaptan odor.

When Performance Matters Rely on *Performance Pipe*

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