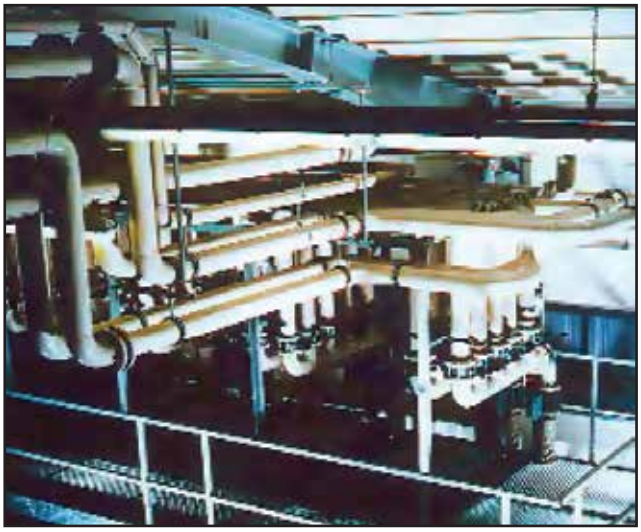
PP: Polypropylene

Polypropylene (PP) is a partially-crystalline thermoplastic from the polyolefin group of materials, and it is characterized by its low density when compared to other thermoplastics. A unique combination of properties including mechanical strength, chemical resistance and thermal stability all combine to make polypropylene one of the most popular piping systems materials.
In accordance with DIN 8078, there are three different types of polypropylene that are referenced for use as piping materials:

Type 1: PP-H (Homopolymer)
Type 2: PP-B (Block -copolymer)
Type 3: PP-R (Random copolymer)

The pipes, sheets and semi-finished products supplied by IPS are manufactured from nucleoid PP-H 100 (Beta 13 -PP), whilst fittings are produced from PP-R (polypropylene random copolymer).

Because of its non-polar nature, polypropylene generally exhibits a good resistance against a variety of chemicals, such as salts, acids, and alkalis. Good chemical resistance is also achieved against contact with solvents, such as alcohols, esters and ketenes'. Consequently, solvent cement welding of polypropylene pipes and fittings is not possible.
In contrast, polypropyler of welding techniques FC High quality, reliable join heating element socket element butt fusion wail (IR) butt welding, and el techniques. Additionally, be joined using flanges, mechanical couplings.
Le is ideally suited to a variety) r pressure piping applications. It can be achieved using fusion jointing, heating ding, non-contact Infra-Red ectrofusion welding polypropylene systems can threaded connections and Polypropylene piping systems are available from IPS in metric dimensions according to DIN 8077/8078 and DIN 16962.



General properties of polypropylene (standard types)

In comparison to other thermoplastics such as PVC-U, polypropylene exhibits thermal stability up to 100°C (short-term 120°C for drainage systems). Polypropylene also shows good impact strength in comparison to PVC-U, with impact strength improving along with increasing temperature.

Polypropylene is physiologically non-toxic (in accordance with ONORM B5014, Part 1, FDA, BGA, and KTW guidelines) making it ideally suited for a piping material in contact with potable water.

Some important advantages of polypropylene are:

- Low specific weight of 0.91g/cm'
- High long term creep resistance
- Excellent chemical resistance
- High resistance to thermal ageing
- Outstanding welding characteristics
- Excellent abrasion resistance
- Smooth internal surfaces

PP: Polypropylene

Materials

A process that involves copolymerizing with ethylene creates the special properties of PP-B and PP-R. This leads to higher impact strength in comparison to PP-H and improved processing characteristics (for example less danger of shrinkage cavitations occurring during the injection molding process).

The demands of industry have also created the need for special versions of polypropylene piping systems to be produced. For example, electro-conductive polypropylene has been developed to dissipate the static charges can result from the flow of fluids or dust in a piping system.

With the supplement of additives, modification of the general properties of polypropylene takes place, however because of these alterations, changes to the mechanical and chemical resistance properties occur when compared to the original material. When considering a special grade of polypropylene, it is therefore necessary to clarify the suitability of the intended application with our technical department.

Some of the special polypropylene piping systems is as follows:

PP Pure PP-R (High purity grade Polypropylene random copolymer) Selected and fully traceable raw materials are manufactured under strictly controlled conditions. This material is ideal for less critical ultra-pure water applications.

