Technical Information
Polyethylene System

Polyethylene (PE)

Polyethylene has been the accepted material for the production of fittings and pressure pipes used in the distribution of drinking water for more than 50 years. The Buteline PE System is predominantly used in the Asian markets, in higher temperature climates. This product is made by Buteline Malaysia Sdn Bhd.

Key Advantages

Polyethylene is characterized by toughness, near-zero moisture absorption, excellent chemical resistance, excellent electrical insulating properties, low coefficient of friction and ease of processing.

Due to its molecular structure, Polyethylene exhibits extremely good strength at room temperatures whilst retaining its flexibility and has longevity of life when used for **cold water plumbing applications**.

The important advantages of PE are:

- ✓ More flexibility offered with PE pipe than metal, PVC or ABS pipes used for similar applications
- ✓ Immunity to scale build-up associated with conventional metal pipes
- ✓ Good chemical resistance and high resistance to most household chemicals
- ✓ Excellent impact resistance, even at low temperatures
- ✓ High tensile strength when used for conveying cold water

Buteline PE Fittings

Buteline PE fittings are manufactured from UV-stabilized engineering polymer which provides good resistance to creep and excellent mechanical properties, as well as resistance to a large range of chemicals. The fittings are also immune to scale build-up.

Buteline PE Pipe

Buteline PE pipes are available in sizes 20mm, 25mm and 32mm manufactured from HDPE material by extrusion process. Available in lengths and coils, they are **suitable for cold water plumbing only**.

Buteline PE pipes are colour coded for easy identification of their different applications – blue-striped black pipe is for cold potable water, green pipe is for rainwater harvesting and lilac pipe is for recycled water.

Buteline PE Clamp Tools

Buteline PE Clamp Tools are robust and easy to maintain.
(Please refer to the section on Buteline Clamp Tools for more information).

PE Pipe Performance Comparisons

Polyethylene (PE) offers many advantages over other alternatives:

Comparative Pipe Performance			
	HDPE	PVC	ABS
Impact Strength	Excellent	Poor	Poor
Flexibility	Excellent	Poor	Poor
Chemical Resistance	Excellent	Poor	Poor
Hot Potable Water Usage	No	No	No
Cold Potable Water Usage	Yes	Yes	Yes

Pipe Dimensions

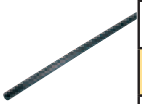
Australia

PE Pipe	Outside Diameter (OD)	Wall Thickness (WT)
20mm PN16	20.0mm - 20.3mm	2.3mm - 2.7mm

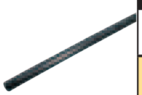
Malaysia

PE Pipe	Outside Diameter (OD)	Wall Thickness (WT)
20mm PN16	20.0mm - 20.3mm	2.3mm - 2.7mm
25mm PN12.5	25.0mm - 25.3mm	2.3mm - 2.7mm
32mm PN 12.5	32.0mm - 32.3mm	2.9mm - 3.4mm

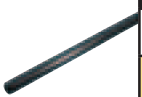
Flow Rates at Specific Velocities for Polyethylene Pipe



20PE	
Velocity	Flow Rate
1.6 m/s	17.8 L/min
2.4 m/s	26.7 L/min
3.0 m/s	33.4 L/min



