



DESIGN-FLOW® HDPE Pipe - General Information

Weatherability

Independent Pipe Products, Inc. black polyethylene pipe, PE3408, is protected against degradation by a combination of stabilizers and carbon black. The pipe formulation contains in excess of 2% carbon black imparting the black color as well as effective protection from ultraviolet radiation. Carbon black is the single most effective additive to enhance weatherability in Independent Pipe Product's polyethylene pipe.

Weatherability studies indicate that carbon black imparts UV stability that makes our polyethylene pipe acceptable for normal outside storage for a period of years without a detrimental loss of physical properties. Good inventory practices should be maintained to insure optimum performance by installing the pipe in two years or less. If pipe must be stored for more than two years, it should be stored under cover, out of direct sunlight.

Joining

Industry standards recommend the butt heat fusion method for joining. The butt heat fusion joints are as strong as the pipe wall itself. Quick bursts tests have shown ductile rupture of the pipe wall before rupture of the fusion joint.

Applications

Independent Pipe Products, Inc. is well qualified to meet the demanding needs of the municipal water and wastewater markets, energy markets in applications such as oil and gas gathering systems, methane recovery from coal seams and landfills, and water supply lines for oil recovery systems.

Pipe marked with NSF-61 meets the rigorous standards of third party testing performed by the National Sanitation Foundation. This pipe is manufactured to ASTM D-3035 and F-714.

Improved Material Designations

The recent updates and additions to ASTM D3350 caused the EHMW-HDPE resins designated as PE3408 in 2006, to become PE3608 in 2007. The HDPE material did not change, but the ASTM D3350 cell classification that described the material did change, necessitating the upgrade to PE3608. Those same changes encompassed the addition of PE4710 High Performance Polyethylene (HPPE) into the arsenal of pipe grade resins. A PE4710 HPPE piping system can result in a 15% savings when compared to current costs of PE3408 piping systems. By virtue of its higher pressure rating enabling the use of the next lower DR, wall thickness becomes less, ID increases and the weight per foot of pipe is reduced.

PE3608 (prev. PE3408) Material Designation

Materials designated as PE3608 have a hydrostatic design basis of 1600 psi for water at 73° F. After applying the 0.5 Design Factor, the design working stress for 73° F is 800 psi.

PE4710 (prev. PE3408) Material Designation

Materials designated as PE4710 have a hydrostatic design basis of 1600 psi for water at 73° F. After applying the 0.63 Design Factor, the design working stress for 73° F is 1000 psi. PE4710 has higher performance as described in PPI's TN41.

Pressure Ratings

The longevity of polyethylene pipe is calculated between 50 years to 100 years when properly engineered and installed for the conditions and application. Pressure ratings for polyethylene pipe are determined by use of the ISO equation:

$$P = [(2 \times HDB) / (SDR - 1)] \times DF \times F_T$$

Where P = Working pressure of the pipeline
 HDB = Hydrostatic Design Basis of the material
 1600 psi for PE 3408, PE3608 or PE4710
 SDR = Standard Dimension Ratio (OD/min wall)
 DF = Design Factor
 F_T = Elevated temperature service factor

A design factor of 0.5 is recommended for water or dry natural gas in areas not affected by Federal regulations. The Design Factor dry natural gas in areas under the U.S. Department of Transportation (DOT) jurisdiction, according to the Code of Federal Regulations, Title 49, Part 192.123, is 0.32 with a maximum allowable operating pressure of 100 psi. The Design Factor for crude oil or wet natural gas is 0.25.

Elevated Temperature Service Factor (F_T)

Maximum Continuously Applied Service Temperature, °F (°C)	Temperature Compensation Factor, FT, for PE3408 / PE3608 / PE4710
< 80 (26)	1.00
< 90 (32)	0.90
< 100 (38)	0.78
< 110 (43)	0.75
< 120 (49)	0.63
< 130 (54)	0.60
< 140 (60)	0.50

Applicable / Available Standards

ASTM F714, F2620, D3035, D3350, D2513
 NSF 61, AWWA C901/C906



IPS HDPE PIPE PE4710

DESIGN-FLOW[®]