Polypure PP-R: Natural (Polypropylene random copolymer, natural coloured) As natural PP-R contains no colour

PP-R: Black (Polypropylene random copolymer, black coloured) This material provides the UV resistance that is not available with standard PP grey.

PPs (Polypropylene homo-Polymer, flame-retardant)
Due to its higher stiffness, is ideally suited for ventilation pipes. The flame-retardant properties enhance the material of this application. Note that this material may not be used outdoors, as it is not UV stabilized.

PPs-el (Polypropylener random copolymer flame-retardant, electro-conductive)
This material combines the benefits of flame retardant properties and electro-conductivity. It can be used for reasons in the transport of combustible material

Properties of Polypropylene (standard types - average values)			
	PP-H	PP-R	
Property	Vlaue	Vlaue	Unit
Density	0.91	0.91	g / cm^3
Tensile Strength	30	25	MPa
Elongation at Break	>300	>300	%
Notched Impact Strength at 23°C	50	25	kJ/ m^2
Notched Impact Strength at -30°C	5	2	kJ/ m^2
Modulus of Elasticity (Young's Modulus)	1300	900	MPa
Coefficient of liner Expansion	0.16	0.16	mm/m °C
Maximum Operating Temperature	90	90	°C
Minimum Operating Temperature	-10	-10	°C
Crystalline Melting Temperature	160-165	150-154	°C
Melt Flow Index	0.50	0.50	g/10min
Surface Resistance	$>10^{13}$	$>10^{13}$	Ω
Thermal Conductivity	0.22	0.24	w / m · K
Flammability	HB	HB	UL94
Colour	7023 Beige Grey	7023 Beige Grey	RAL

PP: Polypropylene

Chemical resistance

The chemical resistance of polypropylene is considered excellent, due to its non-polar nature. It is resistant to dilute (aqueous) solutions of salts, acids and alkalis and to a large number of organic solvents. Polypropylene is resistant to concentrated hydrochloric acid and hydrofluoric acid, however above certain concentration levels diffusion can occur. This does not damage the material itself but it can cause secondary damage to surrounding steel constructions. In this type of application, double containment piping systems have been found ideally suited. For further information on the suitability of polypropylene for your application, consult the chemical resistance tables or our technical department.

Note: PP-R and Copper: Direct contact between PP-R and copper, especially at higher temperatures, can lead to deterioration of the physical properties of PP-R. Heat ageing is faster due to the accelerated thermal oxidization.

Weathering resistance

Piping systems in beige grey polypropylene are not UV stabilised, and therefore they should be suitably protected against degradation when used outdoors - especially where there are high UV levels. Protection against direct solar radiation can be achieved by the application of a UV absorbent coating such as AGRU Coat, or by adding a layer of insulation. It is also possible to compensate for the surface damage that may arise by increasing the wall thickness of the piping system. In such cases, the additional wall thickness should be not less than 2mm. As polypropylene does not contain light stable colour pigments, it may experience a change of colour (fading) because of long-term weathering.

Physiological characteristics

Polypropylene piping systems from IPS are physiologically non-toxic (in accordance with ONORM B5014, Part 1, DA, BGA, and KTW guidelines) making them ideally suited as a piping material in contact with potable water.

Characteristics of PP-Pure material

PP-Pure piping is manufactured from a high purity grade of random copolymer polpropylene (PP-R} in beige grey colour. The manufacturing process is carried out under controlled conditions, and the finished product is rinsed with de-ionised water before protective packaging. PP-Pure is especially suitable for applications in the chemical and in the semiconductor industry for ultra-pure water systems, where it may be substituted for PVDF in less critical areas.

The performance characteristics of PP-Pure are broadly similar to those of standard grades of polypropylene, therefore it is possible to reference the application and installation guidelines contained in this document. However to achieve the highest levels of performance it is recommended that welding be carried out using the Infra-Red (IR) non-contact butt fusion welding method. This method consistently produces the smallest weld profile and the weld details are computer recorded, enabling complete traceability from raw material to installed system.

Characteristics of Polypure material

Polypure is manufactured from a standard grade of random copolymer polpropylene (PP-R} without heat stabilizers and therefore it is natural in colour. Polypure is therefore suitable for applications handling high purity liquids.

Polypure may be joined using any of the standard polypropylene fusion welding methods. However for best results it is recommended to use Infra-Red (IR) non-contact butt fusion welding method.

