

Selection of materials

PP: Polypropylene



Polypropylene (PP) is a partially-crystalline thermoplastic from the polyolefin group of materials, and it is characterised 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.

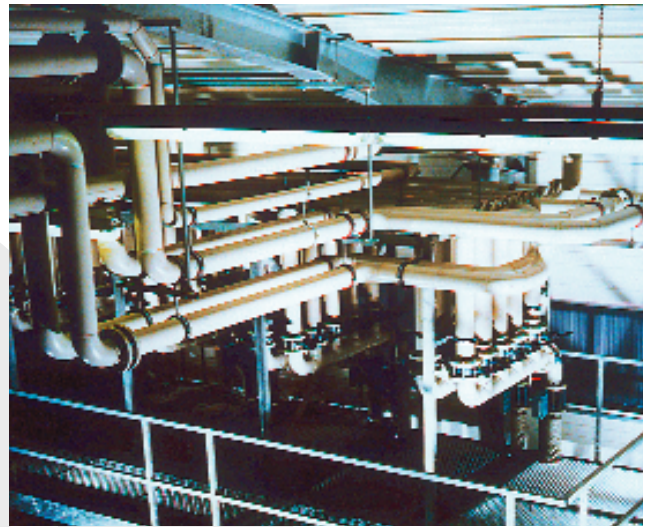
In accordance with DIN 8078, there are three different types of polypropylene that are referenced for use as piping materials:

- 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 β -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 ketones. Consequently, solvent cement welding of polypropylene pipes and fittings is not possible.

In contrast, polypropylene is ideally suited to a variety of welding techniques for pressure piping applications. High quality, reliable joints can be achieved using heating element socket fusion jointing, heating element butt fusion welding, non-contact Infra-Red (IR) butt welding, and electrofusion welding techniques. Additionally, polypropylene systems can be joined using flanges, threaded connections and mechanical couplings.



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/cm³
- High long term creep resistance
- Excellent chemical resistance
- High resistance to thermal ageing
- Outstanding welding characteristics
- Excellent abrasion resistance
- Smooth internal surfaces

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A process that involves copolymerising 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 moulding 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 are 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 additives, it is ideally suited for high purity water piping systems. Note that it is not UV stabilised.

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, PPs is ideally suited for ventilation pipes. The flame-retardent properties enhance the material for this application. Note that this material may not be used outdoors, as it is not UV stabilised.

PPs-el (Polypropylene random copolymer flame-retardant, electro-conductive)

This material combines the benefits of flame retardant properties and electro-conductivity. It can be used for safety reasons in the transport of combustible material.

Properties of Polypropylene (standard types - average values)			
	PP-H	PP-R	
Property	Value	Value	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 Linear 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	7032 Beige Grey	7032 Beige Grey	RAL

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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 oxidation.

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, FDA, 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 polypropylene (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 polypropylene (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 discolouration of the material appears although this has no effect on the mechanical, thermal and/or electrical properties.

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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 (O.D.)	Pressure Rating at 20°C
PP-H Pipe S-20 / SDR41	63mm - 1400mm	2.5 bar
PP-H Pipe S-16 / SDR33	50mm - 1200mm	3.2 bar
PP-H Pipe S-12.5 / SDR26	40mm - 1000mm	4.0 bar
PP-H Pipe S-8.3 / SDR17.6	20mm - 710mm	6.0 bar
PP-H Pipe S-5 / SDR11	16mm - 500mm	10.0 bar
PP-H Pipe S-3.2 / SDR7.4	12mm - 160mm	16.0 bar
PP-R Pipe 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 Diaphragm Valves	20mm - 110mm	10.0 bar
PP-R Butterfly Valves	90mm - 140mm	10.0 bar
PP-R Butterfly Valves	160mm - 225mm	6.0 bar