Iron Pipe Size High Density Polyethylene Pipe

ASTM F 714 . ASTM D 3035 . AWWA C901/C906 . NSF - 61

Size		DR 17 CLASS 130 WPR @ 130 psi			DR 13.5 CLASS 160 WPR @ 160 psi			DR 11 CLASS 200 WPR @ 200 psi			DR 9 CLASS 250 WPR @ 250 psi			DR 7 CLASS 335 WPR @ 335 psi		
IPS Pipe Size	Pipe OD (in)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)
2"	2.375	2.078	0.140	0.43	2.002	0.176	0.53	1.917	0.216	0.64	1.815	0.264	0.77	1.656	0.339	0.95
3"	3.500	3.063	0.206	0.94	2.951	0.259	1.16	2.826	0.318	1.39	2.675	0.389	1.66	2.440	0.500	2.06
4"	4.500	3.938	0.265	1.55	3.794	0.333	1.92	3.633	0.409	2.31	3.440	0.500	2.75	3.137	0.643	3.40
5"	5.563	4.870	0.327	2.37	4.690	0.412	2.93	4.490	0.506	3.52	4.253	0.618	4.20	3.877	0.795	5.20
6"	6.625	5.798	0.390	3.36	5.584	0.491	4.15	5.349	0.602	5.00	5.065	0.736	5.96	4.619	0.946	7.37
8"	8.625	7.550	0.507	5.69	7.270	0.639	7.04	6.963	0.784	8.47	6.594	0.958	10.11	6.013	1.232	12.50
10"	10.750	9.410	0.632	8.83	9.062	0.796	10.93	8.679	0.977	13.16	8.219	1.194	15.70	7.494	1.536	19.42
12"	12.750	11.160	0.750	12.43	10.749	0.944	15.38	10.293	1.159	18.51	9.746	1.417	22.08	8.889	1.821	27.31
14"	14.000	12.253	0.824	14.98	11.802	1.037	18.54	11.301	1.273	22.32	10.701	1.556	26.63	9.760	2.000	32.93
16"	16.000	14.005	0.941	19.57	13.488	1.185	24.22	12.915	1.455	29.15	12.231	1.778	34.78	11.154	2.286	43.01
18"	18.000	15.755	1.059	24.77	15.174	1.333	30.65	14.532	1.636	36.89	13.760	2.000	44.02	12.549	2.571	54.43
20"	20.000	17.507	1.176	30.58	16.860	1.481	37.84	16.146	1.818	45.54	15.289	2.222	54.34	13.943	2.857	67.20
22"	22.000	19.257	1.294	37.00	18.544	1.630	45.79	17.760	2.000	55.10	16.819	2.444	65.75	15.337	3.143	81.32
24"	24.000	21.007	1.412	44.03	20.231	1.778	54.49	19.374	2.182	65.58	18.346	2.667	78.25	16.731	3.429	96.77
26"	26.000	22.758	1.529	51.67	21.917	1.926	63.95	20.989	2.364	76.96	19.876	2.889	91.84	-	-	-
28"	28.000	24.508	1.647	59.93	23.603	2.074	74.17	22.604	2.545	89.26	21.404	3.111	106.51	-	-	-
30"	30.000	26.259	1.765	68.80	25.289	2.222	85.14	24.218	2.727	102.47	22.933	3.333	122.27	-	-	-
32"	32.000	28.009	1.882	78.28	26.975	2.370	96.87	25.833	2.909	116.58	-	-	-	-	-	-
36"	36.000	31.511	2.118	99.07	30.347	2.667	122.60	29.062	3.273	147.55	-	-	-	-	-	-

Pressure Ratings are calculated using 0.63 design factor for HDS at 73°F as listed in PPI TR-4 for PE4710 materials. Temperature, chemical, and environmental use considerations may require use of additional design factors. Pipe weights are calculated in accordance with PPI TR-7. Average inside diameter is calculated with nominal OD and minimum wall thickness plus 6%. Actual ID's will vary and are controlled by the dimensions and tolerances listed in the applicable pipe specifications.

Per AWWA C906, the working pressure rating equals the pressure class, with an allowance included in the WPR for pressure surge. The pressure and surge design basis for polyethylene pipe is different from the PVC and DI pipe design basis. For DR's not listed please contact your customer service representative.

$$DR = \frac{\text{Pipe OD (inches)}}{\text{Minimum Wall Thickness (inches)}}$$

The Long-Term Hydrostatic Strength of PE4710 Polyethylene Pipe is 1600 psi at 73.4 F. All pipe sizes with the same DR and Long Term Hydrostatic Strength will have equal operating pressure capability.