The performance of Polypure against chemicals is broadly similar to standard grades of polypropylene. However it is recommended that it is installed for use at temperatures only up to 50°C. At higher temperatures a discoloration of the material appears although this has no effect on the mechanical, thermal and/or electrical properties.

PP: Polypropylene

Pressure ratings for polypropylene pipe, fittings and valves

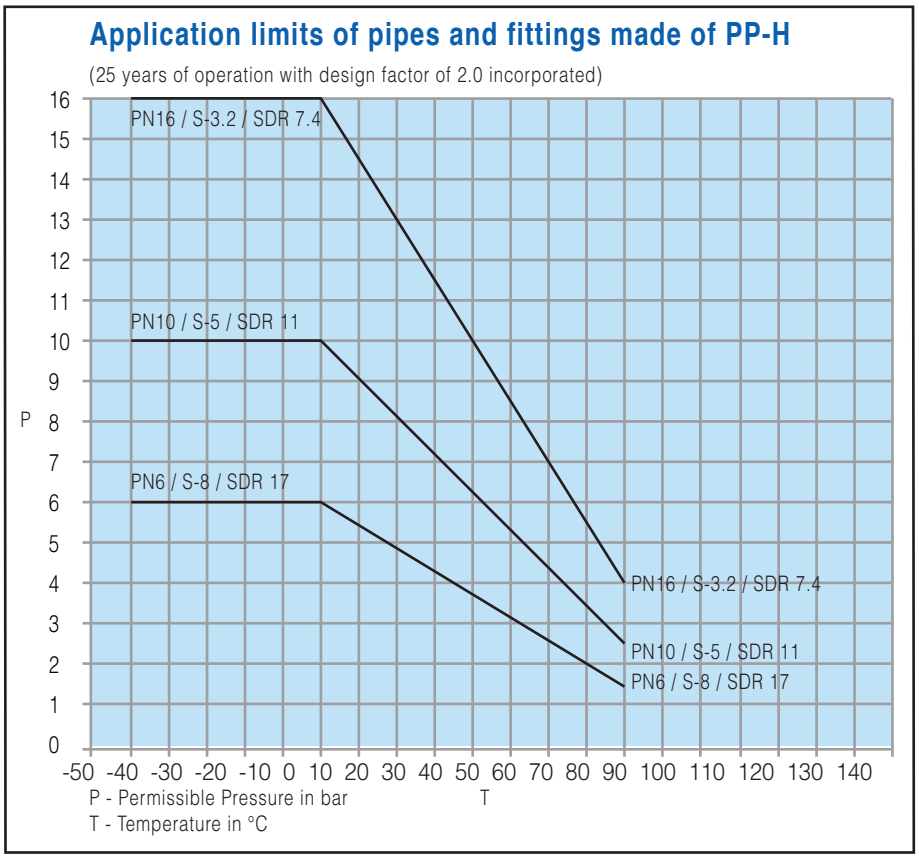
For guidance, the following table gives an indication of the available pressure ratings for polypropylene pipes and fittings. Valves are available in a variety of types, including ball, diaphragm and butterfly. The pressure rating is dependant upon the size and type and is typically within the range 6 bar (87 psi) to 10 bar (145 psi). The pressure rating of individual items should always be verified with our technical department before installation.

Product	Size	Pressure Rating at 20°C
PP-H Pipes S - 20 / SDR41	63mm - 1400mm	1.5 bar
PP-H Pipes S - 16 / SDR33	50mm - 1200mm	3.2 bar
PP-H Pipes S - 12.5 / SDR26	40mm - 1000mm	4.0 bar
PP-H Pipes S - 8.3 / SDR17.6	20mm - 710mm	6.0 bar
PP-H Pipes S - 5 / SDR11	16mm - 500mm	10.0 bar
PP-H Pipes S - 3.2 / SDR7.4	12mm - 160mm	16.0 bar
PP-R Pipes S - 5 / SDR11	20mm - 315mm	10.0 bar
PP-R Socket Fusion Fittings	20mm - 110mm	10.0 bar
PP-R Butt Fusion Fittings S - 16 / SDR33	110mm - 500mm	3.2 bar
PP-R Butt Fusion Fittings S - 8.3 / SDR17.6	50mm - 500mm	6.0 bar
PP-R Butt Fusion Fittings S - 5 / SDR11	20mm - 500mm	10.0 bar
PP-H Electro-Fusion Fittings	20mm - 225mm	10.0 bar
PP-R Ball Valves	16mm - 75mm	10.0 bar
PP-R Ball Valves	90mm - 110mm	6.0 bar
PP-R Ball Diaphragm Valves	20mm - 110mm	10.0 bar
PP-R Ball Butterfly Valves	90mm - 140mm	10.0 bar
PP-R Ball Butterfly Valves	160mm - 225mm	6.0 bar