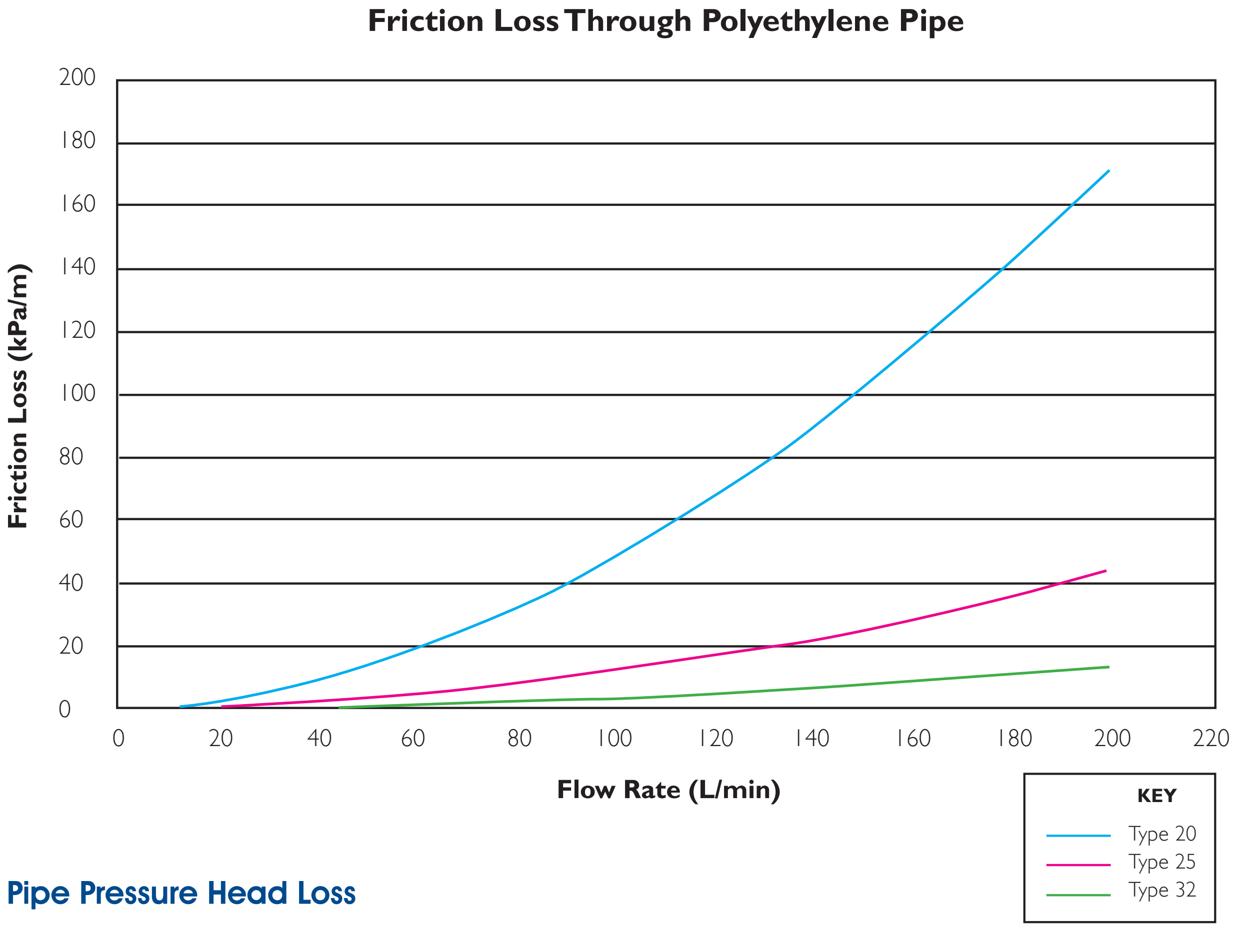
25PE	
Velocity	Flow Rate
1.6 m/s	31.2 L/min
2.4 m/s	46.8 L/min
3.0 m/s	58.5 L/min



32PE	
Velocity	Flow Rate
1.6 m/s	50.1 L/min
2.4 m/s	76.5 L/min
3.0 m/s	95.6 L/min

