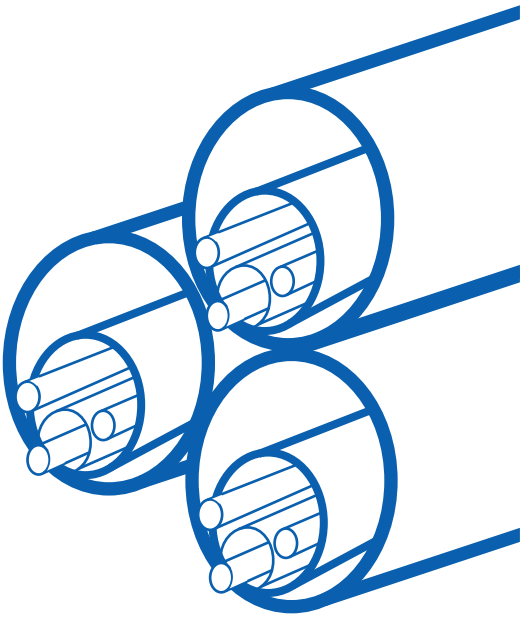
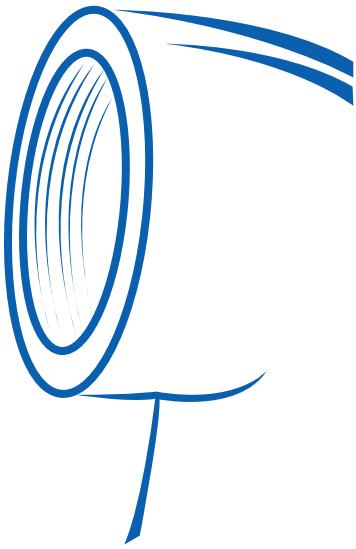
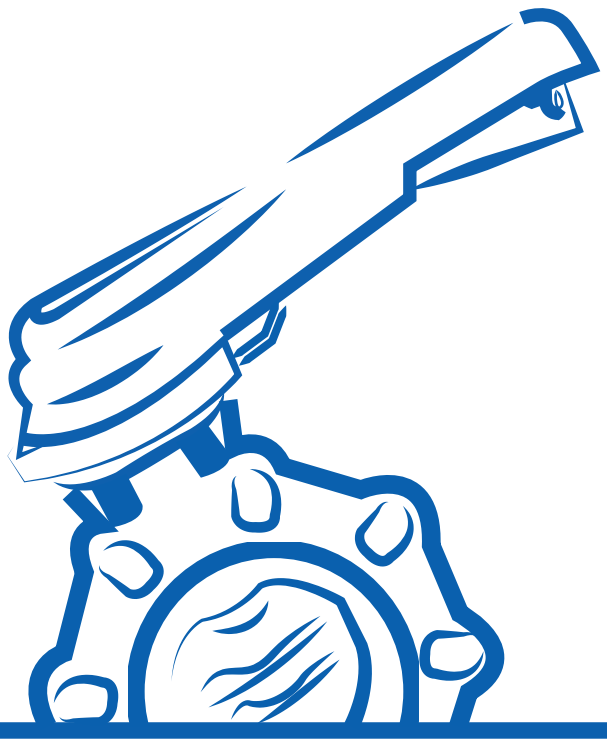
HYDRO PLAST
PIPING SYSTEMS

Technical Information

Selection of materials







1. Available materials

There are six thermoplastic materials in common use for pressure piping systems:

- PVC-U (Unplasticised Polyvinyl Chloride)
- PVC-C (Post-chlorinated Polyvinyl Chloride)
- ABS (Acrilonitrile Butadiene Styrene)
- PP (Polypropylene)
- PE (Polyethylene)
- PVDF(Polyvinylidene Fluoride)

In addition, developments in raw material formulation has provided new variations of some of these materials with specifically enhanced properties, such as flame retardency or electrical conductivity. The following pages provide more detailed information on each material and on the range of products that are available.

2. PVC-U: Unplasticised Polyvinyl Chloride

Unplasticised Polyvinylchloride (PVC-U) is one of the oldest and most widely used plastics for piping systems worldwide. It is a highly versatile material that is used for both pressure and drainage piping systems for above and below ground applications. It is an amorphous thermoplastic material with good tensile, flexural and mechanical strength, low moisture absorption, good flammability characteristics, and exceptional dimensional stability.

PVC-U has excellent chemical resistance across its operating temperature range of 0°C to 60°C, with a broad band of operating pressures. In addition, because of its long term strength characteristics, high stiffness and cost effectiveness, PVC-U systems typically account for a large proportion of thermoplastic piping installations.

Consequently, PVC-U systems feature the widest range of pipe sizes, fitting configurations, valves choices and ancillary items compared to all other thermoplastic piping materials.

PVC-U piping systems are joined by solvent cement welding, whilst transition joints can be made using flanges, threaded connections, mechanical fittings, and compression fittings.

PVC-U piping systems are available from IPS in both inch and metric dimensions, according to BS, ASTM and ISO standards. Systems are available in inch sizes up to 24', and metric sizes up to 630mm. Pipes, fittings and valves are available in grey, white and clear PVC-U.

General properties of PVC-U

PVC-U exhibits thermal stability in the temperature range 0°C to 60°C, however at low temperatures the impact strength of PVC-U decreases. It is therefore not recommended for use at very low temperatures unless there is no likelihood of the piping materials being disturbed or subjected to impact damage. PVC-U is free from toxic metals thus ensuring that it is physiologically harmless for drinking water and foodstuffs applications.

Some important advantages of PVC-U are:
- Extensive choice of component parts
- Wide range of applications
- Good chemical and corrosion resistance
- Safe for potable water applications
- Low friction loss - Self extinguishing
- High mechanical strength - Simplified installation techniques using solvent cement welding
- Approved for potable water applications

PVC-U: Unplasticised Polyvinyl Chloride

Materials

PVC-U piping systems are produced without plasticizers and fillers, however for injection moulding purposes lubricants are added to assist in the production of complex parts, and to combat the effects of UV light, stabilisers are added.

PVC-U is produced by the polymerisation of vinylchloride, a gaseous monomer. Technical products manufactured from PVC-U can have a monomer content of 0.1ppm, which is considerably less than the specified limits. Owing to the high chlorine content of PVC-U, it does not support combustion after removal of a flame, and thus PVC-U falls into the class V-0 according to UL94.

Properties of PVC-U (Average values)		
Property	Vlaue	Unit
Density	1.38	g / cm^3
Tensile Strength	55	N / mm^2
Elongation at Break	> 30	%
Impact Strength	No crack	kJ / m^2 (23°C)
Modulus of Elasticity (Young's Modulus)	3000	N / mm / m^2
Coefficient of Linear Expansion	0.08	mm / m °C
Maximum Operating Temperature	60	°C
Minimum Operating Temperature	0	°C
Vicat Softening Point	> 76	°C(VST / B 50)
Water Absorption	< 4	mg / cm^3
Surface Resistance	Approx. 10	Ω
Thermal Conductivity	0.140	w / m · K
Flammability	v-0	UL_{94}
Colour 3000	7011 Dark Grey	RAL

Chemical resistance

PVC-U displays excellent chemical resistance to a wide variety of commonly encountered industrial chemicals, such as acids, bases and salt solutions. Resistance to sodium hypochlorite solutions is also very good. PVC-U is not resistant to aromatic and chlorinated hydrocarbons, solvents, esters and ketones. The chemical resistance of PVC-U should be checked with our technical department for applications involving varnish, oils or fats, and PVC-U is not recommended for use with compressed air or gases. For guidance on the suitability of PVC-U for your application, consult the chemical resistance tables or our technical department.

Weathering resistance

With the use of additives such as ultraviolet absorbers, PVC-U systems display excellent weathering resistance to the long-term effects of sunlight, wind and rain. Over time, grey PVC-U will lose some of its colour because of exposure to UV light, and it will have slightly reduced impact strength. In extreme cases, the use of insulation or an application of a UV absorbent coating such as AGRU Coat, or the use of a water or latex based paint will help to minimise the effects of solar radiation. Solvent based paints should not be used on PVC-U piping. For outdoor installations, or where the aesthetic appearance of the piping system is important, a fully matched system of UV stabilised white PVC pipes and fittings is also available.

Electrical characteristics

PVC-U is non-conductive, therefore systems will remain free from electrolytic corrosion. Precautions should be taken to avoid static discharge should any part of a PVC-U piping system pass through an area where explosive gases may be present.

Physiological characteristics

PVC-U piping systems from IPS are free from lead, cadmium or other poisonous heavy metals. They are suitable for use in contact with cold potable water, and are WRAS listed for this application.

PVC-U: Unplasticised Polyvinyl Chloride

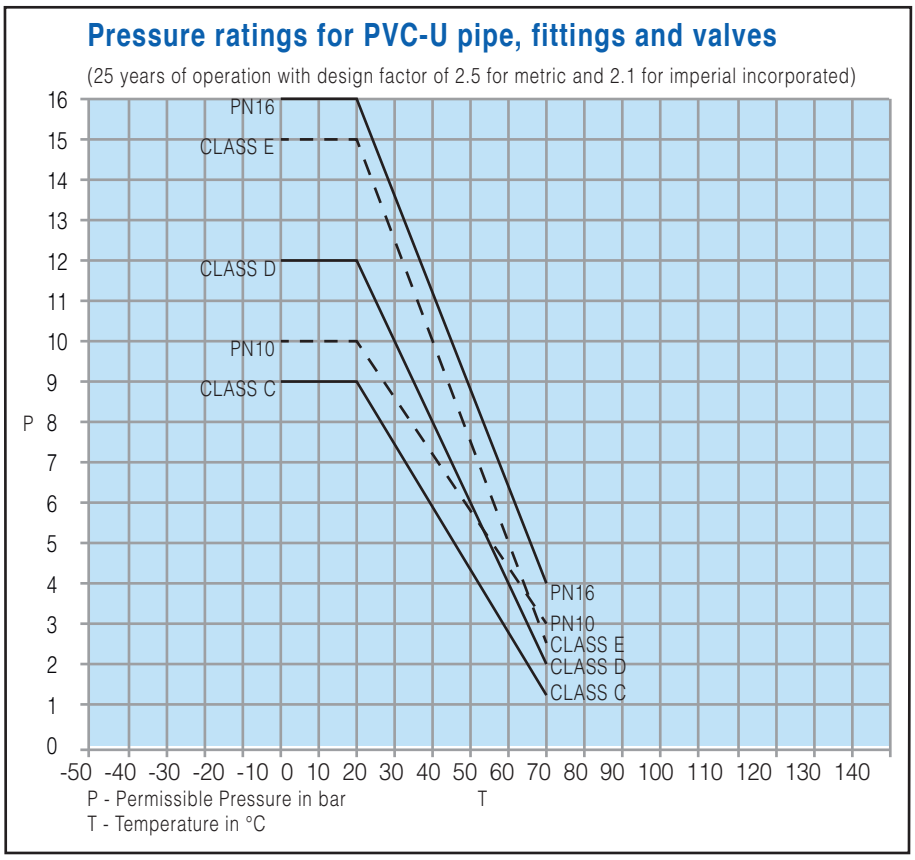
Pressure ratings for PVC-U pipe, fittings and valves

For guidance, the following table gives an indication of the pressure ratings for PVC-U pipes, fittings and valves. The pressure rating of individual items should always be verified with our technical department before installation.

Product	Size	Pressure Rating at 20°C
PVC-U Pipes Class C	2" - 24"	9.0 bar
PVC-U Pipes Class D	1 ¼"- 18"	12.0 bar
PVC-U Pipes Class E	3/8" - 16"	15.0 bar
PVC-U Pipes Sch 40	1/8" - 16"	55.5 bar - 9.0 bar
PVC-U Pipes Sch 80	1/8" - 18"	84.5 bar - 15.2 bar
PVC-U Pipes PN10	25mm - 500mm	10.0 bar
PVC-U Pipes PN16	12mm - 400mm	16.0 bar
PVC-U Standard Inch Fittings	3/8" - 24"	15.0 bar - 6.0 bar
PVC-U Industrial Inch Fittings	1/8 " - 24"	15.0 bar - 10.0 bar
PVC-U Standard Metric Fittings	20mm - 400mm	10.0 bar - 6.0 bar
PVC-U Industrial Metric Fittings	12mm - 500mm	16.0 bar - 6.0 bar
PVC-U Ball Valves	3/8" - 16mm - 6" / 160mm	16.0 bar - 10.0 bar
PVC-U Diaphragm Valves	1/8" - 20mm - 8" - 200mm	10.0 bar - 5.0 bar
PVC-U Butterfly Valves	1½" / 50mm - 12" / 315mm	10.0 bar

* Pressure rating dependant on diameter

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 PVC-U piping materials are shown in the following diagram:



PVC-U pipe availability: inch sizes

		ASTM D 2241				ASTM D 1785			BS EN 1452 / BS 3505				
	Class Colour	SDR 41 White	SDR 26 White	SDR 21 White	SDR 13.5 White	Sch 40 Wh&Grey	Sch 80 Grey	Sch 120 Grey	Class B Grey	Class C Grey	Class D Grey	Class E Grey	Class 7 Grey
1/8"	O.D (mm)					10.3	10.3						
	Wall (mm)					1.7	2.4						
	Max WP (bar)					55.5	84.5						
	Weight/m (kg)					0.1	0.1						
1/4"	O.D (mm)					13.7	13.7						
	Wall (mm)					2.2	3.0						
	Max WP (bar)					53.8	77.9						
	Weight/m (kg)					0.1	0.2						
3/8"	O.D (mm)					17.1	17.1					17.1	
	Wall (mm)					2.3	3.2					1.9	
	Max WP (bar)					42.8	63.5					15.0	
	Weight/m (kg)					0.2	0.2					0.1	
1/2"	O.D (mm)				21.3	21.3	21.3	21.3				21.3	21.3
	Wall (mm)				1.6	2.8	3.7	4.3				2.1	4.0
	Max WP (bar)				21.7	41.4	58.6	70.0				15.0	12.0
	Weight/m (kg)				0.2	0.2	0.3	0.3				0.2	0.3
3/4"	O.D (mm)				26.7	26.7	26.7	26.7				26.7	26.7
	Wall (mm)				1.5	2.9	3.9	4.3				2.5	4.2
	Max WP (bar)				13.8	33.1	47.6	53.3				15.0	12.0
	Weight/m (kg)				0.2	0.3	0.4	0.4				0.2	0.7
1"	O.D (mm)		33.4	33.4		33.4	33.4	33.4				33.4	33.4
	Wall (mm)		1.5	1.6		3.4	4.5	5.1				2.7	4.8
	Max WP (bar)		11.0	13.8		31.0	43.5	49.5				15.0	12.0
	Weight/m (kg)		0.3	0.3		0.5	0.6	0.7				0.3	0.5
1"1/4"	O.D (mm)		42.2	42.2		42.2	42.2	42.2			42.2	42.2	42.2
	Wall (mm)		1.6	2.0		3.6	4.9	5.5			2.7	3.2	5.2
	Max WP (bar)		11.0	13.8		25.5	35.9	41.0			12.0	15.0	12.0
	Weight/m (kg)		0.3	0.4		0.6	0.8	0.9			0.4	0.5	0.7
1"1/2"	O.D (mm)		48.3	48.3		48.3	48.3	48.3			48.3	48.3	48.3
	Wall (mm)		1.9	2.3		3.7	5.1	5.7			3.0	3.7	5.5
	Max WP (bar)		11.0	13.8		22.8	32.4	37.0			12.0	15.0	12.0
	Weight/m (kg)		0.4	0.5		0.8	1.0	1.1			0.5	0.7	0.9
2"	O.D (mm)		60.3	60.3		60.3	60.3	60.3		60.3	60.3	60.3	60.3
	Wall (mm)		2.3	2.9		3.9	5.5	6.4		3.0	3.7	4.5	6.0
	Max WP (bar)		11.0	13.8		19.3	27.6	32.5		9.0	12.0	15.0	12.0
	Weight/m (kg)		0.6	0.8		1.0	1.4	1.6		0.7	0.8	1.0	1.4
21/2"	O.D (mm)		73.0	73.0		73.0	73.0	73.0		75.0*		75.0*	
	Wall (mm)		2.8	3.5		5.2	7.0	7.6		3.6		5.6	
	Max WP (bar)		11.0	13.8		20.7	29.0	32.1		10.0		16.0	
	Weight/m (kg)		0.9	1.1		1.6	2.1	2.3		1.2		1.8	
3"	O.D (mm)		88.9	88.9		88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9
	Wall (mm)		3.4	4.2		5.5	7.6	8.9	3.1	4.1	5.3	6.5	4.2
	Max WP (bar)		11.0	13.8		17.9	25.5	30.6	6.0	9.0	12.0	15.0	12.0
	Weight/m (kg)		1.4	1.7		2.1	2.8	3.3	1.2	1.4	1.8	2.2	0.4
3"1/2"	O.D (mm)		101.6	101.6		101.6	101.6						
	Wall (mm)		3.9	4.8		5.7	8.1						
	Max WP (bar)		11.0	13.8		16.6	24.1						
	Weight/m (kg)		1.8	2.2		2.5	3.5						
4"	O.D (mm)		114.3	114.3		114.3	114.3	114.3	114.3	114.3	114.3	114.3	
	Wall (mm)		4.4	5.4		6.0	8.6	11.1	3.6	5.2	6.8	8.3	
	Max WP (bar)		11.0	13.8		15.2	22.1	29.7	6.0	9.0	12.0	15.0	
	Weight/m (kg)		2.2	2.7		3.0	4.2	5.3	1.8	2.3	3.0	3.6	
5"	O.D (mm)		141.3	141.3		141.3	141.3		140.0*	140.0*	140.0*	140.0*	
	Wall (mm)		5.4	6.7		6.6	9.5		4.0	6.3	8.3	10.1	
	Max WP (bar)		11.0	13.8		13.1	20.0		6.0	9.0	12.0	15.0	
	Weight/m (kg)		3.4	4.2		4.1	5.8		2.5	3.5	4.5	5.5	
6"	O.D (mm)		168.3	168.3		168.3	168.3	168.3	168.3	168.3	168.3	168.2	
	Wall (mm)		6.5	8.0		7.1	11.0	14.3	4.8	7.5	9.9	12.2	
	Max WP (bar)		11.0	13.8		12.4	19.3	25.6	6.0	9.0	12.0	15.0	
	Weight/m (kg)		4.8	5.9		5.3	7.9	10.1	3.4	5.0	6.5	7.9	
8"	O.D (mm)		219.1	219.1		219.1	219.1		219.1	219.1	219.1	219.1	
	Wall (mm)		8.4	10.4		8.2	12.7		5.6	8.8	11.6	14.1	
	Max WP (bar)		11.0	13.8		11.0	16.6		6.0	9.0	12.0	15.0	
	Weight/m (kg)		8.2	10.0		7.9	12.0		5.3	7.7	10.0	12.1	
10"	O.D (mm)		273.0	273.0		273.0	273.0		273.0	273.0	273.0	273.0	
	Wall (mm)		10.5	13.0		9.3	15.1		7.0	10.9	14.3	17.5	
	Max WP (bar)		11.0	13.8		9.7	15.9		6.0	9.0	12.0	15.0	
	Weight/m (kg)		12.7	15.5		11.2	17.8		8.2	11.9	15.5	18.8	
12"	O.D (mm)		323.9			323.9	323.9		323.9	323.9	323.9	323.9	
	Wall (mm)		12.5			10.3	17.5		8.2	2.9	17.0	20.8	
	Max WP (bar)		11.0			9.0	15.9		6.0	9.0	12.0	15.0	
	Weight/m (kg)		17.8			14.8	24.5		11.5	16.8	21.8	26.5	
14"	O.D (mm)		355.6			355.6	355.6		355.6	355.6	355.6	355.6	
	Wall (mm)		13.7			11.1	19.1		9.0	14.1	18.6	22.8	
	Max WP (bar)		11.0			9.0	15.2		6.0	9.0	12.0	15.0	
	Weight/m (kg)		21.5			17.6	29.6		13.4	20.1	26.3	31.9	
16"	O.D (mm)		406.4			406.4	406.4		406.4	406.4	406.4	406.4	
	Wall (mm)		15.6			12.7	12.7		10.2	16.2	21.1	26.0	
	Max WP (bar)		11.0			9.0	15.2		6.0	9.0	12.0	15.0	
	Weight/m (kg)		28.1			23.0	37.9		17.9	26.4	34.2	41.2	
18"	O.D (mm)	457.2	457.2				457.2		457.2	457.2	457.2		
	Wall (mm)	11.2	17.6				23.8		11.9	18.2	23.8		
	Max WP (bar)	6.9	11.0				15.2		6.0	9.0	12.0		
	Weight/m (kg)	23.5	35.6				47.5		21.8	33.3	43.3		
20"	O.D (mm)	508.0	508.0						508.0	508.0			
	Wall (mm)	12.4	19.5						13.2	20.2			
	Max WP (bar)	6.9	11.0						6.0	9.0			
	Weight/m (kg)	28.2	44.0						26.9	41.2			
24"	O.D (mm)	609.6	609.6						609.6	609.6			
	Wall (mm)	14.9	23.4						15.7	24.1			
	Max WP (bar)	6.9	11.0						6.0	9.0			
	Weight/m (kg)	40.76	63.4						38.6	59.3			

* DIN 8061/2

PVC-U pipe availability: mm sizes

		EN 1452						DIN 8016 / 2				
	Type	PN 6	PN 7.5	PN 10	PN 12.5	PN 16	PN 20	PN 4	PN 6	PN 10	PN 16	PN 20
12 mm	O.D (mm)						12.0				12.0	12.0
	Wall (mm)						1.5				1.0	1.4
	Max WP (bar)						20.0				16.0	20.0
	Weight/m (kg)						0.1				0.1	0.1
16 mm	O.D (mm)						16.0				16.0	16.0
	Wall (mm)						1.5				1.2	1.8
	Max WP (bar)						20.0				16.0	20.0
	Weight/m (kg)						0.1				0.1	0.1
20 mm	O.D (mm)					20.0	20.0				20.0	20.0
	Wall (mm)					1.5	1.9				1.5	2.3
	Max WP (bar)					16.0	20.0				16.0	20.0
	Weight/m (kg)					0.1	0.2				0.1	0.2
25 mm	O.D (mm)				25.0	25.0	25.0			25.0	25.0	25.0
	Wall (mm)				1.5	1.9	2.3			1.5	1.9	2.8
	Max WP (bar)				12.5	16.0	20.0			10.0	16.0	20.0
	Weight/m (kg)				0.2	0.2	0.2			0.2	0.2	0.3
32 mm	O.D (mm)			32.0	32.0	32.0	32.0			32.0	32.0	32.0
	Wall (mm)			1.6	1.9	2.4	2.9			1.8	2.4	3.6
	Max WP (bar)			10.0	12.5	16.0	20.0			10.0	16.0	20.0
	Weight/m (kg)			0.3	0.3	0.3	0.4			0.3	0.3	0.5
40 mm	O.D (mm)		40.0	40.0	40.0	40.0	40.0		40.0	40.0	40.0	40.0
	Wall (mm)		1.5	1.9	2.4	3.0	3.7		1.8	1.9	3.0	4.5
	Max WP (bar)		7.5	10.0	12.5	16.0	20.0		6.0	10.0	16.0	20.0
	Weight/m (kg)		0.3	0.4	0.5	0.5	0		0.4	0.4	0.5	0.8
50 mm	O.D (mm)	50.0	50.0	50.0	50.0	50.0	50.0		50.0	50.0	50.0	50.0
	Wall (mm)	1.5	1.6	2.4	3.0	3.7	4.6		1.8	2.4	3.7	5.6
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0		6.0	10.0	16.0	20.0
	Weight/m (kg)	6.5	0.5	0.6	0.7	0.8	1.0		0.4	0.6	0.8	1.2
63 mm	O.D (mm)	63.0	63.0	63.0	63.0	63.0	63.0		63.0	63.0	63.0	63.0
	Wall (mm)	1.9	2.0	3.0	3.8	4.7	5.8		1.9	3.0	4.7	7.0
	Max WP (bar)	6.0	7.5	10.3	12.5	16.0	20.0		6.0	10.0	16.0	20.0
	Weight/m (kg)	0.6	0.6	0.9	1.1	1.3	1.7		0.6	0.6	1.3	1.8
75 mm	O.D (mm)	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
	Wall (mm)	2.2	2.3	3.6	4.5	5.6	6.8	1.8	2.2	3.6	5.6	8.4
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	20.0
	Weight/m (kg)	0.8	0.8	1.3	1.6	1.9	2.3	0.6	0.8	1.2	1.8	2.6
90 mm	O.D (mm)	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0
	Wall (mm)	2.7	2.8	4.3	5.1	6.7	8.2	1.8	2.7	4.3	6.7	10.0
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	20.0
	Weight/m (kg)	1.2	1.2	1.8	2.3	2.7	3.2	0.8	1.1	1.8	2.6	3.7
110 mm	O.D (mm)	110.2	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
	Wall (mm)	2.7	3.2	4.2	5.3	6.6	8.1	2.0	3.2	5.3	8.2	12.3
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	20.0
	Weight/m (kg)	1.4	1.7	2.1	2.7	3.2	4.0	1.2	1.6	2.6	3.9	5.6
125 mm	O.D (mm)	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	
	Wall (mm)	3.1	3.7	4.8	6.0	7.4	9.0	2.5	3.7	6.0	9.3	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	
	Weight/m (kg)	1.8	2.2	2.8	3.4	4.1	5.1	1.5	2.1	3.3	5.0	
140 mm	O.D (mm)	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	
	Wall (mm)	3.5	4.1	5.4	6.7	.3	10.3	2.8	4.1	6.7	10.4	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	
	Weight/m (kg)	2.3	2.7	3.5	4.3	5.2	6.4	1.8	2.7	4.2	6.3	
160 mm	O.D (mm)	160.0	160.0	160.0	160.0	160.0	160.0	160.0	160.0	160.0	160.0	
	Wall (mm)	4.0	4.7	6.2	7.7	9.5	11.8	3.0	4.7	7.7	11.9	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	
	Weight/m (kg)	3.0	4.5	4.6	5.7	6.7	8.4	2.4	3.4	5.5	8.2	
180 mm	O.D (mm)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
	Wall (mm)	4.4	5.3	6.9	8.6	10.7	13.3	3.6	5.3	8.6	13.4	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.3	4.0	6.0	10.0	16.0	
	Weight/m (kg)	3.0	4.5	5.7	7.1	8.5	10.6	3.0	4.4	6.9	10.4	
200 mm	O.D (mm)	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	
	Wall (mm)	4.9	5.9	7.7	9.6	11.9	14.7	4.0	5.9	9.6	14.9	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	
	Weight/m (kg)	4.6	5.6	7.1	8.8	10.5	13.0	3.7	5.4	8.5	13.2	
225 mm	O.D (mm)	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	
	Wall (mm)	5.5	6.6	8.6	10.8	13.4	16.6	4.5	6.6	10.8	16.7	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	
	Weight/m (kg)	5.8	7.0	8.9	11.1	13.4	16.6	4.7	5.4	10.8	16.1	
250 mm	O.D (mm)	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	
	Wall (mm)	6.2	7.3	9.6	11.9	14.8	18.4	4.9	7.3	11.9	18.0	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	
	Weight/m (kg)	7.4	8.7	11.0	13.6	16.2	20.1	5.7	8.3	13.2	20.6	
280 mm	O.D (mm)	280.0	280.0	280.0	280.0	280.0	280.0		280.0	280.0	280.0	
	Wall (mm)	6.9	8.2	10.7	13.4	16.6	20.6		8.2	13.4	20.8	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0		6.0	10.0	16.0	
	Weight/m (kg)	9.1	10.9	13.8	17.3	20.6	25.6		10.2	16.6	25.8	
315 mm	O.D (mm)	315.0	315.0	315.0	315.0	315.0	315.0	315.0	315.0	315.0	315.0	
	Wall (mm)	7.7	9.2	12.1	15.0	18.7	23.2	6.2	9.2	15.0	23.4	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0	4.0	6.0	10.0	16.0	
	Weight/m (kg)	11.5	13.7	17.5	21.7	26.1	32.3	9.0	13.2	20.9	32.6	
400 mm	O.D (mm)	400.0	400.0	400.0	400.0	400.0	400.0		400.0	400.0	400.0	
	Wall (mm)	9.8	11.7	15.3	19.1	23.7	29.4		11.7	19.1	29.7	
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0		6.0	10.0	16.0	
	Weight/m (kg)	18.6	22.2	27.7	34.5	39.3	48.8		19.6	31.7	49.3	
500 mm	O.D (mm)	500.0	500.0	500.0	500.0	500.0	500.0		500.0	500.0		
	Wall (mm)	12.3	14.6	19.1	23.9	29.7	36.8		14.6	23.9		
	Max WP (bar)	6.0	7.5	10.0	12.5	16.0	20.0		6.0	10.0		
	Weight/m (kg)	29.4	34.9	41.3	51.7	64.3	79.6		31.6	51.7		
630 mm	O.D (mm)	630.0	630.0	630.0	630.0				630.0			
	Wall (mm)	15.4	18.4	24.1	30.0				18.4			
	Max WP (bar)	6.0	7.5	10.0	12.5				6.0			
	Weight/m (kg)	41.0	49.0	64.2	79.9				49.0			

7. PVC-C: Post-Chlorinated Polyvinly Chloride

Post-chlorinated Polyvinylchloride (PVC-C} is a highly versatile material that has been used for both pressure and drainage piping systems for above and below ground applications for more than forty years. It is an amorphous thermoplastic material with good tensile, flexural and mechanical strength, low moisture absorption, good flammability characteristics, exceptional dimensional stability and good tenacity.

PVC-C also has excellent chemical resistance across its operating temperature range of 0°C to 90°C, with a broad band of operating pressures. In addition, because of its long-term strength characteristics, high stiffness and cost effectiveness, PVC-C systems are suitable for a wide diversity of thermoplastic piping installations.

PVC-C systems feature a broad range of pipe sizes, fitting configurations, valve choices and ancillary items compared to other thermoplastic piping materials.

PVC-C piping systems are joined by solvent cement welding, whilst transition joints can be made using flanges, threaded connections, mechanical fittings, and compression fittings.

Hidro Plast supplies a comprehensive range of PVC-C piping systems in inch dimensions according to ASTM standards.

General Properties of PVC-C

PVC-C exhibits thermal stability in the temperature range 5°C to 100°C, however at low temperatures the impact strength of PVC-C decreases. It is therefore not recommended for use at very low temperatures unless there is no likelihood of the piping materials being disturbed or subjected to impact damage. PVC-C is free from toxic metals thus ensuring that it is physiologically harmless for drinking water and foodstuffs applications.

Some important advantages of PVC-C are:

- Low Specific weight 1.5 g/cm^3
- Wide range of applications
- Good chemical and corrosion resistance
- Safe for potable water applications
- Low friction loss - Self extinguishing
- High mechanical strength
- Low coefficient of thermal expansion
- Rigid and requires less support

PVC-C: Post-Chlorinated Polyvinyl Chloride

Materials

PVC-C piping systems are produced without plasticizers and fillers, however for injection moulding purposes lubricants are added to assist in the production of complex parts, and to combat the effects of UV light, stabilisers are added.
PVC-C is created when PVC homopolymer undergoes a chlorinating reaction resulting in additional chlorine atoms on the base atom. Owing to the high chlorine content of PVC-C, it does not support combustion after removal of a flame, and thus PVC-C falls into the class V-0 according to UL94. This material meets FMRC 4910 clean rooms materials flammability test protocol.

Properties of PVC-C (Average values)		
Property	Vlaue	Unit
Density	1.55	g / cm^3
Tensile Strength	55	N / mm^2
Elongation at Break	30	%
Impact Strength	80	J / m (23°C)
Modulus of Elasticity (Young's Modulus)	2500	N / mm^2
Coefficient of Linear Expansion	0.07	mm / m °C
Maximum Operating Temperature	90	°C
Minimum Operating Temperature	0	°C
Vicat Softening Point	> 105	°C(VST / B 50)
Water Absorption	0.03	%
Surface Resistance	Approx. 10_{13}	Ω
Thermal Conductivity	0.066	w / m · K
Flammability	v-0	UL_{94}
Colour	Light Grey	

Chemical resistance

PVC-C displays excellent chemical resistance to a variety of commonly encountered industrial chemicals, such as acids, bases and salt solutions. Resistance to sodium hypochlorite solutions is also very good. PVC-C is not resistant to aromatic and chlorinated hydrocarbons, solvents, esters and ketones. The chemical resistance of PVC-C should be checked with our technical department for applications involving varnish, oils or fats, and PVC-C is not recommended for use with compressed air or gases. For information on the suitability of PVC-C for your application, consult the chemical resistance tables or our technical department.