PP: Polypropylene

Pressure ratings for polypropylene pipe, fittings and valves

Pressure ratings for thermoplastic pipes are determined in a water environment at a temperature of 20°C. As the temperature of the media (and/or the piping environment) increases, the thermoplastic material becomes more ductile, causing a decrease in the tensile strength. Because of this, the pressure rating of the system must be reduced as the temperature rises to allow for safe operation. The application limits for PP piping material are shown in the following diagram:



PP-H Polypropylene pipe avalability

Metric Sizes DIN 8077 / 8078

Size	Series SDR Working Pressure	Ventilation	S-20 SDR41 PN2.5	S-16 SDR33 PN3.2	S-12.5 SDR26 PN4	S-8.3 SDR17.6 PN6	S-5 SDR11 PN10	S-3.2 SDR7.4 PN16
10	O.D (mm) Wall (mm) Weight/m (kg)							10 1.8 0.05
12	O.D (mm) Wall (mm) Weight/m (kg)							12 1.8 0.06
16	O.D (mm) Wall (mm) Weight/m (kg)						16 1.8 0.08	16 2.2 0.09
20	O.D (mm) Wall (mm) Weight/m (kg)					20 1.8 0.10	20 2.5 0.14	20 2.8 0.15
25	O.D (mm) Wall (mm) Weight/m (kg)					25 1.8 1.13	25 2.7 0.19	25 3.5 0.23
32	O.D (mm) Wall (mm) Weight/m (kg)					32 1.9 0.18	32 2.9 0.26	32 4.4 0.37
40	O.D (mm) Wall (mm) Weight/m (kg)				40 1.8 0.22	40 2.3 0.27	40 3.7 0.41	40 5.5 0.58
50	O.D (mm) Wall (mm) Weight/m (kg)			50 1.8 0.27	50 2.0 0.30	50 2.9 0.42	50 4.6 0.64	50 6.9 0.90
63	O.D (mm) Wall (mm) Weight/m (kg)		63 18.0 0.35	63 2.0 0.38	63 2.5 0.47	63 3.6 0.66	63 5.8 1.01	63 8.6 1.41
75	O.D (mm) Wall (mm) Weight/m (kg)		75 1.9 0.44	75 2.3 0.52	75 2.9 0.65	75 4.3 0.93	75 6.8 1.40	75 10.3 2.00
90	O.D (mm) Wall (mm) Weight/m (kg)		90 2.2 0.60	90 2.8 0.76	90 3.5 0.94	90 5.1 1.32	90 8.2 2.02	90 12.3 2.86
110	O.D (mm) Wall (mm) Weight/m (kg)		110 2.7 0.90	110 3.4 1.11	110 4.2 1.36	110 6.3 1.98	110 10.0 3.01	110 15.1 4.29
125	O.D (mm) Wall (mm) Weight/m (kg)		125 3.1 1.17	125 3.9 1.45	125 4.8 1.76	125 7.1 2.54	125 11.4 3.89	125 17.1 5.52
140	O.D (mm) Wall (mm) Weight/m (kg)		140 3.5 1.48	140 4.3 1.78	140 5.4 2.21	140 8.0 3.20	140 12.7 4.87	140 19.2 6.93
160	O.D (mm) Wall (mm) Weight/m (kg)		160 4.0 1.91	160 4.9 2.32	160 6.2 2.89	160 9.1 4.15	160 14.6 6.38	160 21.9 9.04
180	O.D (mm) Wall (mm) Weight/m (kg)		180 4.4 2.36	180 5.5 2.94	180 6.9 3.63	180 10.2 5.22	180 16.4 6.05	180 24.6 11.40
200	O.D (mm) Wall (mm) Weight/m (kg)		200 4.9 2.93	200 6.2 3.65	200 7.7 4.50	200 11.4 6.47	200 18.2 9.92	200 27.4 14.10
225	O.D (mm) Wall (mm) Weight/m (kg)		225 5.5 3.70	225 6.9 4.57	225 8.6 5.65	225 12.8 8.19	225 20.5 12.60	225 30.8 17.90
250	O.D (mm) Wall (mm) Weight/m (kg)		250 6.2 4.59	250 7.7 5.67	250 9.6 6.99	250 14.2 10.10	250 22.7 15.50	
280	O.D (mm) Wall (mm) Weight/m (kg)		280 6.9 5.73	280 8.6 7.09	280 10.7 8.72	280 15.9 12.60	280 25.4 19.40	
315	O.D (mm) Wall (mm) Weight/m (kg)		315 7.7 7.19	315 9.7 8.97	315 12.1 11.10	315 17.9 16.00	315 28.6 24.60	
355	O.D (mm) Wall (mm) Weight/m (kg)		355 8.7 9.14	355 10.9 11.30	355 13.6 14.00	355 20.1 20.20	355 32.2 31.10	
400	O.D (mm) Wall (mm) Weight/m (kg)	400 6.0 7.20	400 9.8 11.60	400 12.3 14.40	400 15.3 17.70	400 22.7 25.70	400 36.3 39.50	
450	O.D (mm) Wall (mm) Weight/m (kg)	450 6.0 8.12	450 11.0 15.60	450 13.8 18.20	450 17.2 22.40	450 25.50 32.50	450 40.9 50.10	
500	O.D (mm) Wall (mm) Weight/m (kg)	500 8.0 11.90	500 12.3 18.10	500 15.3 22.30	500 19.1 27.60	500 28.3 40.10	500 45.4 61.70	
560	O.D (mm) Wall (mm) Weight/m (kg)	560 10.0 16.60	560 13.7 22.60	560 17.2 28.10	560 21.4 34.60	560 31.7 50.30		
630	O.D (mm) Wall (mm) Weight/m (kg)	630 10.0 18.80	630 15.4 28.50	630 19.3 35.50	630 24.1 43.90	630 35.7 63.70		
710	O.D (mm) Wall (mm) Weight/m (kg)	710 12.0 25.30	710 17.4 36.30	710 21.8 45.20	710 27.2 55.80	710 40.2 80.70		
800	O.D (mm) Wall (mm) Weight/m (kg)	800 12.0 28.60	800 19.6 46.10	800 24.5 57.20	800 30.6 70.80			
900	O.D (mm) Wall (mm) Weight/m (kg)	900 15.0 40.10	900 22.0 58.10	900 27.6 72.50	900 34.4 89.40			
1000	O.D (mm) Wall (mm) Weight/m (kg)	1000 15.0 44.60	1000 24.5 72.00	1000 30.6 89.20	1000 38.2 110.00			
1200	O.D (mm) Wall (mm) Weight/m (kg)	1200 18.0 64.10	1200 29.4 103.00	1200 36.7 128.00				
1400	O.D (mm) Wall (mm) Weight/m (kg)	1400 21.0 83.20	1400 34.3 141.00					

