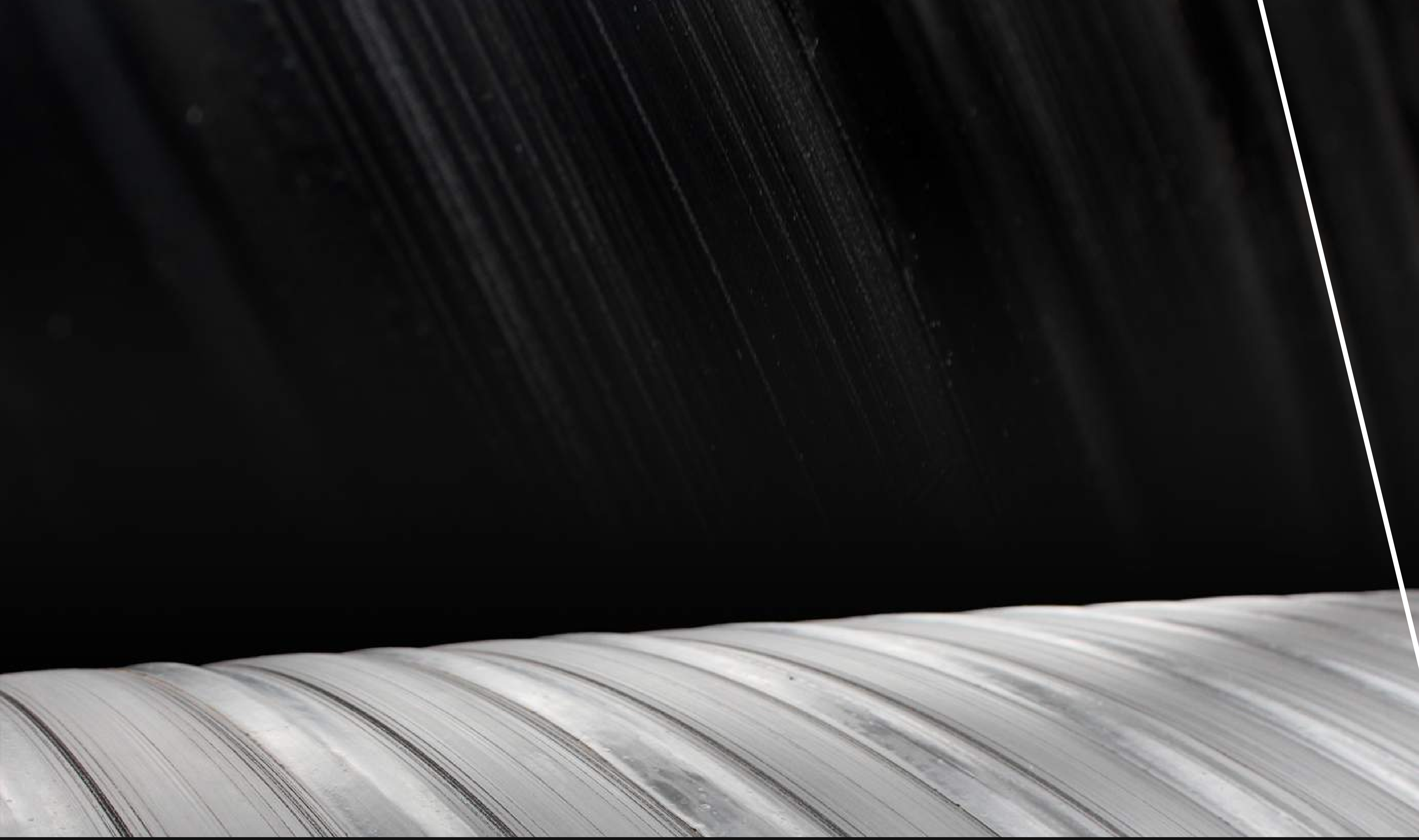
POLYNEX

STRUCTURED PIPE SYSTEMS



STRUCTURED WALL
HDPE PIPE

MADE IN AUSTRALIA

Partnered with POLYWORLD™

made great in australia

1.0 Introduction

It’s globally recognised. Internationally accepted.
And it's now here.