DIPS HDPE PIPE PE4710 DESIGN-FLOW®

Ductile Iron Pipe Size High Density Polyethylene Pipe

ASTM F 714 . ASTM D 3035 . AWWA C901/C906 . NSF - 61

Size		DR 21 CLASS 100 WPR @ 100 psi			DR 17 CLASS 130 WPR @ 130 psi			DR 13.5 CLASS 160 WPR @ 160 psi			DR 11 CLASS 200 WPR @ 200 psi			DR 9 CLASS 250 WPR @ 250 psi		
DIPS Pipe Size	Pipe OD (in)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)	Avg ID (in)	Min Wall (in)	Weight (lbs/ft)
4"	4.800	4.315	0.229	1.44	4.202	0.282	1.76	4.045	0.356	2.18	3.876	0.436	2.62	3.670	0.533	3.13
6"	6.900	6.203	0.329	2.98	6.039	0.406	3.64	5.817	0.511	4.50	5.571	0.627	5.42	5.274	0.767	6.47
8"	9.050	8.136	0.431	5.13	7.922	0.532	6.26	7.630	0.670	7.75	7.305	0.823	9.32	6.917	1.006	11.13
10"	11.100	9.979	0.529	7.72	9.716	0.653	9.42	9.357	0.822	11.66	8.961	1.009	14.03	8.486	1.233	16.74
12"	13.200	11.867	0.629	10.92	11.555	0.776	13.32	11.127	0.978	16.48	10.656	1.200	19.84	10.090	1.467	23.67
14"	15.300	13.755	0.729	14.67	13.392	0.900	17.89	12.898	1.133	22.15	12.351	1.391	26.65	11.696	1.700	31.80
16"	17.400	15.643	0.829	18.97	15.229	1.024	23.14	14.667	1.289	28.64	14.046	1.582	34.47	13.302	1.933	41.13
18"	19.500	17.531	0.929	23.83	17.068	1.147	29.07	16.439	1.444	35.97	15.741	1.773	43.29	14.906	2.167	51.66
20"	21.600	19.419	1.029	29.24	18.905	1.271	35.66	18.208	1.600	44.14	17.436	1.964	53.12	16.512	2.400	63.38
24"	25.800	23.195	1.229	41.71	22.582	1.518	50.88	21.749	1.911	62.97	20.829	2.345	75.78	19.722	2.867	90.43
30"	32.000	28.770	1.524	64.17	28.009	1.882	78.28	26.975	2.370	96.87	25.833	2.909	116.58	-	-	-
36"	38.300	34.434	1.824	91.92	33.524	2.253	112.13	32.285	2.837	138.77	-	-	-	-	-	-

Pressure Ratings are calculated using 0.63 design factor for HDS at 73°F as listed in PPI TR-4 for PE4710 materials. Temperature, chemical, and environmental use considerations may require use of additional design factors. Pipe weights are calculated in accordance with PPI TR-7. Average inside diameter is calculated with nominal OD and minimum wall thickness plus 6%. Actual ID's will vary and are controlled by the dimensions and tolerances listed in the applicable pipe specifications.

Per AWWA C906, the working pressure rating equals the pressure class, with an allowance included in the WPR for pressure surge. The pressure and surge design basis for polyethylene pipe is different from the PVC and DI pipe design basis. For DR's not listed please contact your customer service representative.

$$DR = \frac{\text{Pipe OD (inches)}}{\text{Minimum Wall Thickness (inches)}}$$

The Long-Term Hydrostatic Strength of PE4710 Polyethylene Pipe is 1600 psi at 73.4 F. All pipe sizes with the same DR and Long Term Hydrostatic Strength will have equal operating pressure capability.



DESIGN-FLOW® High Density Polyethylene Pipe 2” - 14” IPS PE Pipe Packaging and Loading Information

IPS Pipe Size	Pipe OD (in)	Bundle Style	SDR	Joints Per Pack*	Joints Per Layer*	Layers Per Truck*	Packs Per Truck		Joints Per Truck		Feet Per Truck	
							40's / 50's	40's / 50's	40's	50's	40's	50's
2"	2.375	Soft Pack	7	88 / 88	176	6	11	968	38720	48400		
			9 - 32.5	88 / 88	176	6	12	1056	42240	52800		
3"	3.500	Hard Pack	7	50 / 50	100	7	11 / 9	550 / 450	22000	22500		
			9	50 / 50	100	7	13 / 11	650 / 550	26000	27500		
			11	50 / 50	100	7	14 / 13	700 / 650	28000	32500		
			13.5 - 32.5	50 / 50	100	7	14	700	28000	35000		
4"	4.500	Hard Pack	7	29 / 29	58	7	11 / 9	319 / 261	12760	13050		
			9	29 / 29	58	7	14 / 11	406 / 319	16240	15950		
			11 - 32.5	29 / 29	58	7	14	406	16240	20300		
5"	5.563	Hard Pack	7	15 / 15	30	8	14 / 12	210 / 180	8400	9000		
			9	15 / 15	30	8	16 / 14	240 / 210	9600	10500		
			13.5 - 32.5	15 / 15	30	8	16	240	9600	12000		
6"	6.625	Hard Pack	7	13 / 13	26	7	12 / 9	156 / 117	6240	5850		
			11	13 / 13	26	7	14 / 12	182 / 156	7280	7800		
			13.5 - 32.5	13 / 13	26	7	14	182	7280	9100		
8"	8.625	Hard Pack	7	12 / 10	22	5	8 / 6	88 / 66	3520	3300		
			9	12 / 10	22	5	10 / 8	110 / 88	4400	4400		
			13.5 - 32.5	12 / 10	22	5	10	110	4400	5500		
10"	10.750	Bulk Pack	7	5 / 4	9	7	13 / 10	59 / 45	2360	2250		
			9	5 / 4	9	7	14 / 13	63 / 58	2520	2900		
			11 - 32.5	5 / 4	9	7	14	63	2520	3150		
12"	12.75	Bulk Pack	7	4 / 4	8	6	10 / 8	40 / 32	1600	1600		
			9	4 / 4	8	6	12 / 10	48 / 40	1920	2000		
			11 - 32.5	4 / 4	8	6	12	48	1920	2400		
14"	14.00	Bulk Pack	7	4 / 3	7	6	10 / 8	35 / 28	1400	1400		
			9	4 / 3	7	6	12 / 10	42 / 35	1680	1750		
			11-32.5	4 / 3	7	6	12	42	1680	2100		

DESIGN-FLOW® HDPE Pipe is stocked in 40' joints. Special order lengths are available if specified for a production run, cutting fees may apply if shorter lengths are needed otherwise. Order quantities requiring packaging of joints other than the standard pack amount(s) shown will require a "repack" fee.