Polypropylene pipe avalability - special grades

Metric Sizes DIN 8077 / 8078		PP-R Copolymer	PP Pure	Polypure
Size	Series SDR Working Pressure	S-5 SDR 11 PN10	S-5 SDR 11 PN10	S-5 SDR 11 PN10
20	O.D (mm) Wall (mm) Weight/m (kg)	20 2.5 0.15	20 2.5 0.15	20 2.5 0.15
25	O.D (mm) Wall (mm) Weight/m (kg)	25 2.7 0.19	25 2.7 0.19	25 2.7 0.19
32	O.D (mm) Wall (mm) Weight/m (kg)	32 2.9 0.26	32 2.9 0.26	32 2.9 0.26
40	O.D (mm) Wall (mm) Weight/m (kg)	40 3.7 0.41	40 3.7 0.41	40 3.7 0.41
50	O.D (mm) Wall (mm) Weight/m (kg)	50 4.6 0.64	50 4.6 0.64	50 4.6 0.64
63	O.D (mm) Wall (mm) Weight/m (kg)	63 5.8 1.01	63 5.8 1.01	63 5.8 1.01
75	O.D (mm) Wall (mm) Weight/m (kg)	75 6.8 1.40	75 6.8 1.40	
90	O.D (mm) Wall (mm) Weight/m (kg)	90 8.2 2.02	90 8.2 2.02	90 8.2 2.02
110	O.D (mm) Wall (mm) Weight/m (kg)	110 10.0 3.01	110 10.0 3.01	110 10.0 3.09
125	O.D (mm) Wall (mm) Weight/m (kg)	125 11.4 3.89	125 11.4 3.89	
140	O.D (mm) Wall (mm) Weight/m (kg)	140 12.7 4.87	140 12.7 4.87	
160	O.D (mm) Wall (mm) Weight/m (kg)	160 14.6 6.38	160 14.6 6.38	
180	O.D (mm) Wall (mm) Weight/m (kg)	180 16.4 8.04	180 16.4 8.04	
200	O.D (mm) Wall (mm) Weight/m (kg)	200 18.2 9.92	200 18.2 9.92	
225	O.D (mm) Wall (mm) Weight/m (kg)	225 20.5 12.60	225 20.5 12.60	
250	O.D (mm) Wall (mm) Weight/m (kg)	250 22.7 15.50	250 22.7 15.50	
280	O.D (mm) Wall (mm) Weight/m (kg)	280 25.4 19.40	280 25.4 19.40	
315	O.D (mm) Wall (mm) Weight/m (kg)	315 28.6 24.60	315 28.6 24.60	