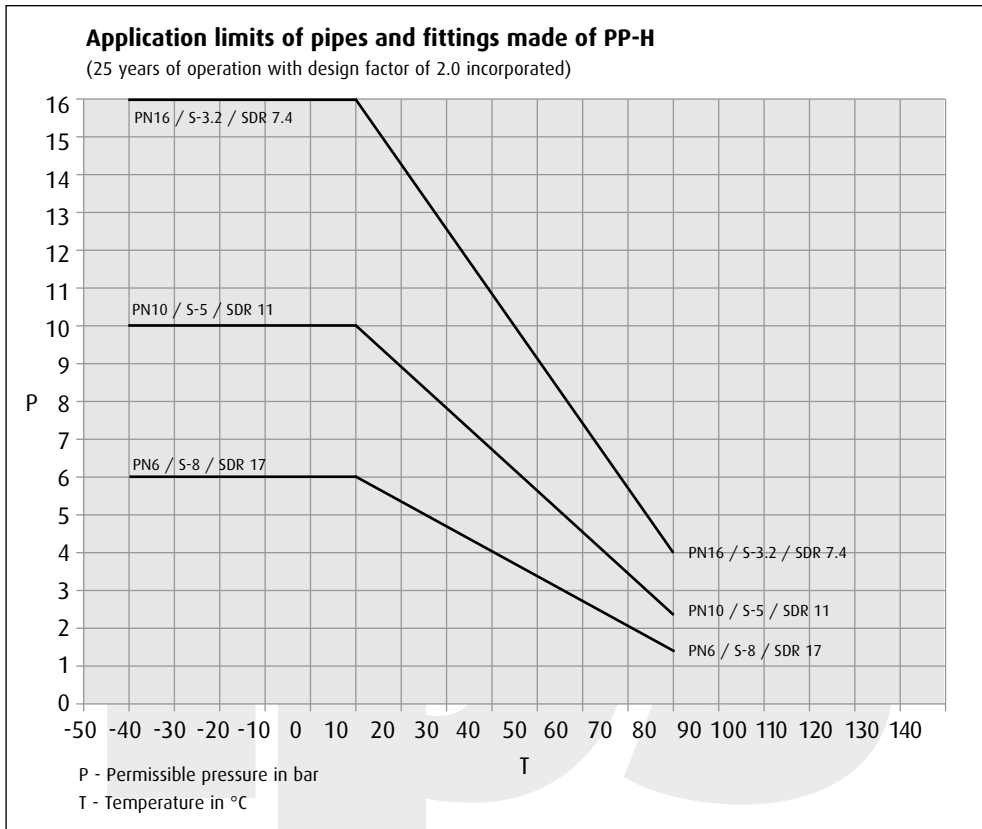
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Pressure ratings for polypropylene pipe, fittings and valves