"Joints Per Pack, Joints Per Layer & Layers Per Truck" quantities are based on full truck load stacks. "Packs Per Truck, Joints Per Truck & Feet Per Truck" quantities are based on SDR as listed. Quantities shown are based on a trailer height of 56" with a load height not exceeding 13' 6". Load weight limit is 46,500 pounds. Height and weight regulations vary from state to state, special permits may be required in some areas. Certain states allow loads larger than listed. Please inquire with our Customer Service Department for information on load limits in your area.



DESIGN-FLOW® High Density Polyethylene Pipe 16” - 36” IPS PE Pipe Packaging and Loading Information

IPS Pipe Size	Pipe OD (in)	Bundle Style	SDR	Joints Per Pack*	Joints Per Layer*	Layers Per Truck*	Packs Per Truck	Joints Per Truck	Feet Per Truck	
							40's / 50's	40's / 50's	40's	50's
16"	16.00	Hard Pack	7	3 / 3	6	5	9 / 7	27 / 21	1080	1050
			9	3 / 3	6	5	10 / 9	30 / 27	1200	1350
			11 - 32.5	3 / 3	6	5	10	30	1200	1500
18"	18.00	Hard Pack	7	3 / 2	5	5	8 / 7	20 / 17	800	850
			9	3 / 2	5	5	10 / 8	25 / 20	1000	1000
			11 - 32.5	3 / 2	5	5	10	20	1000	1250
20"	20.00	Hard Pack	7	3 / 2	5	4	7 / 5	17 / 13	680	650
			9	3 / 2	5	4	8 / 7	20 / 17	800	850
			11 - 32.5	3 / 2	5	4	8	20	800	1000
22"	22.0	Hard Pack	7	2 / 2	4	4	7 / 5-1/2	14 / 11	560	550
			9	2 / 2	4	4	8 / 7	16 / 14	640	700
			11 - 32.5	2 / 2	4	4	8	16	640	800
24"	24.00	Hard Pack	7	2 / 2	4	4	6 / 4-1/2	12 / 9	480	450
			9	2 / 2	4	4	7 / 6	14 / 12	560	600
			11	2 / 2	4	4	8 / 7	16 / 14	640	700
			13.5 - 32.5	2 / 2	4	4	8	16	640	800
26"	26.00	Hard Pack	7	2 / 1	3	3	6 / 6.5	9 / 8	360	400
			9 - 32.5	2 / 1	3	3	6	9	360	450
28"	28.00	Bulk Pack	9	2 / 1	3	3	6 / 5	9 / 8	360	400
			11 - 32.5	2 / 1	3	3	6	9	360	450
30"	30.00	Bulk Pack	9	2 / 1	3	3	6 / 5	9 / 7	360	350
			11 - 32.5	2 / 1	3	3	6	9	360	450
32"	32.00	Bulk Pack	11	2 / 1	3	3	6 / 5	9 / 8	360	400
			13.5 - 32.5	2 / 1	3	3	6	9	360	450
36"	36.00	Bulk Pack	11 - 32.5	1 / 1	2	2	4	4	160	200

DESIGN-FLOW® HDPE Pipe is stocked in 40' joints. Special order lengths are available if specified for a production run, cutting fees may apply if shorter lengths are needed otherwise. Order quantities requiring packaging of joints other than the standard pack amount(s) shown will require a "repack" fee.

"Joints Per Pack, Joints Per Layer & Layers Per Truck" quantities are based on full truck load stacks. "Packs Per Truck, Joints Per Truck & Feet Per Truck" quantities are based on SDR as listed. Quantities shown are based on a trailer height of 56" with a load height not exceeding 13' 6". Load weight limit is 46,500 pounds. Height and weight regulations vary from state to state, special permits may be required in some areas. Certain states allow loads larger than listed. Please inquire with our Customer Service Department for information on load limits in your area.