Weathering resistance

With the use of additives such as ultraviolet absorbers, PVC-C systems display excellent weathering resistance to the long-term effects of sunlight, wind and rain. Over time, grey PVC-C will lose some of its colour because of exposure to UV light and it will have slightly reduced impact strength. In extreme cases, the use of insulation or an application of UV absorbent coating such as AGRU Coat or the use of a water based paint will help to minimise the effects of solar radiation.

Electrical characteristics

PVC-C is non-conductive therefore systems will remain free from electrolytic corrosion. Precautions should be taken to avoid static discharge should any part of a PVC-C piping system pass through an area where explosive gases may be present.

Physiological characteristics

PVC-C piping systems from IPS are free from lead, cadmium or other poisonous heavy metals. They are suitable for use in contact with cold potable water, and are WRAS listed for this application.

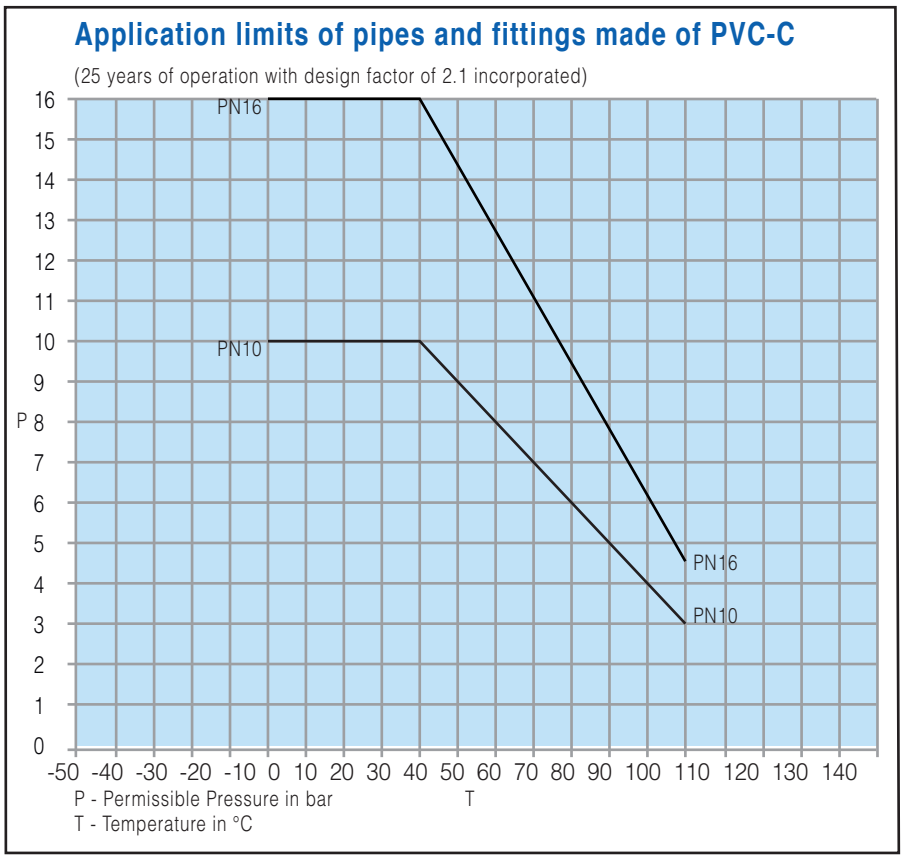
PVC-C: Post-Chlorinated Polyvinyl Chloride

Pressure ratings for PVC-C pipe, fittings and valves

For guidance, the following table gives an indication of the pressure ratings for PVC-C pipes, fittings and valves. The pressure rating of individual items should always be verified with our technical department before installation. The test requirements of ASTM standards for PVC-C pipes and fittings require minimum burst pressure ratings to be achieved. Consequently, in comparison to other materials, the pressure rating of PVC-C pipes and fittings can appear to be unusually high. Care should be taken to ensure that PVC-C systems are engineered in such a way that the pressure rating of the lowest rated component in the system is not exceeded.

Product	Size	Pressure Rating at 20°C
PVC-C Sch 40 pipe	1 ¼"- 12"	53 bar - 9 bar
PVC-C Sch 80 pipe	1 ¼"- 16"	78 bar - 15 bar
PVC-C Fabricated Fittings	4" - 16"	10 bar
PVC-C Moulded Fittings	1 ¼"- 8"	16 bar
PVC-C Moulded Fittings	10" - 12"	10 bar
PVC-C Ball Valves	½" - 2"	16 bar
PVC-C Ball Valves	2½" - 6"	10 bar
PVC-C Butterfly Valves	1½ - 12"	10 bar
PVC-C Diaphragm Valves	1½ - 8"	16 bar - 5 bar

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 PVC-C piping materials are shown in the following diagram:



PVC-C pipe availability: inch sizes

			ASTM F441	
	Class Colour	Vent Pipe * Grey	Sch 40 Grey	Sch 80 Grey
1/4"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		13.7 2.2 53.8 0.1	13.7 3.0 77.9 0.2
3/8"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		17.1 2.3 42.8 0.2	17.1 3.2 63.5 0.2
1/2"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		21.3 2.8 41.4 0.3	21.3 3.7 58.6 0.3
3/4"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		26.7 2.9 33.1 0.4	26.7 3.9 47.6 0.5
1"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		33.4 3.4 31.0 0.5	33.4 4.5 43.5 0.7
1"1/4"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		42.2 3.6 25.5 0.7	42.2 4.9 35.9 0.9
1"1/2"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		48.3 3.7 22.8 0.9	48.3 5.1 32.4 1.1
2"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		60.3 3.9 19.3 1.1	60.3 5.5 27.6 1.6
21/2"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		73.0 5.2 20.7 1.8	73.0 7.0 29.0 2.4
3"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		88.9 5.5 17.9 2.3	88.9 7.6 25.5 3.2
3"1/2"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		101.6 5.7 16.6 2.8	101.6 8.1 24.1 4.1
4"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		114.3 6.0 15.2 3.3	114.3 8.6 22.1 4.6
5"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		168.3 7.1 12.4 5.9	168.3 11.0 19.3 8.8
6"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	168.3 4.7 - 3.8	219.1 8.2 11.0 8.9	219.1 12.7 16.6 13.5
8"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	219.1 4.7 - 5.0	273.0 9.3 9.7 12.6	273.0 15.1 15.9 20.0
10"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	273.0 4.7 - 6.2	323.9 10.3 9.0 14.8	323.9 17.5 15.9 27.5
12"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	323.9 4.7 - 7.4	355.6 11.1 9.0 16.7	355.6 19.1 15.2 33.1
14"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	355.6 4.7 - 8.2	406.4 12.7 9.0 27.1	406.4 21.4 15.2 42.6
16"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	406.4 4.7 - 9.4	457.2 14.3 9.0 34.2	457.2 23.8 15.2 55.8
18"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	457.2 4.7 - 11.3		
20"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	508.0 5.6 - 13.6		
24"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	609.6 6.4 - 18.7		

* Harvel Plastics PVC-C vent pipe is manufactured from raw material with a cell classification of 23437 as defined in ASTM 01784. This material meets the FMRC 4910 Clean Room Materials Flammability Test protocol.

11. ABS: Acrilonitrile Butadiene Styrene

Acrylonitrile Butadiene Styrene (ABS) has been manufactured as a pressure piping system for more than 30 years, and it is a widely used versatile material that can also be found in car parts, household goods, DIY tools as well as thermoplastic piping.

ABS is a copolymer of Styrene and Acrylonitrile grafted to Polybutadiene. The chemical resistance of Acrylonitrile, added to the impact strength of Butadiene, combined with the processing properties of Styrene, produce and homogenous material with chemical resistance, ductility and tensile strength.

The Butadiene content of ABS provides exceptional resistance to impact damage at temperatures as low as -40°C and up to 70°C. ABS offers good abrasion resistance to aggressive slurries, and its smooth bore allows high flow velocities whilst inhibiting the formation of scale.

ABS piping systems are joined by solvent cement welding, whilst transition joints can be made using flanges, threaded connections, mechanical fittings, and compression fittings.

ABS piping systems are available from IPS in both inch and metric dimensions, according to BS and ISO standards. Systems are available in inch sizes from 3/8" to 12" and metric sizes from 16mm to 315mm. ABS products are mid grey in colour in accordance with BS5252.

General Properties of ABS

With the benefit of low temperature handling characteristics down to -40°C, ABS is used extensively for applications in conditioning and chilled water piping systems. Another key benefit is the high impact strength of the material, making ABS ideal for piping systems in exposed situations where potential damage may occur. ABS does not contain metallic stabilizers making it physiologically harmless and therefore suitable for use with food and water applications.

Some of the important advantages of ABS are:

- Low specific weight 1.04g/cm^3
- Wide range of applications
- Good chemical and corrosion resistance
- Safe for potable water applications
- High impact strength at low temperatures
- Good abrasion resistance

ABS: Acrilonitrile Butadiene Styrene

Materials

ABS piping systems are produced without any harmful additives, making it a material that is ideally suited for food and water applications, including soft drinks, medical preparations and potable water. ABS is especially suitable for a wide range of applications at low temperatures, while in addition the low thermal conductivity of the material (0.2W/m°C) makes this piping material ideally suited to temperature sensitive applications, such as refrigeration and chilled water systems.

Properties of PVC-C (Average values)		
Property	Vlaue	Unit
Density	1.03	g / cm^3
Tensile Strength	> 737	N / mm^2
Elongation at Break	> 10	%
Impact Strength	44	kJ m^2 (23°C)
Modulus of Elasticity (Young's Modulus)	2100	N/mm^2
Coefficient of Linear Expansion	0.1	mm/m °C
Maximum Operating Temperature	70	°C
Minimum Operating Temperature	-40	°C
Vicat Softening Point	90	°C(VST / B 50)
Water Absorption	> 1	%
Surface Resistance	Approx. 10_{13}	Ω
Thermal Conductivity	0.170	w / m · K
Flammability	HB	UL_{94}
Colour	7001 Light Grey	RAL

Chemical resistance

ABS displays good chem bases. ABS is not resist chlorinated and aromatic cal resistance to a wide range of chemicals including salt solutions, and most dilute acids and ant to concentrated mineral acids, organic acids and solvents such as esters, ketones and hydrocarbons. For detailed guidance on the chemical resistance of ABS, consult the chemical resistance tables or our technical department.

Weathering resistance

Over time, ABS will suffer some loss of properties when exposed to UV light. The surface of the material will lose shine and experience some colour change. In extreme cases, the use of insulation or an application of a UV absorbent coating such as AGRU Coat, or the use of a water based paint will help to minimise the effects of solar radiation.

Electrical characteristics

ABS is non-conductive therefore systems will remain free from electrolytic corrosion. Precautions should be taken to avoid static discharge should any part of a ABS piping system pass through an area where explosive gases may be present.

Physiological characteristics

ABS piping systems from IPS are free from lead, cadmium or other poisonous heavy metals. They are suitable for use in contact with cold potable water, and are WRAS listed for this application.

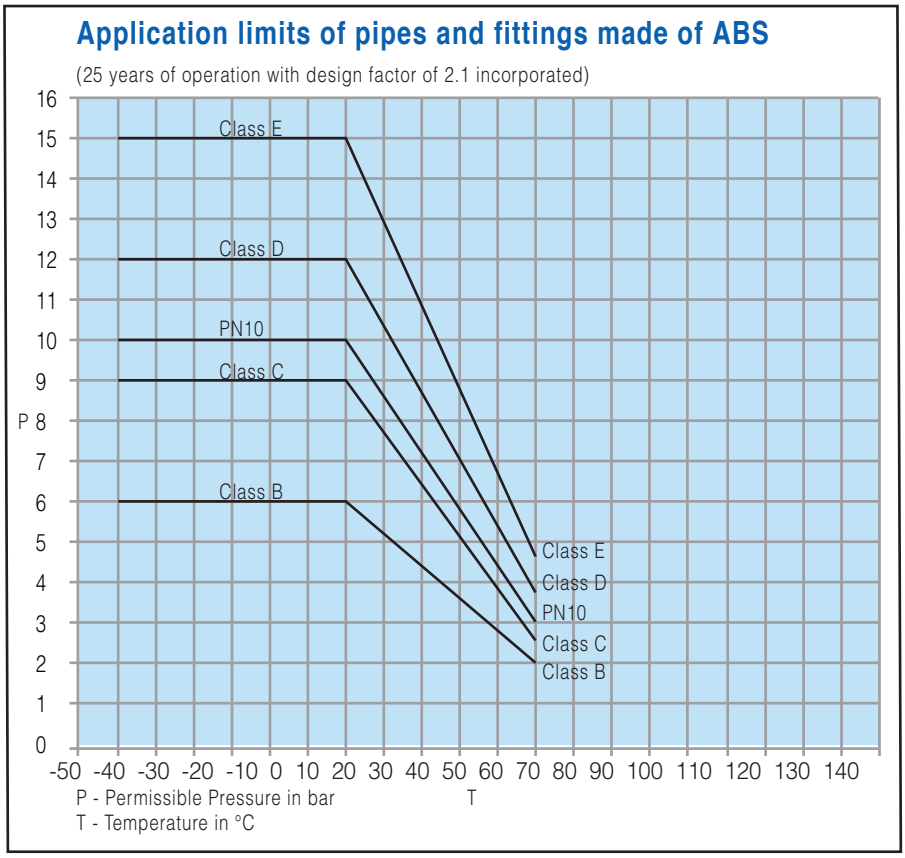
ABS: Acrilonitrile Butadiene Styrene

Pressure ratings for ABS pipe, fittings and valves

For guidance, the following table gives an indication of the pressure ratings for ABS pipes, fittings and valves. The pressure rating of individual items should always be verified with our technical department before installation.

Product	Size	Pressure Rating at 20°C
ABS Class B Pipe	10"- 12"	6 bar
ABS Class C Pipe	3/8"- 8"	9 bar
ABS Class D Pipe	3/8"- 6"	12 bar
ABS Class E Pipe	3/8"- 4"	15 bar
ABS Class B Fittings	10" - 12"	6 bar
ABS Class C Fittings	2½",5" and 8"	9 bar
ABS Class D Fittings	6"	12 bar
ABS Class E Fittings	3/8" - 4"	15 bar
ABS Metric Pipe & Fittings	16mm-250mm	10 bar
ABS Metric Pipe & Fittings	315mm	8 bar
ABS Ball Valves	3/8 / 16mm-2" / 63mm	16 bar
ABS Ball Valves	2½" / 75mm-4" / 110mm	10 bar
ABS Valves (other types)	3/8 / 16mm-12" / 315mm	10 bar or 6 bar

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 ABS piping material are shown in the following diagram:



ABS pipe availability: inch sizes

		Inch Sizes Bs 5391							Metric Sizes ISO 161			
	Class Colour	B Grey	C Grey	D Grey	E Grey	T Grey			Class Colour	PN6 Grey	PN10 Grey
3/8"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)				17.1 1.7 15 0.09	17.1 3.5 12 0.16		16	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		16 1.4 10 0.07
1/2"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)				21.4 2.0 15 0.14	21.4 3.6 12 0.22		20	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		20 1.5 10 0.10
3/4"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)				26.7 2.5 15 0.21	26.7 3.6 12 0.29		25	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		25 1.8 10 0.15
1"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		33.6 2.0 9 0.22		33.4 3.1 15 0.52	33.4 4.3 12 0.44		32	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		32 2.0 10 0.22
11/4"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		42.2 2.5 9 0.34		48.3 4.5 15 0.68	42.2 5.3 12 0.87		40	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		40 2.5 10 0.34
1"1/2"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		48.3 2.8 9 0.45		60.3 5.6 15 1.06	60.3 7.2 12 1.31		50	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		50 3.2 10 0.52
2"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		60.3 3.6 9 0.70					63	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		63 4.0 10 0.83
21/2"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		75.2 5.0 9 1.35					75	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		75.0 4.7 10 1.15
3"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		88.9 5.2 9 1.48		88.9 8.3 15 2.28			90	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		90 5.7 10 1.67
4"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		114.3 6.7 9 2.48		114.3 10.6 15 3.76			110	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		110 6.9 10 2.47
								125	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		125 7.9 10 0.18
5"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		140.2 9.2 9 4.65					140	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		140 8.8 10 1.02
6"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		168.3 9.9 9 5.47	168.3 7.1 12.4 5.3				160	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		160 10.0 10 5.27
								200	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		200 12.5 10 8.14
8"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		219.1 12.7 9 9.53					225	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		225 14.1 10 10.35
10"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	273.0 12.1 6 10.2						250	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	250 9.7 6 10.20	250 15.7 10 12.65
12"	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	323.9 13.1 6 14.17						315	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	315 12.2 6 14.20	315 19.7 10 20.08