Since Australian pipe manufacture began in the 1950s, polyethylene pipes have been recognised for their outstanding physical properties and chemical resistance. Now, enormous leaps in technology have rendered polyethylene the material of choice for engineers in the 21st century, and for mega-cities such as New York and London.

Polynex High-Density Polyethylene pipes (HDPE) are formed using a unique double-wall ‘i’beam profiling, resulting in compression strengths up to 8kN/m^2. Resistant to fatigue and corrosion, the HDPE pipe has an estimated asset life of 100 years.

HDPE pipes have been utilised in a range of applictions, from culverts to sewerage, manholes to below-ground water storage. Pipe sizes range from DN800 to DN3600, making implementation only as limited as your ingenuity.

Here’s how we can help you reach your mark.

2.0 pipe properties

2.1 Sizes and Weights

Polynex pipes are manufactured in multiple sizes to suit any application.

TABLE 1. Pipe Properties						
Pipe Diameter	ø500		ø600		ø800	
Stiffness	4kN/m²	8kN/m²	4kN/m²	8kN/m²	4kN/m²	8kN/m²
Inner/Outer Diameter (mm)	500/550	500/560	600/660	600/678	800/888	800/900
Dimensions of Profile	25 x 33	31 x 41	31 x 41	39 x 49	44 x 57	50 x 67
Wall Thickness of Profile	3.3	3.5	3.8	4	4.8	5.5
Weight (kg/m) (± 5%)	16.5	18	23	26	43	49
	ø1000		ø1200		ø1400	
Stiffness	4kN/m²	8kN/m²	4kN/m²	8kN/m²	4kN/m²	8kN/m²
Inner/Outer Diameter (mm)	1000/1100	1000/1124	1200/1324	1200/1350	1400/1550	1400/1590
Dimensions of Profile	50 x 67	62 x 67	62 x 67	75 x 81	75 x 81	95 x 104
Wall Thickness of Profile	6	6.8	6.8	7.8	7	8.2
Weight (kg/m) (± 5%)	66	83	99	116	123	147

Pipe Diameter	ø1600		ø1800		ø2000	
Stiffness	4kN/m²	8kN/m²	4kN/m²	8kN/m²	4kN/m²	8kN/m²
Inner/Outer Diameter (mm)	1600/1770	1600/1810	1800/1990	1800/2030	2000/2210	2000/2250
Dimensions of Profile	85 x 92	105 x 118	95 x 104	115 x 130	105 x 118	125 x 142
Wall Thickness of Profile	8	9.5	8.5	11	10	13
Weight (kg/m) (± 5%)	160	190	194	244	245	314
	ø2200		ø2400		ø2600	
Stiffness	4kN/m²	8kN/m²	4kN/m²	8kN/m²	4kN/m²	8kN/m²
Inner/Outer Diameter (mm)	2200/2430	2200/2470	2400/2650	2400/2690	2600/2870	2600/2930
Dimensions of Profile	115 x 130	135 x 154	125 x 142	145 x 165	135 x 154	165 x 185
Wall Thickness of Profile	11	15	13	17	15	18
Weight (kg/m) (± 5%)	295	392	373	478	457	570

Pipe Diameter	ø3000	
Stiffness	4kN/m²	8kN/m²
Inner/Outer Diameter (mm)	3000/3330	3000/3370
Dimensions of Profile	165 x 185	185 x 210
Wall Thickness of Profile	18	22
Weight (kg/m) (± 5%)	645	778

3.0 product material

Polynex realises that when it comes to large scale, long-term investment projects, details are at the core of success.