DESIGN-FLOW® High Density Polyethylene Pipe 4” - 36” DIPS PE Pipe Packaging and Loading Information

DIPS Pipe Size	Pipe OD (in)	Bundle Style	SDR	Joints Per Pack	Joints Per Layer	Layers Per Truck	Packs Per Truck	Joints Per Truck	Feet Per Truck	
							40's / 50's	40's / 50's	40's	50's
4"	4.800	Hard Pack	9	29 / 29	58	6	12	348 / 290	13920	14500
			11 - 32.5	29 / 29	58	6	12	348	13920	17400
6"	6.900	Hard Pack	9	13 / 13	26	6	12	156 / 143	6240	7150
			11 - 32.5	13 / 13	26	6	12	156	6240	7800
8"	9.050	Hard Pack	9	6 / 5	11	9	18 / 15	99 / 83	3960	4150
			11 - 32.5	6 / 5	11	9	18	99	3960	4950
10"	11.100	Bulk Pack	9	5 / 4	9	7	14 / 12	63 / 54	2520	2700
			11 - 32.5	5 / 4	9	7	14	63	2520	3150
12"	13.200	Bulk Pack	9	4 / 3	7	6	12 / 11	42 / 39	1680	1950
			11 - 32.5	4 / 3	7	6	12	42	2680	2100
14"	15.300	Bulk Pack	9	3	6	5	10 / 9	30 / 27	1200	1350
			11 - 32.5	3	6	5	10	30	1200	1500
16"	17.400	Bulk Pack	9	3 / 2	5	5	10 / 9	25 / 22	1000	1100
			11 - 32.5	3 / 2	5	5	10	25	1000	1250
18"	19.500	Bulk Pack	9	3 / 2	5	4	8 / 7	20 / 18	800	900
			11 - 32.5	3 / 2	5	4	8	20	800	1000
20"	21.600	Bulk Pack	9 - 11	2 / 2	4	4	8 / 7	16 / 14	640	700
			13.5 - 32.5	2 / 2	4	4	8	16	640	800
24"	25.800	Bulk Pack	9 - 32.5	2 / 1	3	3	6	9	360	450
30"	32.000	Bulk Pack	11	2 / 1	3	3	6 / 5	9 / 8	360	400
			13.5 - 32.5	2 / 1	3	3	6	9	360	450
36"	38.300	Bulk Pack	13.5 - 32.5	1 / 1	2	2	4	4	160	200

DESIGN-FLOW® HDPE Pipe is stocked in 40' joints. Special order lengths are available if specified for a production run, cutting fees may apply if shorter lengths are needed otherwise. Order quantities requiring packaging of joints other than the standard pack amount(s) shown will require a "repack" fee.

"Joints Per Pack, Joints Per Layer & Layers Per Truck" quantities are based on full truck load stacks. "Packs Per Truck, Joints Per Truck & Feet Per Truck" quantities are based on SDR as listed. Quantities shown are based on a trailer height of 56" with a load height not exceeding 13' 6". Load weight limit is 46,500 pounds. Height and weight regulations vary from state to state, special permits may be required in some areas. Certain states allow loads larger than listed. Please inquire with our Customer Service Department for information on load limits in your area.



DESIGN-FLOW® High Density Polyethylene Pipe

Calculation of Fusion Gage Pressure for Hydraulic Fusion Machines

When calculating the recommended hydraulic pressure shown on the pressure gage, the manufacturer for the specific machine in use should be consulted. In order to calculate the required hydraulic gage pressure the fusion machine effective hydraulic piston area must be known.

CALCULATION:

$$\text{Hydraulic Gauge Pressure (psi)} = \left[\frac{.785 \times (\text{OD}^2 - \text{ID}^2) \times \text{IP.}}{\text{Piston Area}} \right] + \text{Drag Factor}$$

Where: OD = Pipe outside diameter (in)
 ID = Pipe inside diameter (in)
 IP = Interfacial pressure required (75 psi)
 Piston Area = Total hydraulic piston area (in²)
 *Drag Factor = Hydraulic gage pressure required to move the pipe and carriage / clamp. 30 psi is generally accepted as a minimum.

* The drag factor is an important parameter easily overlooked. If two long pieces of pipe are being fused, the drag factor can easily reach much higher pressures.



DESIGN-FLOW® High Density Polyethylene Pipe Butt Fusion Procedure

PE3408 / PE3608 / PE4710 Butt Fusion Procedure for Pipe & Fittings

1. Clean inside and outside of each pipe end with a clean cloth.
2. Place pipe and/or butt fitting ends into the proper alignment device. Square (face) end of each pipe to be fused.
3. Check alignments of pipe ends and adjust. Check for voids and gaps. Check heater plate for proper surface temperature of 400° F- 425° F , and clean heater surface with a clean cotton cloth. *
4. Insert heater plate between aligned ends and bring ends firmly in contact with plate, but **DO NOT APPLY PRESSURE** while achieving melt pattern. Watch for proper melt.

Approximate Melt Bead Width **

Pipe OD Range (inches)	Nominal Melt Bead Width (inches) **
>1 to <3	1/16 to 1/8
>3 to <8	1/8 to 3/16
>8 to <12	3/16 to 5/16
>12 to <24	5/16 to 7/16
>24 to <36	7/16
>36 to <54	9/16

** As measured from the heater plate face

5. Remove heater plate after achieving proper melt bead.
6. Bring melted ends together rapidly. **DO NOT SLAM**. Apply enough pressure to form a uniform, double rollback bead around entire circumference of the joint.
7. Allow the butt fusion joint to cool properly (until comfortable to the touch) while maintaining pressure.