Friction Loss For Polyethylene Pipe

Flow Rate (L/min)	Type 20		Type 25		Type 32	
	kPa/m	Bar/m	kPa/m	Bar/m	kPa/m	Bar/m
0.5	0.00	0.000	0.00	0.000	0.00	0.000
1	0.01	0.000	0.00	0.000	0.00	0.000
2	0.03	0.000	0.01	0.000	0.00	0.000
3	0.07	0.001	0.02	0.000	0.01	0.000
4	0.12	0.001	0.03	0.000	0.01	0.000
5	0.19	0.002	0.05	0.001	0.01	0.000
10	0.68	0.007	0.17	0.002	0.05	0.001
12	0.95	0.009	0.24	0.002	0.07	0.001
14	1.26	0.012	0.32	0.003	0.10	0.001
16	1.61	0.016	0.41	0.004	0.12	0.001
18	2.00	0.020	0.51	0.005	0.16	0.002
20	2.44	0.025	0.62	0.006	0.19	0.002
25	3.68	0.037	0.93	0.009	0.29	0.003
30	5.16	0.052	1.31	0.013	0.40	0.004
35	6.86	0.069	1.74	0.017	0.53	0.005
40	8.78	0.088	2.22	0.022	0.68	0.007
45	10.92	0.109	2.77	0.028	0.85	0.009
50	13.27	0.130	3.36	0.034	1.03	0.010
55	15.82	0.160	4.01	0.040	1.23	0.012
60	18.59	0.190	4.71	0.048	1.44	0.014
65	21.55	0.220	5.46	0.055	1.67	0.017
70	24.72	0.250	6.26	0.063	1.92	0.020
75	28.09	0.280	7.11	0.071	2.18	0.022
80	31.65	0.320	8.02	0.080	2.45	0.025
85	35.40	0.350	8.97	0.090	2.75	0.028
90	39.35	0.400	9.97	0.100	3.05	0.031
95	43.49	0.430	11.02	0.110	3.37	0.034
100	47.82	0.480	12.11	0.120	3.71	0.038
105	52.34	0.520	13.26	0.130	4.06	0.040
110	57.04	0.570	14.45	0.140	4.42	0.044
115	61.93	0.620	15.69	0.160	4.80	0.048
120	67.01	0.670	16.97	0.170	5.20	0.052
125	72.26	0.720	18.30	0.180	5.60	0.056
130	77.70	0.780	19.68	0.200	6.02	0.060
135	83.32	0.830	21.11	0.210	6.46	0.065
140	89.12	0.900	22.57	0.230	6.91	0.069
145	95.10	0.950	24.09	0.240	7.37	0.074
150	-	-	25.65	0.260	7.85	0.079
155	-	-	27.25	0.270	8.34	0.083
160	-	-	28.90	0.290	8.85	0.089
165	-	-	30.59	0.310	9.36	0.094
170	-	-	32.33	0.320	9.90	0.100
175	-	-	34.11	0.340	10.44	0.100
180	-	-	35.94	0.360	11.00	0.110
185	-	-	37.80	0.380	11.57	0.120
190	-	-	39.72	0.400	12.16	0.120
195	-	-	41.67	0.420	12.76	0.130
200	-	-	43.67	0.440	13.37	0.130



Pipe Pressure Head Loss

The below table shows friction loss over 30 metres (or 100 feet) of Buteline PE pipe:

Pipe Pressure Head Loss Per 30 Metres (100 Feet) For Polyethylene Pipe

Minimum Flow Required		Type 20		Type 25		Type 32	
L/min	Gallons/min	kPa	Bar	kPa	Bar	kPa	Bar
0.5	0.11	0.08	0.001	0.02	0.000	0.01	0.000
1	0.22	0.29	0.003	0.07	0.001	0.02	0.000
2	0.44	1.03	0.010	0.26	0.003	0.08	0.001
3	0.67	2.18	0.022	0.55	0.006	0.17	0.002
4	0.89	3.72	0.037	0.94	0.009	0.29	0.003
5	1.11	5.62	0.056	1.42	0.014	0.44	0.004
10	2.22	20.26	0.203	5.13	0.051	1.57	0.016
12	2.67	28.39	0.284	7.19	0.072	2.20	0.022
14	3.11	37.76	0.378	9.57	0.096	2.93	0.029
16	3.56	48.35	0.483	12.25	0.122	3.75	0.037
18	4.00	60.11	0.601	15.23	0.152	4.66	0.047
20	4.44	73.06	0.731	18.51	0.185	5.66	0.057
25	5.56	110.39	1.104	27.96	0.280	8.56	0.086
30	6.67	154.68	1.547	39.18	0.392	11.99	0.120
35	7.78	205.72	2.057	52.11	0.521	15.95	0.160
40	8.89	263.37	2.634	66.71	0.667	20.42	0.204
45	10.00	327.49	3.275	82.95	0.830	25.39	0.254

NOTE: Please refer to the Appendices for a Pressure Conversion Chart.