Used for Polynex pipe manufacture is Centrene ® HDF193B high-densitypolyethylene, a black, high molecular weight bimodal PE100 HDPE. It is a high performance resin for use in pressure pipes and non-pressure pipes, where service life to 100 years is required. HDF193B offers a balance of excellent processing characteristics along with outstanding toughness, chemical resistance and slow-crack growth resistance. HDF193B also demonstrates tremendous resistance to the effects of ultra-violet light exposure in outdoor applications, due to well dispersed carbon black.

3.1 Application

Centrene ® HDF193B is suitable for extrusion into a full range of pipes, where high density, PE 100 type resins are required. In particular, a broad processing window and good sag resistance enables the extrusion of larger bore, thick wall pipe. HDF193B is suitable for use in the transport of a wide range of fluids for industrial, rural and mining applications, including potable water. Suitability for use in any application should be determined by appropriate performance testing.

3.2 Specifications

HDF193B complies to AS/NZS 4131 2010 for PE100 type compounds. It is intended to be used in pipes conforming to AS/NZS 4130.

TABLE 2. Composition Information

Name	CAS	Proportion
Polyethylene	9002-88-4	96-98%
Carbon Black	1333-86-4	2-3%
Proprietary Additives		0-1%

4.0 physical properties

4.1 Scale and Sediment

Sediment and scale do not readily adhere to or bond with HDPE due to the inert nature of polyethylene. This prevents the occurrence of build-up, resulting in maintained long-term flow characteristics.

TABLE 3. Base Polymer Properties

Property	Test Method	Value[1]	Units
Melt Index at 190°C, 5.0kg	ASTM D1238	0.3	g/10min
Melt Index at 190°C, 21.6kg	ASTM D1238	8.9	g/10min
Density	Qenos method	0.956	g/cm^3
Tensile Strength at Break[2]	ASTM D638	33	MPa
Tensile Strength at Yield[2]	ASTM D638	26	MPa
Elongation at Break[2]	ASTM D638	760	%
Elastic Modulus[2]	ASTM D638	1300	MPa
Flexural Modulus[3] (1% secant)	ASTM D790	1150	MPa
Durometer Hardness	ASTM D2240	63	Shore D

1. Typical values - not to be construed as specifications.
2. At 50mm/min cross head speed, type 4 dumbbell and 1.9mm thickness.
3. At 12.7 mm/min cross head speed.

5.0 pipe durability

Durability is measured by a number of properties, such as the ability to resist abrasion, corrosion, degradation and other service conditions.

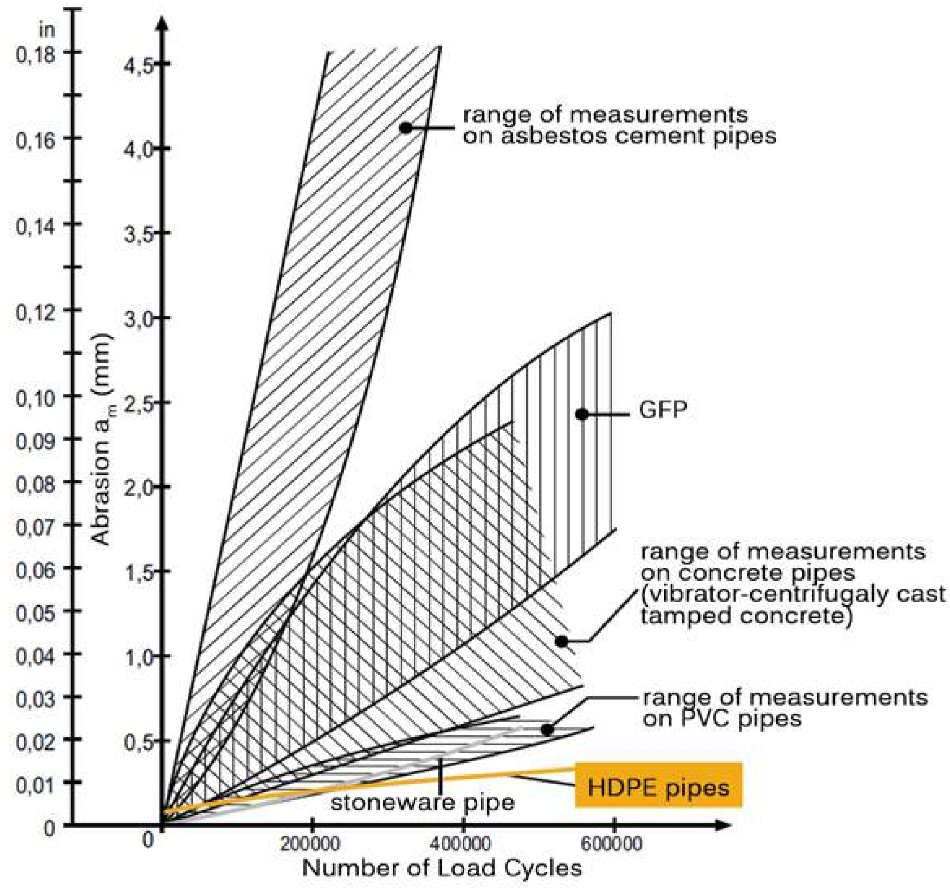
The longevity of pipe infrastructure is dependant on the physical and chemical characteristics of the pipe, and on the environment to which it is exposed. Unlike concrete, HDPE will not spall, crumble or crack. Protective coatings, linings, pavements and other palliative measures, which being superficially acceptable as a short-term solution, are at risk of delamination, erosion and cracking.