REMEMBER:

- Install proper inserts in fusion machine for the pipe, tubing or fittings being joined. A quality butt fusion joint has a double bead rolled back to the body of the pipe.
- Butt fusion temperature of 400° F- 425° F should be used to insure melt bead is of sufficient size.
- Recommended interfacial pressure is 75-psi+/- 5 psi. (PPI Report TR-33 cites 60 psi - 90 psi range.)

Caution: Insufficient melt bead may result in a cold fusion joint. Heater plates should be checked with a pyrometer for correct surface temperature (400° F- 425° F). Butt fusion joints are stronger when the melt beads remain intact. Additional testing should be performed to insure that the fusion is adequate for the application.

* Avoid fabric materials that melt and stick to heater plates.



DESIGN-FLOW® High Density Polyethylene Pipe Sidewall Fusion Procedure

PE3408 / PE3608 / PE4710 Sidewall Fusion Procedure

1. Install fusion machine on the main pipe.
2. Clean the pipe with a clean cotton cloth. Rough the surface with 60 grit or coarser utility cloth. Brush away residue with a clean, dry rag after abrading. **(Do not use sand paper.)**
3. Clean and rough the saddle base of tee (side fitting) with 60 grit or coarser utility cloth. Brush away residue with a clean, dry rag after abrading.
4. Align fitting on main and tighten clamp (insert adapter) on fitting stem while applying slight pressure on movable clamp handle.
5. Check saddle for square alignment on main.
6. Clean face of heater adapters with a clean cotton cloth.* Check heater plates for proper surface temperature of 475° F - 500° F. Raise movable clamp with fitting. Roll in and center heater plate with adapter between base of fitting and main.
7. For all sizes, apply an adequate and uniform pressure until continuous melt bead can be seen on main. Reduce pressure to light pressure; continue heat soak cycle on fitting and main; and, watch base of fitting for the appropriate melt bead to be visible completely around the base of the fitting and on the main around the heating iron base;

Approximate Melt Bead Width **

Pipe OD Range (inches)	Nominal Melt Bead Width (inches) **
>1 to <3	1/16 to 1/8
>3 to <8	1/8 to 3/16
>8 to <12	3/16 to 5/16
>12 to <24	5/16 to 7/16
>24 to <36	7/16
>36 to <54	9/16

** As measured from the heater plate face

8. Raise moveable clamps and remove heater plate.
9. Bring melted surfaces together rapidly and smoothly. Apply continuous progressive pressure until proper fusion bead is formed. Maintain pressure until joint has cooled (until comfortable to the touch). **(For additional information, refer to PPI Report TR41.)**

REMEMBER:

- Install proper sidewall and fitting inserts in fusion unit for the pipe and fittings being joined.
 - Be sure correct sidewall adapters are installed on heater plate.
 - A quality side fusion joint has a uniform, well-aligned appearance all around.
 - Heater plate should be checked periodically with a pyrometer for correct surface temperature (475° F - 500° F).
- * Avoid materials that melt and stick to heater plates.

INDEPENDENT PIPE PRODUCTS, INC.



“BETTER BY DESIGN”®

Specification Sheet #P4

DESIGN-FLOW® High Density Polyethylene Pipe for Municipal & Industrial PE3408 / PE3608 Nominal Physical Properties*

Typical Specification	ASTM Test Method	Nominal Values
Density	ASTM D 1505	.955 gm / cm ³
Melt Index ¹	ASTM D 1238	6.5 gm / 10 min.
Tensile Strength		
@ Yield (2 in/min)	ASTM D 638	3300 psi
@ Break (2 in/min)	ASTM D 638	4500 psi
Hydrostatic Design Basis (HDB)		
@ 23° C (73.4° F)	ASTM D 2837	1600 psi
@ 60° C (140° F)	ASTM D 2837	1000 psi
HDB Design Factor (DF)	PPI TR-4	0.50
Elongation @ Break (2 in/min)	ASTM D 638	>750%
Flexural Modulus ²	ASTM D 790	125,000 psi
Notched Izod Impact Strength	ASTM D 256	6.0 ft-lbf / in
Hardness (Shore D)	ASTM D 2240	66
Brittleness Temperature	ASTM D 746	< -103 ° F
Environmental Stress Crack Resistance ³	ASTM D 1693	>5000 hrs
NSF	STANDARD 61	APPROVED
Cell Classification	ASTM D 3350	345464C (min)
Vicat Softening Point	ASTM D 1525	257 ° F

DESIGN-FLOW® High Density Polyethylene Pipe for M & I is manufactured to ASTM F 714, ASTM D 3035, AWWA C901/C906 and NSF standards as applicable. Standard color of pipe is black with blue print line.