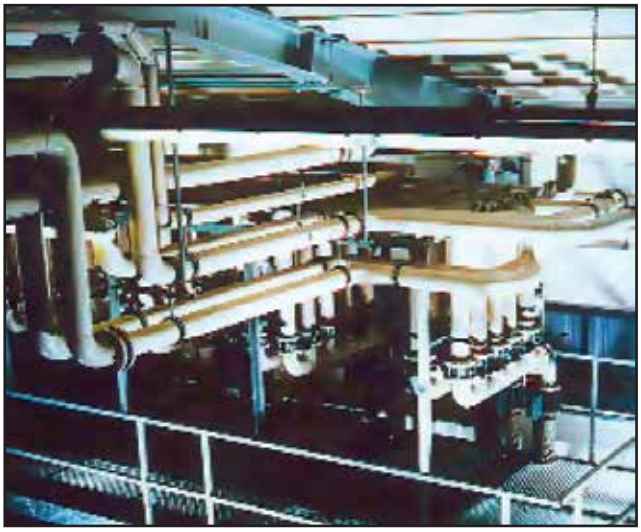
15. PP: Polypropylene

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

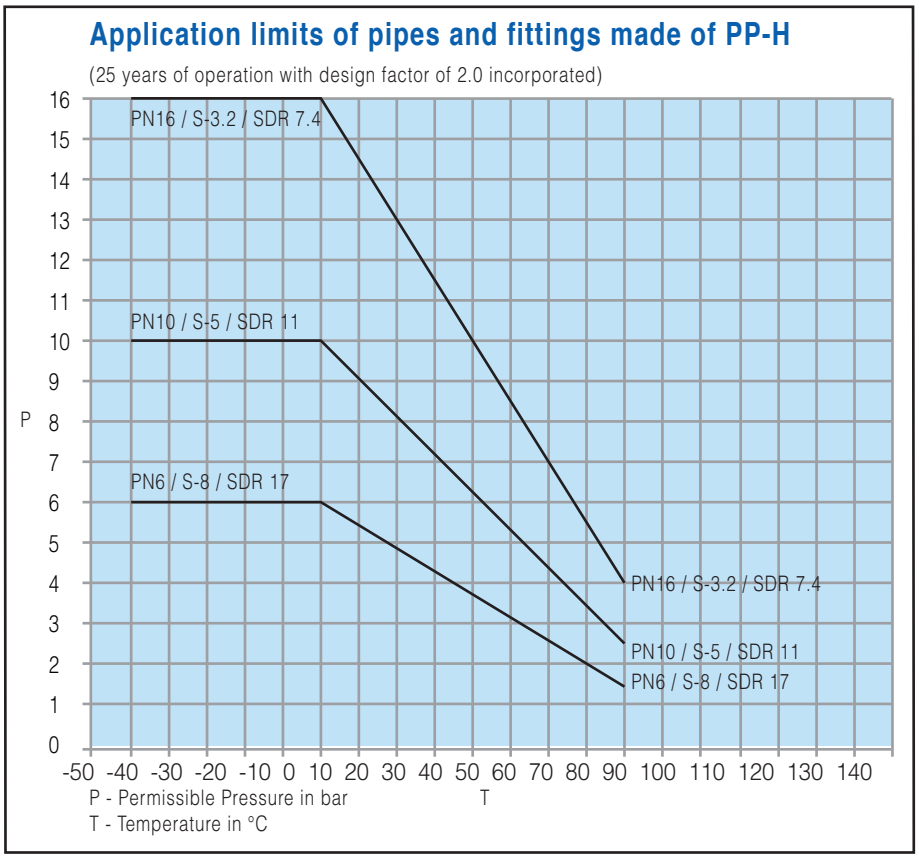
For guidance, the following table gives an indication of the available pressure ratings for polypropylene pipes and fittings. Valves are available in a variety of types, including ball, diaphragm and butterfly. The pressure rating is dependant upon the size and type and is typically within the range 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						

23. PE: Polyethylene

Polyethylene (PE) is a partially-crystalline thermoplastic from the polyolefin in 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 polyethylene one of the most popular piping systems materials.

Polyethylene is non-polar and exhibits a good resistance against a variety of chemicals, however strong oxidising acids attack the material. Good chemical resistance is achieved against contact with solvents, such as alcohols, esters and ketones. Consequently, solvent cement welding of PE pipes and fittings is not possible. When compared to other thermoplastics, PE shows excellent diffusion resistance, and because of this property, polyethylene has been successfully applied for the safe transportation of gases for many years.

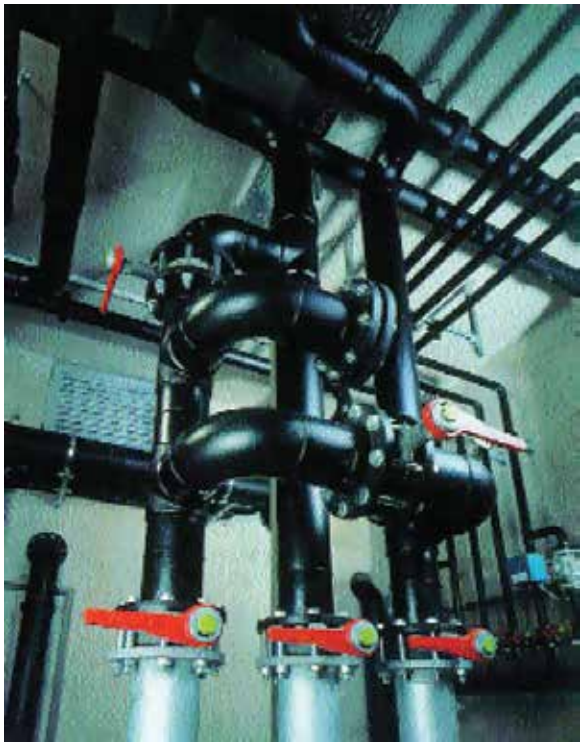
The black colored PE supplied by IPS is stabilized against the effects of UV radiation, and it may therefore safely be used outdoors. The stabilization also counteracts heat fatigue, increasing the operating life.

Polyethylene 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 and electro fusion welding techniques. Additionally, PE systems can be joined using flanges, threaded connections and mechanical couplings.

Polyethylene is no longer described by its density (LDPE, MOPE or HDPE), but by its resistance class according to ISO 9080 (PE 63, PE 80 or PE 100). Polyethylene 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, polyethylene exhibits thermal stability up to 60°C (short-term 70° for drainage systems). Polyethylene shows excellent impact strength, with impact strength rising with increasing temperature.



Some important advantages of polypropylene are:

- Low specific weight of 0.95g/cm^3
- Favourable transportation methods (can be coiles)
- High long term creep resistance
- Very good chemical resistance
- Weathering resistance
- Radiation resistance
- Outstanding weldability
- Excellent abrasion resistance
- Smooth internal surfaces
- Resistant to freezing

PP: Polyethylene

Materials

The polyethylene pipes and fittings supplied by IPS are manufactured from PE8O or from third generation PE100 material. This latest generation PE100 material (also known as MRS 10) has a higher density and improved mechanical properties. Because of these enhanced properties, PE100 material can achieve a corresponding pressure rating using a reduced wall thickness when compared to previous generations of polyethylene piping. Some of the improved properties, such as increased stiffness and hardness, also make it ideally suitable for compressed air applications. In addition, PE100 material exhibits excellent resistance to creep pressure and rapid crack propagation.
Special grades of polyethylene can be made with the supplement of additives, modifying the general properties of the material, however, because of these modifications, changes to the mechanical and chemical resistance properties can occur when compared to the original material. When considering a special grade of polyethylene, it is therefore necessary to clarify the suitability of the intended application with our technical department.

Polyethylene pipes and fittings are also available in the following special grades:
PE8O-el: (Polyethylene, electro-conductive) This material develops the electrical conductivity of PE8O. It can be used for safety reasons in the transport of combustible material, especially for the conveying of dust. A connection to earth is possible.
PE100 FM Approved This material hac hoen tested under FM161O and is approved for underground fire service applications.

Properties of Polypropylene (average values)			
	PE80	PE100	
Property	Vlaue	Vlaue	Unit
Density	0.94	0.95	g / cm^3
Tensile Strength	20	25	MPa
Elongation at Break	>600	>600	%
Notched Impact Strength at 23°C	12	16	kJ/ m^2
Notched Impact Strength at -30°C	4.5	6	kJ/ m^2
Modulus of Elasticity (Young's Modulus)	950	1100	MPa
Coefficient of liner Expansion	0.18	0.18	mm/m °C
Maximum Operating Temperature	60	60	°C
Minimum Operating Temperature	-40	-40	°C
Crystalline Melting Temperature	128-131	127-130	°C
Melt Flow Index	0.40 - 0.50	0.30 - 0.55	g/10min
Surface Resistance	$>10_{13}$	$>10_{13}$	Ω
Thermal Conductivity	0.43	0.40	w / m · K
Flammability	HB	HB	UL_{94}
Colour	Black	Black	

PP: Polyethylene

Chemical resistance

The chemical resistance of polyethylene 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. Against concentrated hydrochloric acid and hydrofluoric acid polyethylene is resistant, however above certain concentration levels diffusion can occur which do not damage the material but causes secondary damage to surrounding steel constructions. In this type of application, double containment piping systems have been found ideally suited. For further details of the suitability of polyethylene for your application, please consult our chemical resistance tables or our technical department.

Weathering resistance

Piping systems in black polyethylene are UV stabilized, and therefore they do not need to be protected against degradation. To help control the heating effects of UV radiation, the pipe surface may be protected by the application of a UV absorbent coating such as AGRU Coat, or by adding a layer of insulation.

Radioactivity resistance

Polyethylene pipes and fittings are well established for drainage systems applications handling radioactive waste water from laboratories as well as for cooling water piping systems for the nuclear power industry. PE remains unaffected by regular exposure to a radiation dose of up to 10^4 Gray.

Physiological characteristics

Polyethylene 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.

PE: Polyethylene

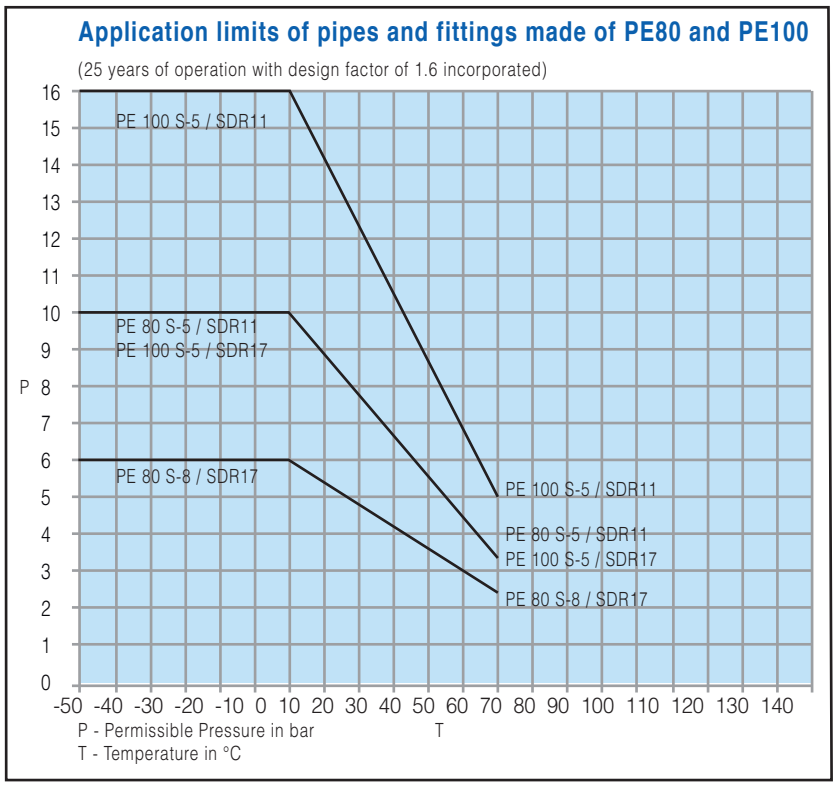
Pressure ratings for polypropylene pipe, fittings and valves

For guidance, the following table gives an indication of the available pressure ratings for polyethylene pipes, fittings and valves 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
PP80 Pipes S - 20 / SDR41	63mm - 1400mm	2.5 bar
PP80 Pipes S - 16 / SDR33	50mm - 1400mm	3.2 bar
PP80 Pipes S - 12.5 / SDR26	40mm - 630mm	4.0 bar
PP80 Pipes S - 8.3 / SDR17.6	20mm - 800mm	6.0 bar
PP80 Pipes S - 5 / SDR11	16mm - 630mm	10.0 bar
PP100 Pipes S - 3.2 / SDR17.6	40mm - 800mm	10.0 bar
PP100 Pipes S - 5 / SDR11	20mm - 630mm	16.0 bar
PP80 Socket Fusion Fittings	20mm - 110mm	10.0 bar
PP80 Butt Fusion Fittings S - 8.3 / SDR17.6	63mm - 315mm	6.0 bar
PP80 Butt Fusion Fittings S - 5 / SDR11	20mm - 315mm	10.0 bar
PP100 Butt Fusion Fittings S - 16 / SDR33	110mm - 500mm	5.0 bar
PP100 Butt Fusion Fittings S - 8.3 / SDR17.6	50mm - 500mm	10.0 bar
PP100 Butt Fusion Fittings S - 5 / SDR11	20mm - 500mm	16.0 bar
PP100 Electro-Fusion Fittings	20mm - 400mm	1.0 bar
PP100 Ball Valves	32mm - 180mm	10.0 bar

* Note that FM approved PE100 systems are rated for continuous use at 12 bar.

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 PE piping is shown in the following diagram:



PE80 Polyethylene pipe availability

Metric Sizes DIN 8074												
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	S-16 SDR33 PN3.2	S-8.3 SDR17.6 PN6	S-5 SDR11 PN10
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 0.11	20 2.5 0.14	20 2.8 0.15			
25	O.D (mm) Wall (mm) Weight/m (kg)					25 1.8 1.14	25 2.7 0.19	25 3.5 0.24			
32	O.D (mm) Wall (mm) Weight/m (kg)					32 1.9 0.19	32 2.9 0.27	32 4.4 0.38			32 2.9 0.28
40	O.D (mm) Wall (mm) Weight/m (kg)				40 1.8 0.23	40 2.3 0.28	40 3.7 0.43	40 5.5 0.60			40 3.7 0.45
50	O.D (mm) Wall (mm) Weight/m (kg)			50 1.8 0.29	50 2.0 0.31	50 4.9 0.44	50 4.6 0.67	50 6.9 0.94			50 4.6 0.69
63	O.D (mm) Wall (mm) Weight/m (kg)		63 1.8 0.36	63 2.0 0.40	63 2.5 0.49	63 3.6 0.69	63 5.8 1.05	63 8.6 1.47			63 5.8 1.10
75	O.D (mm) Wall (mm) Weight/m (kg)		75 1.9 0.46	75 2.3 0.54	75 2.9 0.68	75 4.3 0.97	75 6.8 1.47	75 10.3 2.09			75 6.8 1.53
90	O.D (mm) Wall (mm) Weight/m (kg)		90 2.2 0.63	90 2.8 0.79	90 3.5 0.98	90 5.1 1.38	90 8.2 2.11	90 12.3 2.99		90 5.1 1.44	90 8.2 2.20
110	O.D (mm) Wall (mm) Weight/m (kg)		110 2.7 0.94	110 3.4 1.16	110 4.2 1.42	110 6.3 2.07	110 10.0 3.14	110 15.1 4.48	110 3.4 1.21	110 6.3 2.15	110 10.0 3.28
125	O.D (mm) Wall (mm) Weight/m (kg)		125 3.1 1.22	125 3.9 1.51	125 4.8 1.84	125 7.1 2.65	125 11.4 4.06	125 17.1 5.76	125 3.9 1.58	125 7.0 2.77	125 11.4 4.23
140	O.D (mm) Wall (mm) Weight/m (kg)		140 3.5 1.54	140 4.3 1.86	140 5.4 2.30	140 8.0 3.34	140 12.7 5.08	140 19.2 7.24			
160	O.D (mm) Wall (mm) Weight/m (kg)		160 4.0 2.00	160 4.9 2.42	160 6.2 3.02	160 9.1 4.33	160 14.6 6.67	160 21.9 9.44	160 4.9 2.53	160 9.1 4.51	160 14.6 6.95
180	O.D (mm) Wall (mm) Weight/m (kg)		180 4.4 2.46	180 5.5 3.07	180 6.9 3.79	180 10.2 5.54	180 16.4 8.40	180 24.6 11.90	180 5.5 3.19	180 10.2 5.68	180 16.4 8.75
200	O.D (mm) Wall (mm) Weight/m (kg)		200 4.9 3.05	200 6.2 3.81	200 7.7 4.69	200 11.4 6.76	200 18.2 10.40	200 27.4 14.70	200 6.2 3.97	200 11.4 7.04	200 18.2 10.80
225	O.D (mm) Wall (mm) Weight/m (kg)		225 5.5 3.86	225 6.9 4.77	225 8.6 5.89	225 12.8 8.55	225 20.5 13.10	225 30.8 18.60	225 6.9 4.99	225 12.8 8.91	225 20.5 13.70
250	O.D (mm) Wall (mm) Weight/m (kg)		250 6.2 4.79	250 7.7 5.92	250 9.6 7.30	250 14.2 10.50	250 22.7 16.20	250 34.2 23.00	250 7.7 6.17	250 14.2 11.00	250 22.7 16.80
280	O.D (mm) Wall (mm) Weight/m (kg)		280 6.9 5.98	280 8.6 7.40	280 10.7 9.10	280 15.9 13.20	280 25.4 20.20	280 38.3 28.80			
315	O.D (mm) Wall (mm) Weight/m (kg)		315 7.7 7.51	315 9.7 9.37	315 12.1 11.50	315 17.9 16.70	315 28.6 25.60	315 43.1 36.50	315 9.7 9.76	315 17.9 17.40	315 28.6 26.70
355	O.D (mm) Wall (mm) Weight/m (kg)		355 8.7 9.55	355 10.9 11.80	355 13.6 14.60	355 20.1 21.10	355 32.2 35.50	355 48.8 46.30			
400	O.D (mm) Wall (mm) Weight/m (kg)	400 8.0 9.93	400 9.8 12.10	400 12.3 15.00	400 15.3 18.50	400 22.7 26.90	400 36.3 41.20	400 54.7 58.80	400 12.3 15.60		
450	O.D (mm) Wall (mm) Weight/m (kg)	450 8.0 11.20	450 11.0 15.20	450 13.8 19.00	450 17.2 23.40	450 25.5 34.00	450 40.9 52.30				
500	O.D (mm) Wall (mm) Weight/m (kg)	500 8.0 12.50	500 12.3 18.90	500 15.3 23.30	500 19.1 28.90	500 28.3 41.80	500 45.4 64.50				
560	O.D (mm) Wall (mm) Weight/m (kg)	560 10.0 17.40	560 13.7 23.60	560 17.2 29.40	560 21.4 36.20	560 31.7 52.50	560 50.8 80.80				
630	O.D (mm) Wall (mm) Weight/m (kg)	630 10.0 19.60	630 15.4 29.80	630 19.3 37.00	630 24.1 44.80	630 35.7 66.50	630 57.2 102.00				
710	O.D (mm) Wall (mm) Weight/m (kg)	710 12.0 26.40	710 17.4 37.90	710 21.8 47.20	710 27.2 58.30	710 40.2 84.00					
800	O.D (mm) Wall (mm) Weight/m (kg)	800 12.0 29.80	800 19.6 48.10	800 24.5 59.70	800 30.6 73.90	800 45.3 107.00					
900	O.D (mm) Wall (mm) Weight/m (kg)	900 15.0 41.80	900 22.0 60.70	900 27.6 75.60	900 34.4 93.30						
1000	O.D (mm) Wall (mm) Weight/m (kg)	1000 15.0 46.60	1000 24.5 75.20	1000 30.6 93.10	1000 38.2 115.00						
1200	O.D (mm) Wall (mm) Weight/m (kg)	1200 18.0 67.00	1200 29.4 108.00	1200 36.7 134.00	1200 45.9 166.00						
1400	O.D (mm) Wall (mm) Weight/m (kg)	1400 20.0 86.80	1400 34.3 147.00	1400 42.9 183.00							

PE100 Polyethylene pipe availability

Metric Sizes DIN 8074		PE100		PE100 FM Approved
Size	Series SDR Working Pressure	S-5 SDR 17 PN10	S-5 SDR 11 PN16	S-5 SDR 11 PN12
20	O.D (mm) Wall (mm) Weight/m (kg)		20 2.0 0.12	
25	O.D (mm) Wall (mm) Weight/m (kg)		25 2.3 0.17	
32	O.D (mm) Wall (mm) Weight/m (kg)		32 2.9 0.27	
40	O.D (mm) Wall (mm) Weight/m (kg)	40 2.4 0.29	40 3.7 0.43	
50	O.D (mm) Wall (mm) Weight/m (kg)	50 3.0 0.46	50 4.6 0.67	
63	O.D (mm) Wall (mm) Weight/m (kg)	63 3.8 0.72	63 5.8 1.05	63 5.8 1.05
75	O.D (mm) Wall (mm) Weight/m (kg)	75 4.5 1.01	75 6.8 1.47	75 6.8 1.47
90	O.D (mm) Wall (mm) Weight/m (kg)	90 5.4 1.46	90 8.2 2.11	90 8.2 2.11
110	O.D (mm) Wall (mm) Weight/m (kg)	110 6.6 2.15	110 10.0 3.14	110 10.0 3.14
125	O.D (mm) Wall (mm) Weight/m (kg)	125 7.4 2.76	125 11.4 4.06	125 11.4 4.06
140	O.D (mm) Wall (mm) Weight/m (kg)	140 8.3 4.45	140 12.7 5.08	140 12.7 5.08
160	O.D (mm) Wall (mm) Weight/m (kg)	160 9.5 4.52	160 14.6 6.67	160 14.6 6.67
180	O.D (mm) Wall (mm) Weight/m (kg)	180 10.7 5.69	180 16.4 8.40	180 16.4 8.40
200	O.D (mm) Wall (mm) Weight/m (kg)	200 11.19 7.05	200 18.2 10.40	200 18.2 10.40
225	O.D (mm) Wall (mm) Weight/m (kg)	225 13.4 8.93	225 20.5 13.10	225 20.5 13.10
250	O.D (mm) Wall (mm) Weight/m (kg)	250 14.8 10.90	250 22.7 16.20	250 22.7 16.20
280	O.D (mm) Wall (mm) Weight/m (kg)	280 16.6 13.70	280 25.4 20.20	280 25.4 20.20
315	O.D (mm) Wall (mm) Weight/m (kg)	315 18.7 17.40	315 28.6 25.60	315 28.6 25.60
355	O.D (mm) Wall (mm) Weight/m (kg)	355 21.1 22.10	355 32.2 32.50	355 32.2 32.50
400	O.D (mm) Wall (mm) Weight/m (kg)	400 23.7 28.00	400 36.3 41.20	400 36.3 41.20
450	O.D (mm) Wall (mm) Weight/m (kg)	450 26.7 35.40	450 40.9 52.30	
500	O.D (mm) Wall (mm) Weight/m (kg)	500 29.7 43.80	500 45.4 64.50	
560	O.D (mm) Wall (mm) Weight/m (kg)	560 33.2 54.80	560 50.8 80.80	
630	O.D (mm) Wall (mm) Weight/m (kg)	630 37.4 69.40	630 57.2 102.00	
710	O.D (mm) Wall (mm) Weight/m (kg)	710 42.1 88.10		
800	O.D (mm) Wall (mm) Weight/m (kg)	800 47.4 112.00		

29. PVDF: Polyvintlidene Fluoride

Polyvinylidene fluoride (PVDF) is a thermoplastic that is distinguished from other fluorinated polymers by its ease of processing, good welding characteristics, and good heat formability. PVDF also has high mechanical strength, excellent chemical resistance, and high operating temperature capabilities. It has the widest range of applications of any of the thermoplastics used for rigid piping systems.

The excellent chemical resistance of PVDF means that it is extensively used in the chemical industry as a piping system for aggressive liquids, and in the field of tank construction and lining. PVDF is a homopolymer without additives such as stabilizers and processing agents. It also displays excellent flame retardant properties. Consequently, PVDF is listed with many worldwide agencies as suitable for use with foodstuffs, dairy products, hot and cold water in the semi-conductor and pharmaceutical industries, and for other applications in the food and drug sector.

Physiologically non-toxic, the smooth surface finish of PVDF does not encourage the growth of microorganisms. When coupled with its low friction coefficient, these natural anti fouling characteristics make PVDF ideally suited to applications involving ultra-pure liquids.

PVDF also has good resistance to UV and gamma radiation, including ageing resistance. However, in the case of direct radiation from UV lamps with a wavelength of 184 nanometer, it is recommended to use a stainless steel diaphragm valve or a 90° bend at the connection points to reflect the UV light.

PVDF does not support combustion after removal of a flame, and thus it falls into the class V-0 according to UL94 This material meets FMRC 4910 clean rooms materials flammability test protocol.
PVDF has excellent welding characteristics, and can be joined by either heating element socket fusion welding, heating element butt fusion welding, non-contact Infra-Red (IR) welding or electro fusion welding techniques. Additionally, PVDF systems can be joined using flanges, threaded connections and mechanical couplings. PVDF piping systems are available from IPS in metric dimensions according to DIN 8077/8078 and DIN 16962.

General properties of PVC-U

In comparison to other thermoplastics such as polypropylene, PVDF exhibits thermal stability up to 120°C, (short term 140°C for drainage systems). PVDF also has good impact strength, which rises further as the temperature increases.

Some important advantages of polypropylene are:

- Low specific weight of 0.91g/cm^3
- High long term creep resistance
- Excellent chemical resistance
- High resistance to thermal ageing
- Outstanding welding characteristics
- Excellent abrasion resistance
- Smooth internal surfaces

High purity grades of PVDF

PVDF UHP is an extremely pure grade of polyvinylidene fluoride containing no UV or heat stabilizers, lubricants or flame-retardent additives. Consequently it is particularly suitable for ultra-pure water piping installations and for the transportation of clear chemical liquids in the semiconductor or pharmaceutical industries.

PVDF: Polyvinylidene Fluoride

Materials

Properties of Polypropylene (average values)		
Property	Vlaue	Unit
Density	1.76	g / cm^3
Tensile Strength	>50	MPa
Elongation at Break	80	%
Notched Impact Strength at 23°C	11	kJ/ m^2
Modulus of Elasticity (Young's Modulus)	2000	MPa
Coefficient of liner Expansion	0.12	mm/m °C
Maximum Operating Temperature	140	°C
Minimum Operating Temperature	-40	°C
Crystalline Melting Temperature	174	°C
Surface Resistance	$>10_{12}$	Ω
Thermal Conductivity	0.13	w / m · K
Flammability	V-0	UL_{94}
Colour	Natural	

Chemical resistance

PVDF has an outstanding resistance to inorganic and organic acids, oxidizing media, aliphatic and aromatic hydrocarbons, alcohols and halogenated solvents. PVDF is resistant to halogens, in particular bromine (but not fluorine) and to weak bases. It is degraded by fuming sulphuric acid, some strong basic amines, concentrated and hot alkalis as well as alkaline metals.

PVDF swells in high-polar solvents such as acetone and ethyl acetate. It is also slightly soluble in aphoristic solvents, for example dimethyl form amide and dimethyl sulphide. For further information on the suitability of PVDF for your application, consult the chemical resistance tables or our technical department.

Weathering resistance

Piping systems in PVDF are resistant to UV, and therefore they do not need to be protected against degradation when used outdoors.

Physiological characteristics

PVDF is physiologically non-toxic, and meets the European Directive 90/128/EEC relating to plastic materials in contact with foodstuffs. It is particularly suitable for high purity applications handling hot and cold water in the semi-conductor and pharmaceutical industries, and for applications in the food and drug sector.

Characteristics of PVDF UHP (Ultra High Purity Grade)

PVDF UHP piping is manufactured from an ultra high purity grade resin in natural colour. The manufacturing process is carried out under controlled clean room conditions, and the finished product is rinsed with de-ionized water before protective packaging. PVDF UHP pipes and fittings meet the high demands of the semiconductor industry - for example they are able to maintain the specific resistance of de-ionized and ultra pure water above 18 MΩ.cm (0.055µS)

The performance characteristics of PVDF UHP are broadly similar to those of standard grades of PVDF, 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.

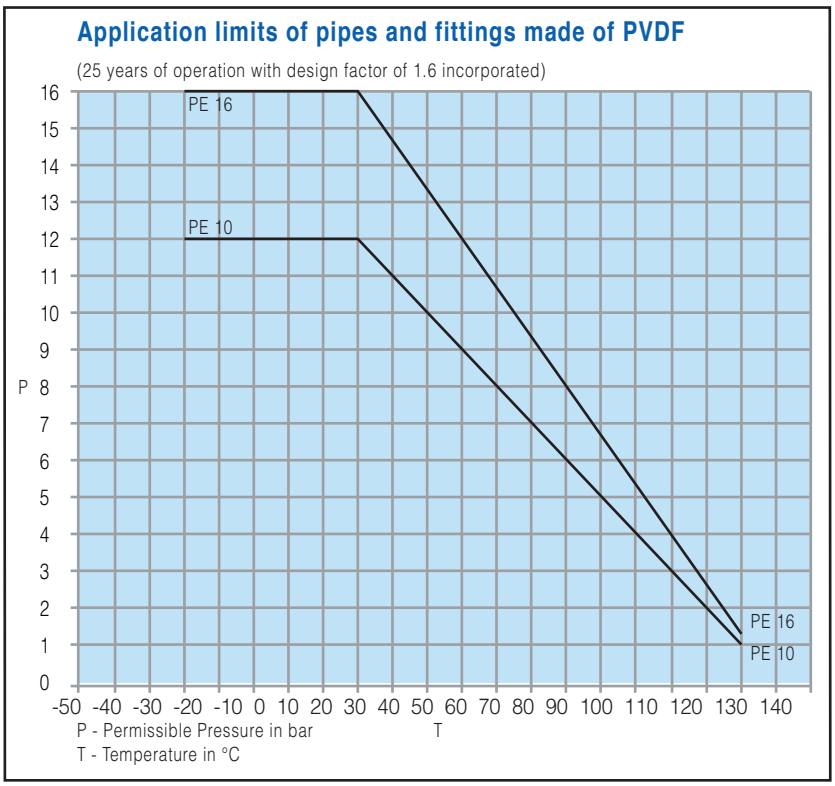
PVDF: Polyvinylidene Fluoride

Pressure ratings for PVDF pipe, fittings and valves

For guidance, the following table gives an indication of the available pressure ratings for polyethylene pipes, fittings and valves. 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
PVDF Pipe S - 16 / SDR33	63mm - 400mm	10.0
PVDF Pipe S - 10 / SDR21	20mm - 280mm	16.0 bar
PVDF Socket Fusion Fittings	20mm - 110mm	20.0 bar*
* Adaptor Fittings 10.0 bar		
PVDF Butt Fusion Fittings S-16 / SDR33	90mm - 315mm	10.0 bar
PVDF Butt Fusion Fittings S-10 / SDR21	20mm - 280mm	16.0 bar
PVDF Electro-Fusion Fittings	20mm - 63mm	16.0 bar
PVDF Ball Valves	20mm - 75mm	16.0 bar
PVDF Ball Valves	90mm - 110mm	10.0 bar
PVDF Diaphragm Valves	20mm - 110mm	10.0 bar
PVDF Butterfly Valves	90mm - 140mm	10.0 bar
PVDF Butterfly Valves	160mm - 225mm	6.0 bar

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 PVDF piping is shown in the following diagram:



PVDF pipe availability

Metric Size ISO 161		Standard Grade			UHP Ultra High Purity Grade	
Size	Series SDR Working Pressure	Ventilation *	S-16 SDR 33 PN 10	S-10 SDR33 PN 16	S-16 SDR 33 PN 10	S-10 SDR21 PN 16
16	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)			16 1.5 16 0.14		
20	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)			20 1.9 16 0.21		20 1.9 16 0.21
25	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)			25 1.9 16 0.27		25 1.9 16 0.27
32	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)			32 2.4 16 0.55		32 2.4 16 0.55
40	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)			40 2.4 16 0.55		40 2.4 16 0.55
50	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)			50 3.0 16 0.85		50 3.0 16 0.85
63	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	63 2.5 - 0.93	63 2.5 10 0.93	63 30 16 1.09		63 30 16 1.09
75	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		75 2.5 10 1.11	75 3.6 16 1.55		75 3.6 16 1.55
90	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		90 2.8 10 1.48	90 4.3 16 2.22	90 2.8 10 1.48	90 4.3 16 2.22
110	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	110 3.0 - 1.94	110 3.4 10 2.20	110 5.3 16 3.32	110 3.4 10 2.20	110 5.3 16 3.32
125	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		125 3.9 10 2.84	125 6.0 16 4.24	125 3.9 10 2.84	125 6.0 16 4.24
140	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	140 3.0 - 2.49	140 4.3 10 3.52	140 6.7 16 5.31	140 4.3 10 3.52	140 6.7 16 5.31
160	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	160 3.0 - 2.86	160 4.9 10 4.54	160 7.7 16 6.96	160 4.9 10 4.54	160 7.7 16 6.96
180	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		180 5.5 10 5.74	180 8.6 16 8.74	180 5.5 10 5.74	180 8.6 16 8.74
200	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	200 3.0 - 3.58	200 6.2 10 7.19	200 9.6 16 10.74	200 6.2 10 7.19	200 9.6 16 10.74
225	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		225 6.9 10 8.95	225 10.8 16 13.67	225 6.9 10 8.95	225 10.8 16 13.67
250	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	250 3.0 - 4.48	250 7.7 10 11.09	250 11.09 16 16.73	250 7.7 10 11.09	250 11.09 16 16.73
280	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)		280 8.6 10 13.86	280 13.4 16 21.11	280 8.6 10 13.86	280 13.4 16 21.11
315	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	315 4.0 - 7.47	315 9.7 10 17.55		315 9.7 10 17.55	
355	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	355 4.0 - 9.34	355 10.9 10 22.00			
400	O.D (mm) Wall (mm) Max WP (bar) Weight/m (kg)	400 5.0 - 11.81	400 12.3 10 28.03			

* Listed by FM Global as meeting the FMRC 4910 Clen Room Materials Flammability Test protocol

33. Selection Guidelines

Overview

Each of the plastic materials used for piping systems has a unique set of properties that make a particular material suitable for some applications and in some cases not for others. In many applications, there will be a choice of materials suitable for a particular process installation, and when this occurs there are many other factors that may be considered, including material cost and ease of installation.