5.1 Abrasion

Many abrasion testing methods have been developed, the most commonly acknowledged being the Darmstadt abrasion test. A test specimen one (1) meter long is tilted back and forth with a frequency of 21.6 cycles/minute. The specimen contains an abrasive mixture of % by volume quartz sand (particle size 0-30mm) in water, resulting in a flow rate of 0.36m/s.

As is seen in Figure 1, HDPE pipe demonstrated an average abrasion of 0.3mm after

FIGURE 1. Average Abbrasion Values for Pipes Made of Various Materials



On the basis of this test, HDPE pipe out-performed cement and GFP pipe in resistance to abrasion.

5.2 Corrosion

Corrosion-abrasion damage arises where corrosive chemicals carried by the water expose the inverts of storm drain pipelines.

Hostile environments result in the development of corrosion products in materials such as unprotected concrete and steel. The corroded surface is stripped, revealing a new surface which eventually develops new corrosion products.

In concrete pipes, damage may be so significant that loss of wall thickness exposes steel reinforcement rods. This is considered to be a failure of the pipe.

1. Kirschmer, O., "Problems of Abrasion in Pipes", Steinzeugin Formationen, 1966, No. 1, pp 3-13.

pipe durability (cont)

5.3 Corrosion and Abrasion

A number of erosion studies have been performed by Dr. Lester Gabriel at the California State University[2]. Sections of 300mm diameter pipe were charged with a slurry containing crushed quartz aggregate and water. The ends of the pipe were capped, and the pipe was rocked and rotated. The average velocity of this abrasive slurry was approximately 0.9m/s.

Aggregate and pH were monitored and adjusted to keep them as close as possible to the original conditions during the test. The loss of wall thickness was them measured to determine the effect of the slurry.

The PE pipe demonstrated to perforation of the inner core pipe, and the remaining wall thickness was between 31% and 40%. The same test performed on concrete pipes resulted in the exposure of the steel reinforcement rods.

Mine drainage applications and concentrated acid rain areas present a significant problem for concrete pipes. Under moderate acidic conditions, the wear rate almost doubled for the concrete pipe. The twin wall corrugated polyethylene pipe wear rate increased by approximately 15%, with the polyethylene pipe retaining some 30% of the central core pipe at the completion of the test.