Working Pressures for Polyethylene Pipe at 20°C

Pipe Size	Pressure Rating	Working Pressure
20mm (1/2")	PN16	1600 kPa (16 Bar)
25mm (3/4")	PN12.5	1250 kPa (12.50 Bar)
32mm (1")	PN12.5	1250 kPa (12.50 Bar)

Hydrostatic Design Stress

From AS1640:1989, this is defined as the maximum hoop stress in the pipe wall due to internal hydrostatic pressure that can be applied continuously with great certainty that failure of the pipe will not occur in a long period of time, as it is obtained by the application of a safety factor to the extrapolated 50 year long-term hydrostatic stress value.

The hydrostatic design stress for our Polyethylene pipe is 5.5 MPa (55 Bar) at 20°C.

Density

The mass per unit volume for Polyethylene is 0.955 kg/L at 25°C.

Vicat Softening Point

Polymers tend to soften rather than melt and the point at which the polymer specimen is able to be penetrated to a depth of 1mm by a flat-ended needle is known as the Vicat softening point.

The Vicat softening point for Polyethylene is 116°C.

Thermal Conductivity of Polyethylene

When any medium which has been heated to a temperature above that of the external environment is transported through pipes, there will inevitably be a loss of heat from the medium being transported, through the pipe wall and into the external environment. This heat loss is expressed in the amount of heat that will be lost in an applicable unit (W) times the length of pipe run (m). For the purposes of the calculation, the medium in the pipe is considered to be stationary. The result is a heat loss factor expressed in terms of energy lost per unit length of pipe (W/m).

The amount of heat lost to the outside environment is directly linked to the thermal characteristics of the material from which the pipe is manufactured. In general, metals exhibit high rates of thermal conductivity, whilst most plastics from which pipes are manufactured have relatively low rates of thermal conductivity. Because of this, plastic piping systems will transfer much smaller amounts of energy from the transported medium to the external environment, meaning that **in plumbing terms, heated water will remain hotter when transported in plastic pipes than in metal pipes, and cold water is less likely to freeze in plastic pipes than in metal pipes when exposed to very low temperatures**.

The thermal conductivity of Polyethylene is 0.4 W/m per °C.

Expansion Rate

Thermal expansion is the tendency for any material to either expand or contract due to changes in temperature. All materials will exhibit this property, but some may be affected to a greater extent than others. The change in size can be calculated for a given temperature rise and expressed as a unit measure of length per degree rise in temperature.

In general, plastic materials exhibit greater thermal expansion than metals, so it is to be expected that plastic piping systems will expand more as they increase in temperature than similar metal systems. Thermal expansion should thus always be taken into account when designing and installing plastic plumbing systems by making allowances to accommodate for the movement of pipes due to temperature changes.

The thermal expansion co-efficient of Polyethylene is 0.26 mm/°C.

Creep Resistance Of Polyethylene

All thermoplastics essentially act like elastic when stressed for a short period of time and will return to their pre-stressed state when the stress is removed. However, when stressed continually over a long period, they will "creep", as the deflection of the material will increase with time.

The amount of "creep" that any plastic part experiences is influenced by several factors – the material from which it is made, the stress under which it is used, and the temperature at which it is exposed to the stress.

Because all plumbing systems are subject to continuous hoop stress from the pressure of the water within the pipes and possibly to elevated temperatures from the transport of hot water, the creep resistance of the materials used within these systems is of vital importance.

Polyethylene molecules demonstrate very similar characteristics as Polybutene-1 molecules at temperatures below around 60°C. The molecular bonds become weaker at elevated temperatures, which in turn severely reduce creep resistance at higher temperatures, making Polyethylene an unsuitable material for the manufacture of hot water plumbing systems. Thus Buteline have adopted Polyethylene as a material for the manufacture of pipes and fittings for cold water plumbing.

All the plastic materials used in the manufacture of Buteline fittings, whether for hot or cold plumbing systems, are selected because of their outstanding resistance to creep. Both Buteline hot and cold system fittings are tested and suitable for use at elevated temperatures.