When choosing the correct material for a particular application, the designer must consider a number of key factors. Optimum life expectancy can only be achieved through the selection of the most cost effective thermoplastic piping material. In this respect, three principal factors must be considered to determine the best choice of material to be used:

1. What is the fluid to be handled?
2. What is the operating (and design) pressure?
3. What is the operating (and design) temperature?

Inevitably, there will also be other factors that influence material selection. Some of these considerations will include:

- What pipe size is required?
- What is the life expectancy of the system?
- Will the pipe run above or below ground?
- What are the environmental conditions?
- Will the pipe be exposed to UV light?
- Is there a risk of impact damage?
- Will the fluid carry suspended solids?

To assist the designer in selecting the correct type of thermoplastic piping for the intended application, the following pages provide a guide to the principal selection criteria. Detailed assistance is readily available from our technical department upon request.

34. Chemical resistance

Chemical resistance of the piping material

Chemical resistance of the piping material Plastics are widely used not only for water, but also to handle aggressive chemicals. Consequently the determination of the fluid to be carried is therefore one of the prime concerns in the selection process. Other factors, such as the installation environment, also need to be considered. However, the usual starting point for most applications is to determine which material provides the best chemical resistance performance.

The chemical resistance of thermoplastic piping against a broad range of commonly used chemicals can be found in the chemical resistance tables, however we would recommend that in case of doubt that you contact our technical department for clarification. The data shown is based on immersion tests and is given as a guide only as no guarantees can be given in respect of the information shown. Where there is any concern over the suitability of a material, it is recommended to test using the specific working conditions in a pilot installation.

In all cases the suitability of the piping materials, jointing methods and sealing materials (elastomeric for '0' rings, and flange gaskets). must be verified before the commencement of an installation.

When referring to the chemical resistance tables, the classifications Resistant, Conditionally Resistant and Not Recommended are shown using the symbols +, 0 and - respectively. Whilst the terms Resistant and Not Recommended are self explanatory, the term Conditionally Resistant indicates that the medium can attack or cause swelling in the material. The service life is usually shortened and may be restricted by pressure and/or temperature. Note that the data in the tables is based on information from the raw material suppliers, gained using direct contact between the chemical and the un-processed raw material. The resistance of any of the finished products against these media has not been verified. There is no given or intended legally binding assurance of material properties or of suitability for a specific purpose. Materials must be tested under actual service conditions to determine the suitability for a specific application

Chemical resistance of solvent cement welded joints

The chemical resistance of the joints in a solvent welded piping system are the same as the material itself. However, PVC-U or PVC-C solvent welded joints in systems handling the following chemicals can be degraded and require the use of Weld On 724 solvent cement to ensure chemical compatibility:

Hydrochloric Acid 25%+ concentration
Nitric Acid 20%+ concentration
Sulphuric Acid 70%+ concentration
Hydrofluoric Acid in any concentration

Chemical resistance of fusion welded joints

joints Thermoplastic piping systems in polypropylene, polyethylene, ECTFE or PVDF are made with fusion-welded joints using either socket fusion, electro fusion and IR or butt fusion welding techniques. Correctly made fusion joints will have the same chemical resistance as the pipe itself, however in situations where the piping material may be susceptible to stress cracking from the media, the joint itself may be subject to increased risk.

Chemical resistance of valves

Chemical resistance of valves In most cases, valves are manufactured from the same parent material as the pipe-fittings and it can therefore be regarded that their chemical resistance matches that of the piping material. However, valves will usually incorporate elastomeric materials that will be exposed to the media during normal operation. Care should be taken to check the chemical resistance of the elastomeric seals against the chemical to be used in the chemical resistance tables.

Chemical resistance

Media A - CO	Material	PVC-U	PVC-C	ABS	PE	PP	PVDF	EPDM	FPM
	°C	20 40 60	20 40 60 80 95	20 40 60 80	20 40 60	20 60 80 100	20 60 80 100 120	20 40 60 80	20 60 80 100 120
	Concentration								
ACETALDEHTDE	Technically	-	-	-	+ 0 0	0 -	-	+ 0 -	0 -
	40% aqueous solution	0 -	0 0	-	+ + 0	+ + 0 -	- +	+ + + +	+ 0 0
ACETIC ACID	technically pure, glacial	0 -	0 -	-	+ + 0	+ 0 -	+ 0 -	0	-
	10% aqueous	+ + 0	+ + + +	+ 0 -	+ + +	+ + + +	+ + + + +	+ + 0	0 -
ACETIC ACID ANHYDRIDE	technically pure	-	-	-	+ +	+	-	0	-
ACETONE	technically pure	-	-	-	+ + +	+ +	- +	+ + +	-
ACRYLONITRILE	technically pure	-	-	-	+ + +	+	0 +	+ + 0	0 -
ADIPIC ACID	saturated, aqueous	+ + 0	+ + + +	-	+ + +	+ + +	+	+ + +	+ +
ALCOHOLIC SPIRITS	app, 40% ethyl alcohol	+	0	-	+	+	+	+	+
ALLTL ALCOHOL	96%	0 -	0	-	+ + +	+ + + 0	+	0 0 0	0 -
ALUMUNIUM CHLORIDE	saturated	+ + +	+ + + +	+ + + 0	+ + +	+ + +	+ + + + +	+ + + +	+ + + +
ALUMUNIUM SULPHATE	cold saturated, aqueous	+ + +	+ + + +	+ + + 0	+ + +	+ +	+ + + + +	+ + +	+ + +
AMMONIA	gaseous, tech pure	+ + +	-	-	+ + +	+ + + +	-	+	+
AMMONIUM ACETATE	aqueous, all	+ + 0	+ + + +	-	+ + +	+ +	+ + + +	+ + + 0	+ +
AMMONIUM HYDROGEN FLUORIDE	50%, aqueous	+ + 0	+ + + +	-	+ + +	+ +	+ + +	+	+
AMMONIUM AOMPOUNDS: SEE SODIUM									
AMYL ACETATE	c	-	-	-	0 + +	0 -	+ 0	0	-
AMYL ALCOHOL	technically pure	+ + 0	-	-	+ + +	+ + +	+ + + + 0	+ + +	0
ANILINE	technically pure	-	-	-	0	0	+ 0 -	-	0 +
ANILINE HYDROCHLORIDE	aqueous, Saturated	+ 0	-	-	+ + 0	+ 0	+	+ + + +	0 -
ANTIMONY TRICHLORIDE	90% aqueous	+ +		-	+ + +	+ +	+ +	+	+
AQUA REGIA		+ 0	+ + 0	-	0	0 -	0	-	0
ARSENIC ACID	80% aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ + +	+ + + + +	+ + + +	+ + + +
BARIUM HYDROXIDE	aqueous, saturated	+ + 0	+ + + +	+ + + 0	+ + +	+ +	-	+ + + +	+ + +
BARIUM SALTS	aqueous, all	+ + +	+ + + +	+ + + 0	+ + +	+ + +	+ + + +	+ + + +	+ + +
BEEF TALLOW EWULSION, SULPHONATED	usual commercial	+			+	+	+ +	-	+
BEER	usual commercial	+ + +	+ + +	+ + + 0	+ + +	+ +	+ + +	+	+
BENZALDEHYDE	aqueous, saturated	-	-	-	+ + +	+	+	+ + +	+ +
BENZENE	technically pure	-	-	-	0 0 0	0 -	+ 0 -	-	+
BENZENE	free of lead and aromatic compounds	+ + +	0 0 0	-	+ + +	0 -	+ + + + +	-	+ +
BENZONIC ACID	aqueous, all	+ + 0	+ + -	+ + 0 -	+ + +	+ + + +	+ + + + +	-	+ + + 0
BENZYL ALCOHOL	technically pure	0	-	-	+ + +	+ + 0	+ 0 -	+	0
BLEACHING LYE	12.5% active chlorine	+ + 0	+ + + +	0	0 - -	0 -	0 +	+	+
BORAX	aqueous								
BORIC ACID	aqueous, all	+ + 0	+ + + +	0	+ + +	+ + + +	+ + + +	+ + + +	+ +
BRINE, SEA WATER	aqueous, all	+ + 0	+ + + +	+ + + 0	+ + +	+ + + +	+ + + + +	+ + + +	+ + +
BROMINE, LIQUID		+ + 0	+ + + +	+ + +	+ + +	+ + + +	+ + + + +	+ + + +	+ + + +
BULADIENE	technically pure	-	-	-	-	-	+ + + 0	-	+
BUTANE	technically pure	+		-	+ + +	+	+ + + +	-	0
BUTANEDIOL	aqueous, 10%	+		+	+	+ +	+ + +	-	+
BUTANOL	technically pure	+ 0		-	+ + +	+ +	+ + +	+ + +	+ +
BUTYLE ACETATE	technically pure	+ + 0	+	-	+ 0 0	+ 0 0	+ + + 0	+ + +	+ 0
BUTLY PHENOL, P-TERTIARY	technically pure	-	-	-	+	0	+ -	+ -	0 -
BUTYLENE GLYCOL	technically pure	0 -	-	-	0	+	+ + +	-	0
BUTYLENE LIQUID	technically pure	+ + 0	+	+ + + 0	+ + +	+ +	+ + +	+ + +	+ 0
BUTYRIC ACID	technically pure	+		-	-	-	+ + +	0	+
			-	-	+ + 0	+	+ + + 0	0	0
CALCIUM BISULPHATE	cold saturated, aqueous	+	+ + + +				+ + + + +	+	+ + + +
CALCIUM CHLORIDE	saturated, aqueous, all	+ + 0	+ + + +	+ + + 0	+ + +	+ + + +	+ + + + +	+ + + +	+ + + +
CALCIUM HYDROXIDE	aqueous, saturated	+ + +	+ + + +	+ + + 0	+ + +	+ + +	0 0 -	+ + + +	+ + + +
CALCIUM HYPOCHLORITE	cold saturated, aqueous	+ +	+ + + +	+ + -	+ + +	+ +	0 0	+ + +	+ + +
CALCIUM NITRATE	50% aqueous	+ +	+ + + +	+ + + 0	+ + +	+ +	+ + + +	+ + +	+ + +
CARBON DIOXIDE (CARBON ACID)	technically pure moist	+ + 0	+ + + +	+ + + 0	+ + +	+ +	+ + +	+ + + +	+ + +
CARBON DISULPHIDE	technically pure	-	-	-	0	0	+	-	+
CARBON TETRACHLORIDE	technically pure	-	-	-	-	-	+ 0	-	+ +
CAUSIT SODA SOLUTION	up to 40% aqueous	+ + 0	+ - + +	+ + + 0	+ + +	+ + + +	0 0 -	+ + +	0 -
(sodium hydroxide)	up to 50% aqueous	+ + +	+ - + +	+ + + 0	+ + +	+ + + +	0 0 -	+ + 0	-
CHLORAL HYDRATE	technically pure	-	-	-	+ + +	0 -	-	0	0
CHLORIC ACID	10% aqueous	+ + 0	+ + + +	-	+ +	-	+	+ + +	-
CHLORINE	moist, 97% gaseous	0	-	-	-	-	+ + + 0	0	+
	anhydrous, tech pure	0	0	-	0 0 -	-	+ + + 0	0	+
	liquid, technically pure	-	-	-	-	-	+	-	0
CHLORINE WATER	saturated	0 0	+ + + +	0 0	0 0	0	+ + + +	0	0
CHLOROACETIC ACID, MONO	50% aqueous	+ +		-	+ + +	+ +	+ -	0	-
CHLOROENZENE	technically pure	-	-	-	0	+	+ + 0 0	-	-
CHLOROETHANOL	technically pure	-	-	-	+ + +	+ +	+ 0 -	0	-
CHLOROFORM	technically pure	-	-	-	-	0	+ + +	-	0
CHLOROSULPHONIC ACID	technically pure	0		-	-	-	0 -	-	-
CHROME ALUM (CHROMIUM POTASSIUM SULPHATE)	cold saturated, aqueous	+ + +	+ + + +	+ + + 0	+ + +	+ +	+	+ + + +	+ + + +
CHROME ACID	all, aqueous	+	+	-	0	0	+ + 0 0	0	+ 0
CIDER		+	+ + + +	+ +		+	+ +	+	+
CITRIC ACID	10% aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ + + +	+ + + +	+ + +	+ +
COPPER SALT	10% aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ -	+ + + +	+ + + +	+ + +

= No Data - = Not Recommended 0 = Conditionally Resistant + = Resistant

The data in the tables is based on information from the raw material suppliers, gained using direct contact between the chemical and the un-processed raw material. The resistance of any of the finished products against these media has not been verified. There is no given or intended legally binding assurance of material properties or of suitability for a specific purpose. Materials must be tested under actual service conditions to determine the suitability for a specific application.