TABLE 4. Influence of the Acidity of the Water on Wear Rates

Pipe	Water acidity	Minimum inner wall thickness (mm)	Loss of wall (mm)	Comments
PE twin wall	Neutral (pH 7.0)	0.9	0.53	No liner perforation 40% left
Concrete	Neutral (pH 7.0)	54.6	20.0	Failure steel reinforcement exposed
PE twin wall	Acidic (pH 4.0)	0.9	0.61	No liner perforation 30% left
Concrete	Acidic (pH 4.0)	54.6	30.5	Significantly greater loss - failure

5.4 Durability and Ultraviolet Radiation

Photo-oxidation may occur through incident wavelengths within the ultraviolet (UV) range. UV radiation and oxygen degrade plastics, altering the physical and mechanical properties of the material. UV stabilisers inhibit both the physical and chemical processes of UV-induced degradation. The most widely accepted high-performance UV stabliser is carbon black.

Polynex HDPE pipes are manufactured using Centrene ® HDF193B high density polyethylene. HDF193B demonstrates extremely high resistance to the effects of ultraviolet light exposure in outdoor applications due to well dispersed carbon black.

The carbon black used in Polynex pipe manufacture conform to AS/NZS 4130 and intended to be used in pipes conforming to AS/NZS 4131.

2.Gabriel, Lester. "Abrasion Resistance of Polyethylene and Other Pipes."California State University, Sacramento, California. 1990.

6.0 flow calculation

TABLE 5. Colebrook-White Formula	
$u = \sqrt{2gdl} \cdot \log \frac{k}{3,7d} + \frac{2,51v}{d\sqrt{2gdl}}$	v = kinematic viscosity (m/s²)
	d = internal diameter
	g = acceleration due to gravity(9.81m/s²)
	u = velocity (m/s)
	l = hydraulic gradient (%$_o$)
	k = roughness coefficient (m) Polynex pipe

6.1 Hydraulic Design

HDPE has a low friction coeficient, resuting in a low friction coefficient for Polynex pipe. The appropriate value for PE pipes is k = 0.003 x 10^{-3} m = 0.003 mm.

6.2 Friction Assessment

The difference in friction between concrete and HDPE is significant. The Manning coefficient of roughness of trowelled concrete is 0.013. HDPE is known for friction coefficients of 0.0095 of better.

7.0 pipe deflection

A rigid pipe is vulnerable to stress and cracking due to longitudinal bending. A flexible pipe must deflect when subjected to external loads.

External loads acting on the pipe are not symmetrical. Vertical loading is greater than lateral soil pressure, due to factors such as superimposed live loads and vertical soil pressure.

The load which can be withstood by a pipe is largely dependant on the nature of the backfill material, natural soil characterisitcs, relative height of the cover and the stiffness of the pipe. Marston load theory states that the amount of load taken by a pipe is affected by the relative movement between the backfill and natural soil as both the pipe and the backfill settle. A rigid pipe attracts load, thus the vertical force acting on the pipe may be expressed as is seen in Table 6.

TABLE 6. Pipe Deflection (5) for Good Compaction (>94% modified Proctor) for 6m Soil Depth

Soil Type	Light			Heavy		
	Short Term Average	Short Term Maximum	Maximum Long Term	Short Term Average	Short Term Maximum	Maximum Long Term
Poorly Graded Gravel	1.6	2.4	3.2	1.4	2.1	2.8
Well Graded Gravel/Sand	1.8	2.7	3.6	1.6	2.4	3.2
Mixed Granular Soils with Low Fines	2.2	3.3	4.4	1.9	2.9	3.8
Mixed Granular Soils with High Fines	2.9	4.4	5.8	2.4	3.6	4.8
Fine Grained Cohesive Soils	3.2	4.8	6.4	2.6	3.9	5.2

The above soil types have been selected based upon the recommendations outlined in British Standard BS 5930 and German Standard 18196.

pipe deflection (cont)

7.1 Flexibility in Pipes

A pipe is deemed to be 'flexible' if a pipe is more compressible than the external soil column without any structural damage which would otherwise be caused as a resut of its vertical deflection.

This allows for the central prism to settle more in relation to the external prisms, and the load on the pipe is less than the load of the central prism. This is due to the direction in which the shearing stresses develop, resulting from the diferential settlement of the central prism in relation to the external prisms.