Polypropylene pipe avalability - special grades

Metric Sizes DIN 8077 / 8078		PPs: Flame Retardent				PPs: Flame Retardent Electrically Conductive			
Size	Series SDR Working Pressure	Ventilation	S-20 SDR41 PN2.5	S-16 SDR33 PN3.2	S-5 SDR11 PN10	Ventilation	S-16 SDR33 PN3.2	S-8.3 SDR17.6 PN6	S-5 SDR11 PN10
20	O.D (mm) Wall (mm) Weight/m (kg)				20 2.5 0.14				
25	O.D (mm) Wall (mm) Weight/m (kg)				25 2.7 0.19				
32	O.D (mm) Wall (mm) Weight/m (kg)				32 2.9 2.27				32 2.9 0.32
40	O.D (mm) Wall (mm) Weight/m (kg)				40 3.7 0.42				
50	O.D (mm) Wall (mm) Weight/m (kg)				50 4.6 0.65				50 4.6 0.79
63	O.D (mm) Wall (mm) Weight/m (kg)			6.3 2.0 0.39	63 5.8 1.03				63 5.8 1.20
75	O.D (mm) Wall (mm) Weight/m (kg)		75 1.9 0.45		75 6.8 1.44				75 6.8 2.50
90	O.D (mm) Wall (mm) Weight/m (kg)		90 2.2 0.62	90 2.8 0.78	90 8.2 2.08		90 2.8 0.39		110 10 3.31
110	O.D (mm) Wall (mm) Weight/m (kg)		110 2.7 0.92	110 3.4 1.14	110 10.0 3.09	110 3.0 1.24	110 3.4 1.40	110 6.3 2.40	110 10 3.31
125	O.D (mm) Wall (mm) Weight/m (kg)		125 3.1 1.20						
140	O.D (mm) Wall (mm) Weight/m (kg)	140 3.6 1.32			140 12.7 4.99				
160	O.D (mm) Wall (mm) Weight/m (kg)	160 3.0 1.53	160 4.0 1.97	160 4.9 0.38	160 14.6 6.55	160 3.0 1.82	160 5.5 2.90	160 9.1 5.1	
180	O.D (mm) Wall (mm) Weight/m (kg)	180 3.0 1.17				180 3.0 0.05			
200	O.D (mm) Wall (mm) Weight/m (kg)	200 3.0 1.71	200 4.9 3.00	200 6.2 3.75		200 3.0 2.28	200 6.9 4.50	200 11.4 8.00	
225	O.D (mm) Wall (mm) Weight/m (kg)	225 3.5 2.47		225 6.9 4.69		225 3.0 2.62	225 7.7 5.86		
250	O.D (mm) Wall (mm) Weight/m (kg)	250 3.5 2.75	250 6.5 4.72	250 7.7 5.82		250 3.5 3.50			
280	O.D (mm) Wall (mm) Weight/m (kg)	280 4.0 3.48							
315	O.D (mm) Wall (mm) Weight/m (kg)	315 5.0 5.54		315 9.7 9.21		315 5.0 5.80			
355	O.D (mm) Wall (mm) Weight/m (kg)	355 5.0 5.54		355 10.9 11.60		355 5.0 6.60			
400	O.D (mm) Wall (mm) Weight/m (kg)	400 6.0 7.39	400 9.8 11.88			400 6.0 7.40			
450	O.D (mm) Wall (mm) Weight/m (kg)	450 6.0 8.33	450 11.0 14.99						