Chemical resistance

Media CO - MA	Material	PVC-U	PVC-C	ABS	PE	PP	PVDF	EPDM	FPM
	°C	20 40 60	20 40 60 80 95	20 40 60 80	20 40 60	20 60 80 100	20 60 80 100 120	20 40 60 80	20 60 80 100 120
	Concentration								
CORN OIL	technically pure	0	0 0	0	+ + 0	+ 0	+ + +	0 -	+ +
CRESOL	cold saturated, aqueous	0	-	-	+ +	+	+ 0 -	-	+
CROTONIC ALDEHYDE	technically pure	-	-	-	+	+	+ -	+	+
CYCLOHEXANE	technically pure	-	-	-	+ + +	+	+ + +	-	+
CYCLOHEXANOL	technically pure	+ + +	0	-	+ + +	+ 0	+ + 0 -	-	+
CYCLOHEXANONE	technically pure	-	-	-	+ 0 0	+ 0	+ -	0	-
DETERGENTS (WASHING POWDERS)	usual washing lathers	+ + 0	0	-	+ + +	+ + +	+ + + +	+ + +	+ +
DEXTRINE (Starch Gum)	usual commercial	+ + +		+ + + 0	+ + +	+	+ + + + +	+ + +	+ +
DIBUTYL ETHER	technically pure	-	-	-	0 -	0 -	+ + + +	-	+ 0
DIBUTYL PHTHLATE	technically pure	-	-	-	+ 0 0	+ 0	+ -	0	0
DIBUTYL SEBACATE	technically pure	-	-	-	+	+	+ -	+	+
DICHLOROACETIC ACID	technically pure	+ + 0	0 0 0 0	-	+ + 0	+ 0	+ 0 -	+ + +	0 -
DICHLOROACETIC ACID METHTL ESHER	technically pure	-	-	-	+ + +	+ +	0	+ + 0	-
DICHLOROBENZENE	technically pure	-	-	-	0	0	+ + 0	-	+
DICHLOROETHYLENE	technically pure	-	-	-	-	0	+ 0	-	0
DIESEL OIL		+ +	0	0	+ 0	0	+ + + + +	-	+
DIETHYLAMINE	technically pure	0	-	-		+	-	0	
DI-ISOBUTYL KETONE	technically pure	-	-	-	+	+	+ 0	0	-
DIMETHYL FORMAMIDE	technically pure	-	-	-	+ + 0	+ +	-	0	+
DIMETHYLAMINE	technically pure	0	-	-	+ 0	+	0 -	0	-
ETHYL ACETATE	technically pure	-	-		+ 0 0	+ 0	0 -	0 0 0	-
ETHYL ALCOHOL	technically pure, 96%	+ + 0	0	-	+ + +	+ + +	+ 0 0	+ + + +	0 0
ETHYL ALCOHOL + ACETIC ACID	fermentation mixture	+ + 0		-	+ + +	+	+ + 0	+ + 0 +	0 0
ETHYL BENZENE	technically pure	-	-	-		0 -	+	-	0
ETHYL CHLORIDE	technically pure	-	-	-	0	0	+ + + 0	-	0
ETHYL ETHER	technically pure	-	-	-	0	+	+	-	-
ETHYLENE CHLORIDE	technically pure	-	-	-	0	0	+ + + 0 -	0 0 -	+ 0
ETHYLENE DIAMINE	technically pure	0	-	-	+ + +	+	0 -	+ + +	0 -
ETHYLENE GLYCOL	technically pure	+ + +	0 0 0 0	+ + + 0	+ + +	+ + + +	+ + + + +	+ + +	+ + 0 0
ETHYLENE OXIDE	technically pure, liquid	-	-	-	-	0	+ + 0	0	-
FATTY ACIDS .C6	technically pure	+ + +	0 0 0	-			+ + +	-	+
FATTY ALCOHOL SULPHONATES	aqueous	+ + 0		-	+ + 0 + + +	+ +	+ + + +	+ + +	+
FERRIC CHLORIDE	saturated	+ + +		-		+ 0	+ + + + 0	+ + + 0	+ + + + +
FERRIC NITRATE	saturated	+ + +		+ 0 -	+ + +	+ + 0	+ + + + 0	+ + 0 -	+ + + + +
FERROUS SULPHATE		+ + +		+ + + 0	+ + 0	0 -	+ + + + 0	+ + + +	+ + + + +
FLUOSILICIC ACID	32%, aqueous	+ + +	+ + + 0	+ + + 0	+ + +	+ + + +	+ + + +	0 0 -	-
FORMALDEHYDE	40%, aqueous	+ +	0	+ + + 0	+ + +	+	+ + +	+ + +	+
FORMAMIDE	technically pure	-	-	-	+ + +	+		+	0
FORMIC ACID	technically pure	+ 0 -	0 -	-	+ + +	+ +	+ + + + +	+ + + 0	-
FRUIT JUICES		+ + +	+ + + +	+ + + 0	+ + +	+ -	+ + + + +	+ + + +	+ + + + +
FUEL OIL		+ +	0	0	0 - -	+ + + +	+ + + + +	-	+ +
FURFURYL ALCOHOL	technically pure	-	-	-	+ + +	0 -	+ 0 -	0	-
GELATINE	all, aqueous	+ +	+ + + +	+ + + 0	+ + +	+ 0	+ + +	+ + + +	+ + + +
GLUCOSE	all, aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ +	+ + + + +	+ + + 0	+ 0 -
GLYCERINE	technically pure	+ + +	+ + + +	+ + 0	+ + +	+ + +	+ + + + +	+ +	+
GLYCOCOLL	10%, aqueous	+ +		+	+ + +	+ + +	+ + +	+ +	+
GLYCOLIC ACID	37%, aqueous	+		+ +	+ + +	+	+ + + +	+	+
HEPTANE	technically pure	+	+	+ -	+ 0	+ 0	+ + + +	-	+ +
HEXANE	technically pure	+	+	+ -	+ 0	+ 0	+ + + +	-	+ +
HYDRAZINE HYDRATE	aqueous	+		-	+ + +	+ +	+ 0	+	+
HYDROBROMIC ACID	50%, aqueous	+ + +	+ + + +	+ +	+ + +	+ +	+ + + +	+ + 0 -	+ +
HYDROCHLORIC ACID	up to 10%, aqueous	+ + 0	+ + + +	+ + 0 -	+ + +	+ 0 0	+ + + + +	+ + + +	+ + 0
	up to 36%, aqueous	+ + 0	+ + + +	-	+ + +	+ -	+ + + +	+ 0 -	+ - +
HYDROCYANIC ACID	technically pure	+ + 0		+ +	+ + +	+ +	+ + +	+ 0	+
HYDROFLUORIC ACID	up to 10%, aqueous	+ 0 0	+ +	+ +	+ + 0	+ +	+ + + +	-	+ 0
	40%, aqueous	+	0 0	-	+ + 0	+ +	+ + + +	-	+
	70%, aqueous	+		-	+ 0	+	+ + + +	-	+
HYDROGEN	technically pure	+ + +		+ + + 0	+ + +	+ +	+ + + +	+ + + +	+ + + +
HYDROGEN CHLORIDE	tech. pure, gaseous	+ + 0	+	-	+ + +	+ +	+ + + + +	+ + +	+ +
HYDROGEN PEROXIDE	3%, aqueous	+ + 0	+	+ +	+ + +	+ +	+ + + +	+ 0 -	+ -
	30%, aqueous	+ +	+	-	+ + +	+ 0	+ + + +	0 -	+ 0 -
	90%, aqueous	+		-	+ -	-	+	0	0
HYDROGEN SULPHIDE	technically pure	+ + +		+	+ + 0	+ +	+ + + + +	+ 0 -	+ 0 -
IODINE SOLUTION	6.5% iodine in ethanol	-	0	-	+ 0	+	+ +	+	+
IRON SALTS	all, aqueous	+ + 0	+ + + +	+ +	+ + +	+ + +	+ + + + +	+ + + +	+ + + +
ISO-OCTANE	technically pure	+		-	+ 0	+ 0	+ + + +	-	+
ISOPROPYL ALCOHOL	technically pure	+	0	-	+ + +	+ + + +	+ + 0	+ + + 0	+ + 0
ISOPROPYL ETHER	technically pure	-	-	-	0 -	0 -	+ +	-	-
LACTIC ACID	10%, aqueous	+ 0 -	+ + 0	+ 0 -	+ + +	+ + + +	+ 0 0 -	0 0 0 -	+ 0 0
LANOLIN	technically pure	+ 0	0 0 0	+ + + 0	+ + +	+ +	+ + + + +	0 -	+ +
LEAD ACETATE	aqueous, saturated	+ + +	+ + + +	+ + + 0	+ + +	+	+ + + +	+ + +	+ +
LINSEED OIL	technically pure	+ + 0	0 0 0	+	+ + +	+ + + +	+ + + + +	0 -	+ +
LUBRICATING OILS		+ + +		0	+ + 0	0	+ + + + +	-	+ + + -
MAGNESIUM SALTS	all, aqueous	+ + 0	+ + + +	+ +	+ + +	+ + + +	+ + + + +	+ + + +	+ + + +
MALEIC ACID	cold saturated, aqueous	+ + 0	+ + + +	+	+ + +	+ +	+ + + + +	0 -	+ + -

= No Data - = Not Recommended 0 = Conditionally Resistant + = Resistant

Chemical resistance

Media ME - SO	Material °C Concentration	PVC-U 20 40 60	PVC-C 20 40 60 80 95	ABS 20 40 60 80	PE 20 40 60	PP 20 60 80 100	PVDF 20 60 80 100 120	EPDM 20 40 60 80	FPM 20 60 80 100 120
MERCURY	pure	+ + +	+ + 0	+	+ + +	+ +	+ + + + +	+ + +	+ + +
MERCURY SALTS	cold, saturated, aqueous	+ + 0	+ + + +	+	+ + +	+ +	+ + + + +	+ + +	+ +
METHANE (natural gas)	technically pure	+		+	+	+	+ +	-	+
METHANOL	all	+ + +	-	-	+ + +	+ +	+ + + +	+ + +	0 0
METHYL ACETATE	technically pure	-	-	-	+	+ 0	+	0	-
METHYL AMINE	32%, aqueous	0	-	-	+	+	0	+	+
METHYL BROMIDE	technically pure	-	-	-	0	-	+ +	-	0
METHYL CHLORIDE	technically pure	-	-	-	0	-	+ +	0	-
METHYLENE CHLORIDE	technically pure	-	-	-	0	0	+ 0	-	0
METHYL ETHYL KETONE	technically pure	-	-	-	+ 0 -	+ 0	- -	+ 0	-
MILK		+ + +	-	+ + + 0	+ + +	+ + + +	+ + + + +	+	+
MOLASSES		+ + 0	+ + + +	+ + 0	+ + +	+ +	+ + +	+ + + +	+ + +
MONOCHLOROACETIC ACID ETHYL ESTER	technically pure	0	-	-	+ + +	+ +	+	+	0
MONOCHLOROACETIC ACID METHYL ESTER	technically pure	0	-	-	+ + +	+ +	+	+	0
MORPHOLIN	technically pure	-	-	-	+ + +	+ +	+ 0	0	+
NAPHTHALENE	technically pure	-	-	-	+ 0	+	0 0	-	+ +
NICKEL SALTS	cold saturated, aqueous	+ + 0	+ + + +	+ + + -	+ + +	+ +	+ + + + +	+ + + +	+ + + + +
NITRIC ACID	5%, aqueous up to	+ + +	+ + + +	+ 0 -	+ + +	+ 0	+ + + +	+ + 0	+ 0 -
	40%, aqueous	+ + 0	+ + + 0	-	0 -	0 -	+ + + +	+ + 0	+ + 0
	65%, aqueous	0 0 -	+ + 0 0	-	0 - -	-	+ + 0 0	-	+ -
NITROBENZENE	technically pure	-	-	-	+ + 0	+ +	+ + - -	-	0
NITROLUENE (o-, m-, p-)	technically pure	-	-	-	+ + 0	+ 0	+ + + 0	-	0 -
NITROUS GASES	diluted, moist, anhydrous	+ 0		0	+ + +	+ -	+ + + +	+ + 0	+ +
OLEIC ACID	technically pure	+ + +	0	+ 0 -	+ + 0	+ 0	+ + + +	-	+ -
OLIVE OIL		+ + +	0 0 0	+	+ + 0	+ + +	+ + + + +	-	+ + +
OXALIC ACID	cold saturated, aqueous	+ + +	+ + + +	+ +	+ + +	+ +	+ 0	0 0 0 -	+ 0 -
OXYGEN	technically pure	+ + +		+ + + -	+ + 0	+ 0	+ + + 0 0	+ + + +	+ + + + +
OZONE	cold saturated, aqueous	+ +		-	0 -	0 -	+ + 0	+ 0 -	+ -
PALMITIC ACID	technically pure	+	0	-	0	-	+ + + + +	0 -	+ -
PALM OIL, PALM NUT OIL		+ -	0		+ + 0	+ 0	+ + + +	+ 0 -	+ +
PARAFFIN EMULSIONS	usual comm., aqueous	+ +		-	+ + 0	+ 0	+ + + +	-	+ + +
PARAFFIN OIL		+ + 0		+ + + 0	+ + +	+ 0	+ + + + +	-	+ + 0
PERCHLORIC ACID	10%, aqueous	+ + 0	+	+ +	+ + +	+ +	+ + + +	+ + + 0	+ + 0
	70%, aqueous	0		-	+ 0 -	0 -	+ + + +	+ + + 0	+ + 0
PERCHLOROETHYLENE (tetrachloroethylene)	technically pure	-	-	-	0	0	+ + 0 0	-	+ +
PETROLEUM	technically pure	+	0 0 0	-	+ + 0	+ 0	+ + + + +	-	+ 0
PETROLEUM ETHER	technically pure	+ + +	+ + +	-	+ 0 0	+ 0	+ + + +	-	+ 0
PETROLEUM JELLY	technically pure	0 -		-	0 -	+ 0	+ + + + +	-	+ + + + +
PHENOL	up to 90%, aqueous	0	+ + +	-	+ + 0	+ +	+ + + +	-	+ -
PHENYLHYDRAZINE	technically pure	-	-	-	0	0	+	0	+ 0
PHENYLHYDRAZINE HYDROCHLORIDE	aqueous gaseous,	0		-	0	+ 0	+ +	+ + 0	+ 0 -
PHOSGENE	technically pure	+ 0 0	-	-		0	+	+ + +	+ 0
PHOSPHORIC ACID	85%, aqueous	+ + +	+ + + +	+ + 0 -	+ + 0	+ + + +	+ + + + +	+ + + 0	+ + + 0
PHOSPHOROUS PENTOXIDE	technically pure	+ +		+ +	+ +	+	+ + + +	+ + +	+ +
PHOTOGRAPHIC DEVELOPER	usual commercial	+ + 0	+	+ + 0	+ + 0	+	+ +	+ +	+
PHOTOGRAPHIC EMULSION		+ +		+ +	+ +	+	+ +	+ +	+
PHOTOGRAPHIC FIXER P	usual commercial	+ + 0		+ + 0	+ +	+	+ +	+ +	+
HTHALIC ACID	saturated, aqueous	+ 0 -		-	+ + +	+ +	+ + + +	+ + 0	-
PICRIC ACID	1%, aqueous	+		-	+	+	+ + + +	+ + 0	+ + 0
POTASH (potassium carbonate)	cold saturated, aqueous	+ +	+ + + +	+ + + 0	+ +	+ +	+ 0	+ +	+
POTASSIUM PERMANGANATE	cold saturated, aqueous	+ + 0	+ + + +	-	+ + 0	+ +	+ + + +	+ + +	
POTASSIUM COMPOUNDS: see SODIUM									+ + +
PROPANE	technically pure, liquid	+		+	+	+	+ +	-	+
PROPANOL, n- and iso-	technically pure	+ 0 0	0 0 0	+	+ + +	+ +	+ + 0	+ + +	+ +
PROPIONIC ACID	50%, aqueous	+ + 0	0 0 0	+	+ + +	+ +	+ +	+ + +	+ 0
PROPYLENE GLYCOL	technically pure	+ + +	0	0	+ + +	+ +	+ +	+ + +	+ 0
PROPYLENE OXIDE	technically pure	0	-	-	+	+	+	+	-
PYRIDINE	technically pure	-	-	-	+ 0 0	0 0	+ 0 0 -	+ 0 -	0 -
SILICONE OIL		+ 0 -	+ 0 0	+	+ + +	+ + + +		0 -	+ +
SILVER SALTS	cold saturated,aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ +	+ + + +	+ + +	+ +
SOAP SOLUTION	all, aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ +	+ + + +	+ + +	+ +
SODIUM ACETATE	all, aqueous	+	+	+ + + 0	+ + +	+ + + +	+ + + 0	+ + + 0	+ + 0
SODIUM BENZOATE	cold saturated, aqueous	+ + 0	+ + + +	+	+ + +	+ +	+ + + 0	+ + + 0	+ + 0
SODIUM BICARBONATE	cold saturated, aqueous	+ + +	+ + + +	+ + + 0	+ + +	+ + +	+ + 0	+ + + +	+ + +
SODIUM BISULPHATE	10%, aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ +	+ + + + +	+ + + 0	+ + + +
SODIUM BISULPHITE	all, aqueous	+ 0 -	+ + + +		+ + +	+ +	+ + + +	+ + + 0	0 -
SODIUM BROMATE	all, aqueous	+ 0	+ + + +		+ 0	+	+ + + +	+ + +	+ +
SODIUM BROMIDE	all, aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ +	+ + + + +	+ + +	+ + +
SODIUM CARBONATE (soda)	cold saturated, aqueous	+ + +	+ + + +	+ + + 0	+ + +	+ + + +	+ 0	+ + + +	+ +
SODIUM CHLORATE	all, aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ +	+ + + + +	+ + + 0	+ + +
SODIUM CHLORIDE	all, aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ + +	+ + + + +	+ + + +	+ + + +