TABLE 7. DN800 Polynex Pipe			
1000mm from Entrance			
Load (t)	Absolute Dimension (mm)	Deflection (mm)	Deflection Rate (%)
0.0	880	0	0.0
2.3	865	15	1.7
3.9	845	35	4.0
5.1	815	65	7.4
5.9	810	70	8.0
7.3	775	105	11.9

TABLE 8. DN1200 Polynex Pipe			
1000mm from Entrance			
Load (t)	Absolute Dimension (mm)	Deflection (mm)	Deflection Rate (%)
0.0	1335	0	0.0
1.5	1325	10	0.7
3.3	1310	25	1.9
5.3	1285	50	3.7
5.8	1275	60	4.5
8.3	1245	90	6.7
9.9	1205	130	9.7
10.7	1175	160	12.0

TABLE 9. DN800 Polynex Pipe			
3000mm from Entrance			
Load (t)	Absolute Dimension (mm)	Deflection (mm)	Deflection Rate (%)
0	880	0	0.0
1.8	865	15	1.7
3.6	845	35	4.0
5.2	825	55	6.3
6.9	795	85	9.7
7.6	775	105	11.9

TABLE 10. DN3000 Polynex Pipe			
Test Direct at the Edge			
Load (t)	Absolute Dimension (mm)	Deflection (mm)	Deflection Rate (%)
0.0	3325	0	0.0
3.0	3305	20	0.6
5.5	3290	35	1.1
7.5	3275	50	1.5
9.3	3255	70	2.1
12.1	3210	115	3.5

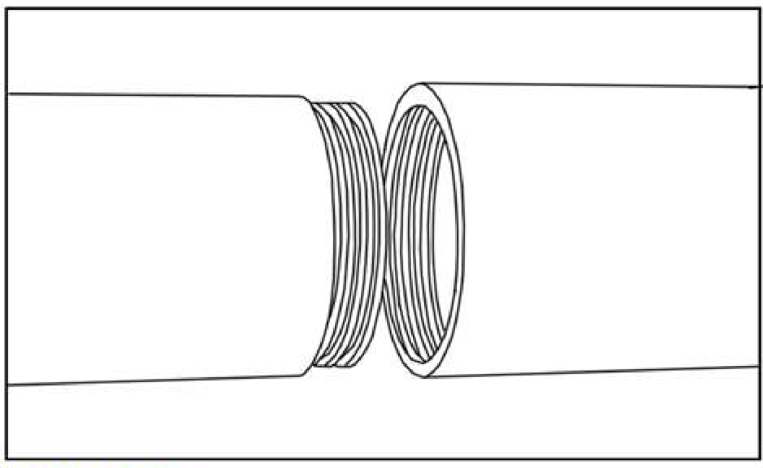
TABLE 11. DN1200 Polynex Pipe			
3000mm from Entrance			
Load (t)	Absolute Dimension (mm)	Deflection (mm)	Deflection Rate (%)
0	1335	0	0.0
2.5	1320	15	1.1
4.3	1290	45	3.4
5.6	1280	55	4.1
7.4	1260	75	5.6
9	1240	95	7.1
10.1	1225	110	8.2
11	1205	130	9.7
12.4	1170	165	12.4