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 availability

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)							10
	Wall (mm)							1.8
	Weight/m (kg)							0.05
12	O.D. (mm)							12
	Wall (mm)							1.8
	Weight/m (kg)							0.06
16	O.D. (mm)						16	16
	Wall (mm)						1.8	2.2
	Weight/m (kg)						0.08	0.09
20	O.D. (mm)					20	20	20
	Wall (mm)					1.8	2.5	2.8
	Weight/m (kg)					0.10	0.14	0.15
25	O.D. (mm)					25	25	25
	Wall (mm)					1.8	2.7	3.5
	Weight/m (kg)					1.13	0.19	0.23
32	O.D. (mm)					32	32	32
	Wall (mm)					1.9	2.9	4.4
	Weight/m (kg)					0.18	0.26	0.37
40	O.D. (mm)				40	40	40	40
	Wall (mm)				1.8	2.3	3.7	5.5
	Weight/m (kg)				0.22	0.27	0.41	0.58
50	O.D. (mm)			50	50	50	50	50
	Wall (mm)			1.8	2.0	2.9	4.6	6.9
	Weight/m (kg)			0.27	0.30	0.42	0.64	0.90
63	O.D. (mm)		63	63	63	63	63	63
	Wall (mm)		1.8	2.0	2.5	3.6	5.8	8.6
	Weight/m (kg)		0.35	0.38	0.47	0.66	1.01	1.41
75	O.D. (mm)		75	75	75	75	75	75
	Wall (mm)		1.9	2.3	2.9	4.3	6.8	10.3
	Weight/m (kg)		0.44	0.52	0.65	0.93	1.40	2.00
90	O.D. (mm)		90	90	90	90	90	90
	Wall (mm)		2.2	2.8	3.5	5.1	8.2	12.3
	Weight/m (kg)		0.60	0.76	0.94	1.32	2.02	2.86
110	O.D. (mm)		110	110	110	110	110	110
	Wall (mm)		2.7	3.4	4.2	6.3	10.0	15.1
	Weight/m (kg)		0.90	1.11	1.36	1.98	3.01	4.29
125	O.D. (mm)		125	125	125	125	125	125
	Wall (mm)		3.1	3.9	4.8	7.1	11.4	17.1
	Weight/m (kg)		1.17	1.45	1.76	2.54	3.89	5.52
140	O.D. (mm)		140	140	140	140	140	140
	Wall (mm)		3.5	4.3	5.4	8.0	12.7	19.2
	Weight/m (kg)		1.48	1.78	2.21	3.20	4.87	6.93
160	O.D. (mm)		160	160	160	160	160	160
	Wall (mm)		4.0	4.9	6.2	9.1	14.6	21.9
	Weight/m (kg)		1.91	2.32	2.89	4.15	6.38	9.04
180	O.D. (mm)		180	180	180	180	180	180
	Wall (mm)		4.4	5.5	6.9	10.2	16.4	24.6
	Weight/m (kg)		2.36	2.94	3.63	5.22	6.05	11.40
200	O.D. (mm)		200	200	200	200	200	200
	Wall (mm)		4.9	6.2	7.7	11.4	18.2	27.4
	Weight/m (kg)		2.92	3.65	4.50	6.47	9.92	14.10
225	O.D. (mm)		225	225	225	225	225	225
	Wall (mm)		5.5	6.9	8.6	12.8	20.5	30.8
	Weight/m (kg)		3.70	4.57	5.65	8.19	12.60	17.90
250	O.D. (mm)		250	250	250	250	250	250
	Wall (mm)		6.2	7.7	9.6	14.2	22.7	34.3
	Weight/m (kg)		4.59	5.67	6.99	10.10	15.50	22.90
280	O.D. (mm)		280	280	280	280	280	280
	Wall (mm)		6.9	8.6	10.7	15.9	25.4	38.4
	Weight/m (kg)		5.73	7.09	8.72	12.60	19.40	28.90
315	O.D. (mm)		315	315	315	315	315	315
	Wall (mm)		7.7	9.7	12.1	17.9	28.6	43.3
	Weight/m (kg)		7.19	8.97	11.10	16.00	24.60	36.90
355	O.D. (mm)		355	355	355	355	355	355
	Wall (mm)		8.7	10.9	13.6	20.1	32.2	48.7
	Weight/m (kg)		9.14	11.30	14.00	20.20	31.10	46.70
400	O.D. (mm)	400	400	400	400	400	400	400
	Wall (mm)	6.0	9.8	12.3	15.3	22.7	36.3	54.3
	Weight/m (kg)	7.20	11.60	14.40	17.70	25.70	39.50	58.30
450	O.D. (mm)	450	450	450	450	450	450	450
	Wall (mm)	6.0	11.0	13.8	17.2	25.5	40.9	60.3
	Weight/m (kg)	8.12	14.60	18.20	22.40	32.50	50.10	72.70
500	O.D. (mm)	500	500	500	500	500	500	500
	Wall (mm)	8.0	12.3	15.3	19.1	28.3	45.4	67.0
	Weight/m (kg)	11.90	18.10	22.30	27.60	40.10	61.70	90.00
560	O.D. (mm)	560	560	560	560	560	560	560
	Wall (mm)	10.0	13.7	17.2	21.4	31.7	50.3	73.4
	Weight/m (kg)	16.60	22.60	28.10	34.60	50.30	75.00	108.00
630	O.D. (mm)	630	630	630	630	630	630	630
	Wall (mm)	10.0	15.4	19.3	24.1	35.7	55.0	80.0
	Weight/m (kg)	18.80	28.50	35.50	43.90	63.70	93.00	135.00
710	O.D. (mm)	710	710	710	710	710	710	710
	Wall (mm)	12.0	17.4	21.8	27.2	40.2	60.0	87.0
	Weight/m (kg)	25.30	36.30	45.20	55.80	80.70	118.00	172.00
800	O.D. (mm)	800	800	800	800	800	800	800
	Wall (mm)	12.0	19.6	24.5	30.6	45.0	66.0	96.0
	Weight/m (kg)	28.60	46.10	57.20	70.80	101.00	148.00	216.00
900	O.D. (mm)	900	900	900	900	900	900	900
	Wall (mm)	15.0	22.0	27.6	34.4	50.0	72.0	105.0
	Weight/m (kg)	40.10	58.10	72.50	89.40	127.00	186.00	270.00
1000	O.D. (mm)	1000	1000	1000	1000	1000	1000	1000
	Wall (mm)	15.0	24.5	30.6	38.2	54.0	78.0	114.0
	Weight/m (kg)	44.60	72.00	89.20	110.00	156.00	225.00	324.00
1200	O.D. (mm)	1200	1200	1200	1200	1200	1200	1200
	Wall (mm)	18.0	29.4	36.7	45.6	65.0	93.0	135.0
	Weight/m (kg)	64.10	103.00	128.00	157.00	221.00	318.00	459.00
1400	O.D. (mm)	1400	1400	1400	1400	1400	1400	1400
	Wall (mm)	21.0	34.3	42.4	52.4	74.0	106.0	153.0
	Weight/m (kg)	83.20	141.00	175.00	215.00	298.00	432.00	621.00