Notes: ¹ 190° C / 21,600 g; ² 2% Secant - Method 1

*This list of typical physical properties is intended for basic characterization of the material and does not represent specific determinations of specifications. The physical properties values reported herein were determined on compression molded specimens prepared in accordance with procedure C of ASTM D 4703 and may differ from specimens taken from pipe.

1-800-499-6927

Page 1 - 10

www.indpipe.net



DESIGN-FLOW® High Density Polyethylene Pipe for Municipal & Industrial PE4710 Nominal Physical Properties*

Typical Specification	ASTM Test Method	Nominal Values
Density	ASTM D 1505	.959 gm / cm ³
Melt Index ¹	ASTM D 1238	7.0 gm / 10 min.
Tensile Strength		
@ Yield (2 in/min)	ASTM D 638	3600 psi
@ Break (2 in/min)	ASTM D 638	4500 psi
Hydrostatic Design Basis (HDB)		
@ 23° C (73.4° F)	ASTM D 2837	1600 psi
@ 60° C (140° F)	ASTM D 2837	1000 psi
HDB Design Factor (DF)	PPI TR-4	0.63
Elongation @ Break (2 in/min)	ASTM D 638	>740%
Flexural Modulus ²	ASTM D 790	150,000 psi
Notched Izod Impact Strength	ASTM D 256	9.0 ft-lbf / in
Hardness (Shore D)	ASTM D 2240	68
Brittleness Temperature	ASTM D 746	< -103 ° F
Slow Crack Growth PENT, hours	ASTM D1473	>10,000 hrs
NSF	STANDARD 61	APPROVED
Cell Classification	ASTM D 3350	445574C
Vicat Softening Point	ASTM D 1525	257 ° F

DESIGN-FLOW® High Density Polyethylene Pipe for M & I is manufactured to ASTM F 714, ASTM D 3035, AWWA C901/C906 and NSF standards as applicable. Standard color of pipe is black with blue print line.

Notes: ¹ 190° C / 21,600 g; ² 2% Secant - Method 1

*This list of typical physical properties is intended for basic characterization of the material and does not represent specific determinations of specifications. The physical properties values reported herein were determined on compression molded specimens prepared in accordance with procedure C of ASTM D 4703 and may differ from specimens taken from pipe.

INDEPENDENT PIPE PRODUCTS, INC.



“BETTER BY DESIGN”®

Specification Sheet #P6

DESIGN-FLOW® D2513 High Density Polyethylene Pipe for Oil & Gas PE3408 / PE3608 Nominal Physical Properties*

Typical Specification	ASTM Test Method	Nominal Values
Density	ASTM D 1505	.955 gm / cm ³
Melt Index ¹	ASTM D 1238	6.5 gm / 10 min.
Tensile Strength		
@ Yield (2 in/min)	ASTM D 638	3300 psi
@ Break (2 in/min)	ASTM D 638	4500 psi
Hydrostatic Design Basis		
@ 23° C (73.4° F)	ASTM D 2837	1600 psi
@ 60° C (140° F)	ASTM D 2837	1000 psi
HDB Design Factor (DF)	PPI TR-9 / PPI TR-22	0.25 Oil & Wet Gas 0.32 Dry Gas
Elongation @ Break (2 in/min)	ASTM D 638	>750%
Flexural Modulus ²	ASTM D 790	125,000 psi
Notched Izod Impact Strength	ASTM D 256	6.0 ft-lbf / in
Hardness (Shore D)	ASTM D 2240	66
Brittleness Temperature	ASTM D 746	< -103 °F
Environmental Stress Crack Resistance ³	ASTM D 1693	>5000 hrs
Cell Classification	ASTM D 3350	345464C (min)
Vicat Softening Point	ASTM D 1525	257 °F

Design-Flow® D2513 High Density Polyethylene Pipe for Oil & Gas is manufactured in accordance with ASTM D 2513 requirements. Standard color of pipe is black with yellow print line.

Notes: ¹ 190° C / 21,600 g; ² 2% Secant - Method 1; ³ Condition C

*This list of typical physical properties is intended for basic characterization of the material and does not represent specific determinations of specifications. The physical properties values reported herein were determined on compression molded specimens prepared in accordance with procedure C of ASTM D 4703 and may differ from specimens taken from pipe.