8.0 section properties

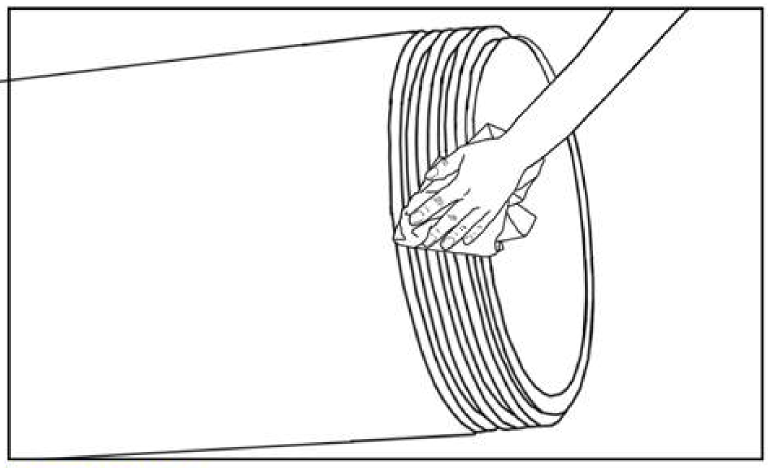
TABLE 12. Polynex Pipe Section Properties								
Section 4kN/m^2								
Nominal Diameter (mm)	w (mm)	d (mm)	t (mm)	$A_{section}$ (mm^2)	$I_{section}$ (mm^4)	A_{pipe} (mm^2/m)	I_{pipe} (mm^4/m)	Ring Stiffness (N/mm^2)
500	25	33	3.3	339	2.93E+04	6.94E+03	3.75E+08	2592
600	31	41	3.8	489	6.61E+04	9.28E+03	7.50E+08	2985
800	44	57	4.8	877	2.44E+05	1.49E+04	2.27E+09	3770
1000	50	67	6	1260	4.46E+05	2.24E+04	5.46E+09	4712
1200	62	67	6.8	1569	8.26E+05	2.99E+04	1.07E+10	5341
1400	71	81	7	1932	1.38E+06	3.58E+04	1.75E+10	5498
1600	85	92	8	2576	2.63E+06	4.59E+04	30.1E+10	6283
1800	95	104	8.5	3094	3.99E+06	5.45E+04	4.54E+10	6676
2000	105	118	10	4060	6.37E+06	7.01E+04	7.33E+10	7854
2200	115	130	11	4906	9.24E+06	8.40E+04	1.07E+11	8639
2400	125	142	13	6266	1.37E+07	1.07E+05	1.64E+11	10210
2600	135	154	15	7770	1.96E+07	1.32E+05	2.41E+11	11781
2800	145	165	17	9384	2.70E+07	1.60E+05	3.41E+11	13352
3000	165	185	18	11304	4.26E+07	1.81E+05	4.48E+11	14137

TABLE 13. Polynex Pipe Section Properties								
Section 8kN/m^2								
Nominal Diameter (mm)	w (mm)	d (mm)	t (mm)	$A_{section}$ (mm^2)	$I_{section}$ (mm^4)	A_{pipe} (mm^2/m)	I_{pipe} (mm^4/m)	Ring Stiffness (N/mm^2)
500	33	41	3.5	469	7.30E+04	7.30E+03	4.16E+08	2749
600	39	49	4	640	1.40E+05	9.71E+03	8.20E+08	3142
800	50	67	5.5	1166	4.21E+05	1.67E+04	2.65E+09	4320
1000	62	67	6.8	1569	8.26E+05	2.50E+04	6.40E+09	5341
1200	75	81	7.8	2190	1.71E+06	3.38E+04	1.27E+10	6126
1400	95	104	8.2	2995	3.89E+06	4.12E+04	2.15E+10	6440
1600	105	118	9.5	3876	6.14E+06	5.37E+04	3.70E+10	7461
1800	115	130	11	4906	9.24E+06	6.89E+04	6.07E+10	8639
2000	125	142	13	6266	1.37E+07	8.92E+04	9.80E+10	10210
2200	135	154	15	7770	1.96E+07	1.12E+05	1.50E+11	11781
2400	145	165	17	9384	2.70E+07	1.37E+05	2.20E+11	13352
2600	165	185	18	11304	4.26E+07	1.57E+05	2.99E+11	14137
2800	170	194	20	12960	5.12E+07	1.87E+05	4.12E+11	15708
3000	185	210	22	15444	7.20E+07	2.19E+05	5.58E+11	17279