Polypropylene pipe availability - special grades



Metric Sizes DIN 8077/8078		PP-R Copolymer	PP Pure	Polypure
Size	Series SDR Working Pressure	S-5 SDR11 PN10	S-5 SDR11 PN10	S-5 SDR11 PN10
20	O.D. (mm)	20	20	20
	Wall (mm)	2.5	2.5	2.5
	Weight/m (kg)	0.14	0.14	0.11
25	O.D. (mm)	25	25	25
	Wall (mm)	2.7	2.7	2.7
	Weight/m (kg)	0.19	0.19	0.19
32	O.D. (mm)	32	32	32
	Wall (mm)	2.9	2.9	2.9
	Weight/m (kg)	0.26	0.26	0.26
40	O.D. (mm)	40	40	40
	Wall (mm)	3.7	3.7	3.7
	Weight/m (kg)	0.41	0.41	0.41
50	O.D. (mm)	50	50	50
	Wall (mm)	4.6	4.6	4.6
	Weight/m (kg)	0.64	0.64	0.64
63	O.D. (mm)	63	63	63
	Wall (mm)	5.8	5.8	5.8
	Weight/m (kg)	1.01	1.01	1.01
75	O.D. (mm)	75	75	
	Wall (mm)	6.8	6.8	
	Weight/m (kg)	1.40	1.40	
90	O.D. (mm)	90		90
	Wall (mm)	8.2		8.2
	Weight/m (kg)	2.02		2.02
110	O.D. (mm)	110	110	110
	Wall (mm)	10.0	10.0	10.0
	Weight/m (kg)	3.01	3.01	3.09
125	O.D. (mm)	125	125	
	Wall (mm)	11.4	11.4	
	Weight/m (kg)	3.89	3.89	
140	O.D. (mm)	140	140	
	Wall (mm)	12.7	12.7	
	Weight/m (kg)	4.87	4.87	
160	O.D. (mm)	160	160	
	Wall (mm)	14.6	14.6	
	Weight/m (kg)	6.38	6.38	
180	O.D. (mm)	180	180	
	Wall (mm)	16.4	16.4	
	Weight/m (kg)	8.05	8.05	
200	O.D. (mm)	200	200	
	Wall (mm)	18.2	18.2	
	Weight/m (kg)	9.92	9.92	
225	O.D. (mm)	225	225	
	Wall (mm)	20.5	20.5	
	Weight/m (kg)	12.60	12.60	
250	O.D. (mm)	250	250	
	Wall (mm)	22.7	22.7	
	Weight/m (kg)	15.50	15.50	
280	O.D. (mm)	280	280	
	Wall (mm)	25.4	25.4	
	Weight/m (kg)	19.40	19.40	
315	O.D. (mm)	315	315	
	Wall (mm)	28.6	28.6	
	Weight/m (kg)	24.60	24.60	

Polypropylene pipe availability - special grades



Metric Sizes DIN 8077/8078		PPs: Flame Retardent				PPs-el: 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 0.27				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)			63 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 1.70
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 0.93		90 8.2 2.50
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 3.0 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 2.38	160 14.6 6.55	160 3.0 1.82	160 4.9 2.90	160 9.1 5.10	
180	O.D. (mm) Wall (mm) Weight/m (kg)	180 3.0 1.71				180 3.0 2.05			
200	O.D. (mm) Wall (mm) Weight/m (kg)	200 3.0 1.90	200 4.9 3.00	200 6.2 3.75		200 3.0 2.28	200 6.2 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 3.5 2.62	225 6.9 5.86		
250	O.D. (mm) Wall (mm) Weight/m (kg)	250 3.5 2.75	250 6.2 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 4.91		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						