1-800-499-6927

Page 1 - 12

www.indpipe.net



DESIGN-FLOW® D2513 High Density Polyethylene Pipe for Oil & Gas PE4710 Nominal Physical Properties*

Typical Specification	ASTM Test Method	Nominal Values
Density	ASTM D 1505	.959 gm / cm ³
Melt Index ¹	ASTM D 1238	7.0 gm / 10 min.
Tensile Strength		
@ Yield (2 in/min)	ASTM D 638	3600 psi
@ Break (2 in/min)	ASTM D 638	4500 psi
Hydrostatic Design Basis		
@ 23° C (73.4° F)	ASTM D 2837	1600 psi
@ 60° C (140° F)	ASTM D 2837	1000 psi
Pressure Design Factor (DF)	PPI TR-9 / PPI TR-22	0.25 Oil & Wet Gas 0.32 Dry Gas
Elongation @ Break (2 in/min)	ASTM D 638	>740%
Flexural Modulus ²	ASTM D 790	125,000 psi
Notched Izod Impact Strength	ASTM D 256	9.0 ft-lbf / in
Hardness (Shore D)	ASTM D 2240	66
Brittleness Temperature	ASTM D 746	< -103 °F
Slow Crack Growth PENT, hours	ASTM D1473	>10,000 hrs
Cell Classification	ASTM D 3350	445576C
Vicat Softening Point	ASTM D 1525	257 °F

Design-Flow® D2513 High Density Polyethylene Pipe for Oil & Gas is manufactured in accordance with ASTM D 2513 requirements. Standard color of pipe is black with yellow print line.

Notes: ¹ 190° C / 21,600 g; ² 2% Secant - Method 1

*This list of typical physical properties is intended for basic characterization of the material and does not represent specific determinations of specifications. The physical properties values reported herein were determined on compression molded specimens prepared in accordance with procedure C of ASTM D 4703 and may differ from specimens taken from pipe.



DESIGN-FLOW® High Density Polyethylene Gray Slip Liner Pipe PE3408 / PE3608 Nominal Physical Properties*

Typical Specification	ASTM Test Method	Nominal Values
Density	ASTM D 1505	.955 gm / cm ³
Melt Index ¹	ASTM D 1238	6.5 gm / 10 min.
Tensile Strength		
@ Yield (2 in/min)	ASTM D 638	3300 psi
@ Break (2 in/min)	ASTM D 638	4500 psi
Hydrostatic Design Basis (HDB)		
@ 23° C (73.4° F)	ASTM D 2837	1600 psi
@ 60° C (140° F)	ASTM D 2837	1000 psi
HDB Design Factor (DF)	PPI TR-4	0.50
Elongation @ Break (2 in/min)	ASTM D 638	>750%
Flexural Modulus ²	ASTM D 790	125,000 psi
Notched Izod Impact Strength	ASTM D 256	6.0 ft-lbf / in
Hardness (Shore D)	ASTM D 2240	66
Brittleness Temperature	ASTM D 746	< -103 °F
Environmental Stress Crack Resistance ³	ASTM D 1693	>5000 hrs
Cell Classification	ASTM D 3350	345464E (min)
Vicat Softening Point	ASTM D 1525	257 °F

Design-Flow® High Density Polyethylene Slip Liner Pipe is manufactured in a standard color of light gray. Black slip liner can be produced by special request. Product is available in all standard sizes and SDR's as listed on the **Design-Flow**® HDPE Pipe Size Charts.

Notes: ¹ 190° C / 21,600 g; ² 2% Secant - Method 1; ³ Condition C

*This list of typical physical properties is intended for basic characterization of the material and does not represent specific determinations of specifications. The physical properties values reported herein were determined on compression molded specimens prepared in accordance with procedure C of ASTM D 4703 and may differ from specimens taken from pipe.



DESIGN-FLOW® High Density Polyethylene Gray Slip Liner Pipe PE4710 Nominal Physical Properties*

Typical Specification	ASTM Test Method	Nominal Values
Density	ASTM D 1505	.959 gm / cm ³
Melt Index ¹	ASTM D 1238	7.0 gm / 10 min.
Tensile Strength		
@ Yield (2 in/min)	ASTM D 638	3600 psi
@ Break (2 in/min)	ASTM D 638	4500 psi
Hydrostatic Design Basis (HDB)		
@ 23° C (73.4° F)	ASTM D 2837	1600 psi
@ 60° C (140° F)	ASTM D 2837	1000 psi
HDB Design Factor (DF)	PPI TR-4	0.63
Elongation @ Break (2 in/min)	ASTM D 638	>740%
Flexural Modulus ²	ASTM D 790	150,000 psi
Notched Izod Impact Strength	ASTM D 256	9.0 ft-lbf / in
Hardness (Shore D)	ASTM D 2240	68
Brittleness Temperature	ASTM D 746	< -103 °F
Slow Crack Growth PENT, hours	ASTM D1473	>10,000 hrs
Cell Classification	ASTM D 3350	445574E
Vicat Softening Point	ASTM D 1525	257 °F

Design-Flow® High Density Polyethylene Slip Liner Pipe is manufactured in a standard color of light gray. Black slip liner can be produced by special request. Product is available in all standard sizes and SDR's as listed on the **Design-Flow**® HDPE Pipe Size Charts.

Notes: ¹ 190° C / 21,600 g; ² 2% Secant - Method 1

*This list of typical physical properties is intended for basic characterization of the material and does not represent specific determinations of specifications. The physical properties values reported herein were determined on compression molded specimens prepared in accordance with procedure C of ASTM D 4703 and may differ from specimens taken from pipe.