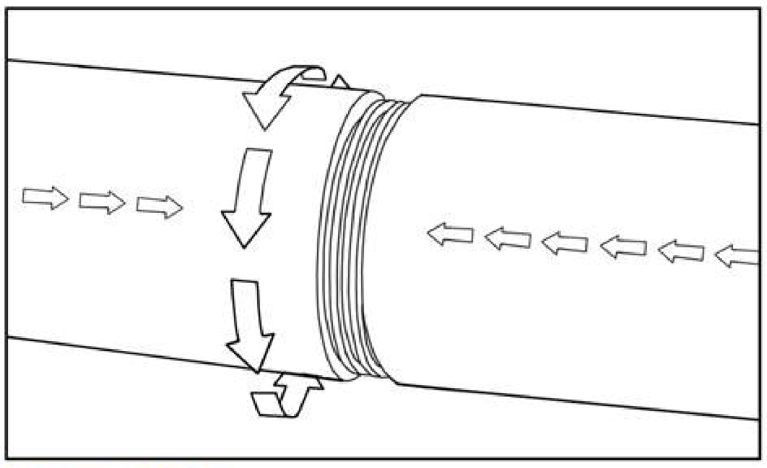
9.0 threaded jointing



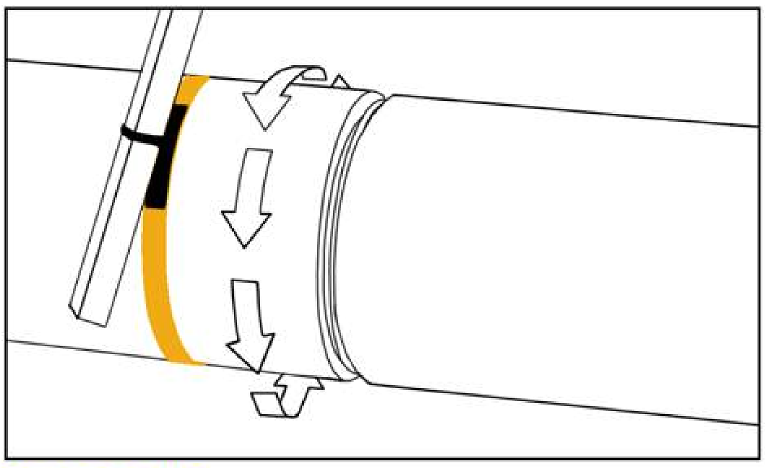
STEP ONE.
The pipes must be aligned vertically and horizontally.



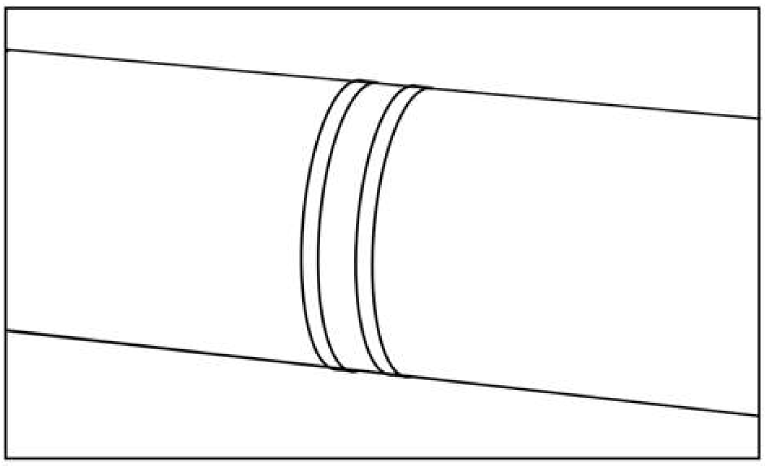
STEP TWO.
The inner and outer threads must be clean and free from moisture, grime and debris.



STEP THREE.
The male pipe end is threaded into the female pipe end.



STEP FOUR.
A lever or rope-sling may be use to aid in the rotation and tighten the joint.



STEP FIVE.
This joint is soil-tight. For water-tightness, an extrusion weld may be used. The weld may be performed internally, externally, or both. An external shrink or rubber sleeve may be used to waterproof the joint.