= No Data - = Not Recommended 0 = Conditionally Resistant + = Resistant

Chemical resistance

Media SO - Z	Material °C Concentration	PVC-U 20 40 60	PVC-C 20 40 60 80 95	ABS 20 40 60 80	PE 20 40 60	PP 20 60 80 100	PVDF 20 60 80 100 120	EPDM 20 40 60 80	FPM 20 60 80 100 120
SODIUM CHLORITE	diluted, aqueous	0	+ + + +		+	+ 0	+ + + 0	+ + +	+ +
SODIUM CHROMATE	10%, aqueous	+ + 0	+ + + +	+ + + 0	+	+	+ + + +	+ + +	+ +
SODIUM DISULPHATE	all, aqueous	+ + 0	+ + + +		+	+	+ + + +	+ + +	+ +
SODIUM DITHIONITE								+ + +	
(hyposulphite)	up to 10%, aqueous	+ + 0	+ + + +		+ + +	+ +	+ 0		+ +
SODIUM FLUORIDE	cold saturated, aqueous	+ +	+ + + +	+ + + 0	+	+	+ + + +	+ + +	+ +
SODIUM HYDROXIDE									
see CAUSTIC SODA									
SODIUM HYPOCHLORITE	aqueous (12.5% active)	+ + 0	+ + + +	-	0 -			+	+
SODIUM IODIDE	all, aqueous	+ + 0	+ + + +	+ + + 0	+	0 -	0 -	+ + +	+ +
SODIUM NITRATE	cold saturated, aqueous	+ + 0	+ + + +	+ +	+ + +	+	+ 0 + + +	+ + +	+ +
SODIUM NITRITE	cold saturated, aqueous	+	+ + + +	+ + + 0	+	+ +	+ + + + +	+ + +	+ +
SODIUM OXALATE	cold saturated, aqueous	+ + 0	+ + + +		+	+	+ +	+	+
SODIUM PERSULPHATE	cold saturated, aqueous	+ + 0	+		+ + +	+	+ 0	+ + +	+ + + +
SODIUM PHOSPHATE	cold saturated, aqueous	+ + 0	+ + + +	+ -	+ + +	+ +	+ + 0 -	+ + +	+ +
SODIUM SILICATE	all, aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ + +	+ + -	+ + +	+ +
SODIUM SULPHATE	cold saturated, aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ +	+ 0 + + +	+ + 0 +	+ + +
SODIUM SULPHIDE	cold saturated, aqueous	+ + 0	+ + + +	+ + + 0	+ + +	+ + +	+ +	+ + +	+
SODIUM SULPHITE	cold saturated, aqueous	+ + 0	+ + + +	+ +	+ + +	+ +	+ 0 + +	+ + +	+ +
SODIUM THIOSULPHATE	cold saturated, aqueous	+ + 0	+ + + +	+ -	+ + +	+ +	+ + + +	+ + +	+ +
SPIRITS (brandy)	usual commercial	+ + +		-	+ + +	+ +	+ + + +	+ + + +	+ + 0
STANNOUS CHLORIDE	cold saturated, aqueous	+ 0 0	+ + + +	+ +	+ + +	+ +	+ + + +	+ 0 -	+ +
STARCH SOLUTION	all, aqueous	+ + +	+ + + +	+ +	+ + +	+ +	+ + + +	+ + +	+ +
STEARIC ACID	technically pure	+ + +	0	+ +	+ 0	+ 0	+ + + + +	+ + 0	+ 0
SUCCINIC ACID	all, aqueous	+ + +	+ + +		+ + +	+ +	+ +	+ + +	+ + +
SUGAR SYRUP	usual commercial	+ + 0	+ + +	+ + + 0	+ + +	+ + + +	+ + + + +	+ + + +	+ + +
SULPHUR	technically pure	0 -		-	+ + +	+ + +	+ + + + +	-	+ + +
SULPHUR DIOXIDE	all, moist	+ + 0		-	+ + +	+ +	+ -	+ + 0 -	+ -
	technically pure, liquid	-		-	-	-	-	0	0
SULPHUR TRIOXIDE		-		-	-	-	0	-	+
SULPHURIC ACID	up to 30%, aqueous	+ + 0	+ + + +	+ + 0 0	+ + +	+ +	+ + + + +	+ + + 0	+ + 0 -
	up to 50%, aqueous	+ + +	+ + + +	+ 0 -	+ + +	+ +	+ + + + +	+ + 0 -	+ + 0
	up to 80%, aqueous	+ + +	+ + + +	-	+ + 0	+ 0	+ + + 0 0	+ 0 -	+ 0 -
	up to 90%, aqueous	+ +	+ + + -	-	0	0	+ + + 0 -	0 -	+
	up to 96%, aqueous	+ + 0	+ + -	-	-	-	+ + 0 -	-	+
SULPHUROUS ACID	saturated, aqueous	+ + 0	+ + + +	-	+ + +	+ +	+ + + +	+ 0 -	+ 0 -
TALLOW	technically pure	+ + +	0 0 0	+ +	+ + +	+ +	+ + + +	+ + +	+ +
TANNIC ACID	all, aqueous	+	+ + + +	+ +	+ + +	+ +		+	+
TARTARIC ACID	all, aqueous	+ + 0	+ + + +	+ +	+ + +	+ +	+ + + + +	+ 0	+ +
TETRACHLOROETHANE	technically pure	-	-	-	0	0	+ 0	-	0
TETRAETHYL LEAD	technically pure	+		-	+	+	+ + + + +	0	+
TETRAHYDROFURANE	technically pure	-	-	-	0	-	0 0	-	-
THIONYL CHLORIDE	technically pure	-	-	-	-	-	+	-	-
TOLUENE	technically pure	-	-	-	0	0 -	+ + 0 -	-	0 -
TRIBUTYLPHOSPHATE	technically pure	-	-	-	+ + +	+ +	+	+	-
TRICHLOROETHYLENE	technically pure	-	-	-	-	0	+ + +	-	+
TRICHLOROACETIC ACID	50%, aqueous	+ 0		-	+ + +	+ +	+ 0 -	0	-
TRICHLOROETHANE				-					
(met hylchlorof orm)	technically pure	-	-	-	0	0	+ 0 -	-	+
1,1,2-TRICHLOR0-				-					
1,2,2-TRIFLUOROETHANE				-					
(Freon 113)	technically pure	+ +	-	-			+	-	+
TRICESYL PHOSPHATE	technically pure	-	-	-	+ + +	+ 0		-	-
TRIETHANOLAMINE	technically pure	0	-	+	+ + +	+	+	-	+
TRIETHYLAMINE	technically pure		-	-			0 -	-	
TRIO CTYL PHOSPHATE	technically pure	-	-	-	0	+		-	-
TURPENTINE OIL	technically pure	+ 0	0 0 0	-	0 0 0	-	+	-	+ +
UREA		+ + 0	+ + + +	+ +	+ + +	+ +	+ + + 0	+ + +	+ +
URINE		+ + 0	+ + + +	+ +	+ + +	+ +	+ + + +	+ + +	+ +
VEGETABLE OILS AND FATS		+ 0	0	+ + + 0	+ 0	+ 0	+ + + +	-	+ +
VINEGAR		+ + +	+ + + +	+ + 0 -	+ + +	+ + +	+ + + +	+ 0 -	0 -
VINYL ACETATE		-	-	-		+ 0		+	+
VINYL CHLORIDE		-	-	-			+ + +	0	+
WASTE GASES, alkaline		+ + +	+ + + +		+ + +	+ + +	+ - -	+ + + +	+ + 0 -
WASTE GASES containing:									
- CARBON OXIDES	all	+ + +	+ + + +		+ + +	+ + +	+ + + + +	+ + + +	+ + + +
- HYDROCHLORIC ACID	all	+ + +	+ + + +		+ + +	+ + 0	+ + + + +	+ + + 0	+ + + +
- HYDROGEN FLUORIDE	traces	+ + +			+ + +	+ +	+ + + +	+ + 0	+ + +
- NITROUS GASES	traces	+ + +	+ + + +		+ + +	+ 0	+ + + +	+ + + 0	+ + + 0
- SULPHUR DIOXIDE	traces	+ + +	+ + + +		+ + +	+ + +	+ + + +	+ + + +	+ + +
- SULPHUR TRIOXIDE	traces	+ + +	+ + + +		+ + +	+ 0 0	+ + + +	+ + + 0	+ + +
- SULPHURIC ACID	all	+ + +	+ + + +		+ + +	+ 0	+ + + +	+ + + 0	+ + +
WATER, condensed		+ + 0	+ + + +	+ + + -	+ + +	+ +	+ + + +	+ + 0	+ + + + +
WATER, distilled, de-ionised		+ + +	+ + + +	+ + + -	+ + +	+ + + +	+ + + + +	+ + 0 -	+ + + +
WATER, drinking		+ + +	+ + + +	+ + + -	+ + +	+ + + +	+ + + + +	+ + 0	+ +
WAX ALCOHOL	technically pure	+ + +		-	0 -	0 -	+ + + +	-	+
WETTING AGENTS	up to 5%, aqueous	+ + 0	0	+	+	+ +	+ + +	+	+
WINES, red and white	usual commercial	+ +	+ + + +	+ + + 0	+ + +	+ +	+ + + +	+	+
WINE VINEGAR	usual commercial	+ + +	+ + + +	+ +	+ + +	+ + +	+ + + +	+ 0	0 -
YEAST	all, aqueous	+ +	+ +	+	+ + +	+ +	+ + +	+ +	+ +
XYLENE	technically pure	-	-	- -	-	-	+ 0 0 -	-	+ +
ZINC SALTS	all, aqueous	+ + 0	+ + + +	+ +	+ + +	+ +	+ + + + +	+ + +	+ +

= No Data - = Not Recommended 0 = Conditionally Resistant + = Resistant

39. Pressure limitations and safety factors

Pressure curves

Hoop or circumferential stress is the single largest stress present in any piping system under pressure. It is therefore the governing factor in determining the pressure that a pipe section can withstand. The hoop stress in any pipe is calculated by the outcome of an equation that includes internal pressure, pipe diameter and wall thickness.

For most manufacturers, the long-term performance of the piping system has been established through the calculation of the hydrostatic pressure curve for each material. These pressure temperature curves show the correlation between the hoop (or circumferential) stresses of the material, measured in megapascals (Mpa), versus the time to fail in hours (h). The result of this calculation shows how the pressure rating of the piping material will perform over time, in conjunction with increasing temperatures.

Pressure curves for all of our piping materials are available upon request. We can also assist you in helping to calculate the design life of your chosen piping material at elevated temperatures. Please contact us for more information or further assistance.

Safety factors

The published pressure ratings for thermoplastic piping systems take into account the circumferential stress of the individual materials over their expected lifetime. In addition, the published data also includes provision for material specific safety factors. These safety factors are published below, and are based upon a minimum 50 year design life with water at 20°C.

Material	Minimum Safety Factor
PVC-U	2.0
PVC-C	2.0
ABS	2.1
PP-H	2.1
PP-R	2.1
PE80	1.6
PE100	1.25
PVDF	2.0
ECTFE	2.0

Pressure ratings for fittings and valves

Whilst there is usually clear definition of the maximum working pressure for pipes, some care needs to be taken with the choice of fittings and valves. In most cases, thermoplastic pipe fittings carry the same pressure rating as the pipe itself. However, some mechanical pipe fittings and valves may be rated lower than the pipe. Some examples include flanges and threaded fittings:

Flange B54504 (EN1092) PN6:	6 bars maximum
Flange B54504 (EN1092) PN10:	10 bars maximum
Flange ASA 150 (PR EN 1759):	10 bars maximum
BSP threaded fittings (IS0787):	10 or 12 bars maximum

Always consider the item with the lowest pressure rating in any system.

Terminology used to define pressure ratings for thermoplastic piping systems

Nominal Pressure (PN)

The most common method of defining pressure ratings for thermoplastic piping systems is to group together pipes, fittings and valves according to a single nominal pressure rating. This method can simplify the selection process, and its use is internationally widespread. The PN rating is the maximum permitted operational pressure in bars calculated at 20°C, for example PN6 indicates a maximum working pressure of 6 bars.

The 'Class' system of pressure ratings

PVC-U Pipes according to BS 3505/3506 (BS EN1452), PVC-U fittings according to BS 4346, ABS pipes according to BS 5391, and ABS fittings according to BS 5392 all use the 'class' system of pressure rating their components. Regardless of size, pipes and fittings are rated for use at a maximum working pressure according to the 'class'. Care must be taken to ensure that the integrity of the system is not compromised through the incorrect match of pipes and fittings from different pressure 'classes'. The pressure ratings of PVC-U and ABS pipes and fittings according to the pressure 'class' system is as follows:-

Class B	6 Bar
Class C	9 Bar
Class D	12 Bar
Class E	15 Bar

PVC-U and ABS pipes with a heavy wall 'Class T' (sometimes referred to as 'Class 7') rating are also produced as threading quality piping materials, or for use in installations requiring special support, temperature or pressure handling capabilities. Note that threading plastic pipes reduces the maximum operating pressure of the system by 50%.

The 'Schedule' system of pressure ratings

PVC-U and PVC-C thermoplastic piping systems manufactured in accordance with ASTM requirements use a 'schedule' system of pressure ratings. Pipes are produced in three different 'schedules', 40, 80 & 120. Under this system the pressure rating of the pipe changes according to the pipe nominal bore size.

Unlike pipe, there is presently no industry standard that specifies a working pressure for fittings. Moulded pipe fittings are manufactured to meet the minimum burst pressure requirements to that of schedule 40 and schedule 80 pipe. In common with the pipe, the pressure rating of the fittings decreases as the nominal pipe sizes increases. By way of example, the range of pressure ratings for 'schedule' pipes is as follows:-

Schedule 40 (PVC & PVC-C)	56 Bar (1/8") - 8.2 Bar (24")
Schedule 80 (PVC & PVC-C)	85 Bar (1/8") - 14.5 Bar (24")
Schedule 120 (PVC)	70 Bar (1/2") - 25.5 Bar (6")

Schedule 40, 80 and 120 pipes are manufactured to ASTM D1784 for materials and ASTM F 441 for pipe dimensions. PVC-U schedule 40 fittings are manufactured according to ASTM D2466, whilst PVC-U Schedule 80 fittings are manufactured according to ASTM D2467. PVC-C Schedule 80 fittings are manufactured according to ASTM F439.

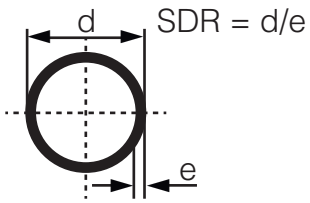
Terminology used to define pressure ratings for thermoplastic piping systems

Standard Dimensional Ratio (SDR)

Standard Dimensional Ratio (SDR) is used to define thermoplastic pipes in a variety of materials including polypropylene, polyethylene, and PVC-U. Taken from ISO 4065, SDR is described as being 'the ratio of the nominal outside diameter of a pipe to its nominal wall thickness'. To calculate the SDR according to ISO 4065 the following equation can be used:

$$SDR = \frac{d}{e}$$

where:
SDR = Vlaue to be calculated
e = Thickness of the pipe wall (mm)
d = Pipe outside diameter (mm)



However, although pipes in different materials might share the same SDR number, there may be distinct differences in both outside diameter and wall thickness. Unlike the `PN' or `S' Series' methods they will not share the same nominal pressure rating. This is because the hoop stress differs from one material to another.
When selecting thermoplastic piping systems, it is recommended that in addition to the material type, the pipe dimensions, wall thickness, pipe series and SDR numbers are all referenced.

'S' Series: ISO 4065

ISO 4065 specifies the relationship between the nominal wall thickness and the nominal outside diameter of thermoplastic pipe. Defined under this method, pipes of the same material with the same series or `S' number have the same pressure rating. According to ISO 4065, `S' is a dimensionless number that can be calculated from the following equation:

$$S = \frac{SDR - 1}{2}$$

Example: SDR 11 Polypropylene

$$S = \frac{SDR - 1}{2}$$

$$S = \frac{11 - 1}{2}$$

$$S = 5$$

Comparison of SDR value with nominal pressure rating for common materials

	Nominal Pressure Rating (PN) by Material					
SDR	PE 80	PE 100	PP	PVDF	PVC-U	PVC-C
51	2.5	3.2	-	-	4	-
41	3.2	4	2.5	-	-	-
33	4	5	3.2	10	6	-
26	5	6.3	4	-	-	-
22	6	7.6	-	-	-	-
21	6.3	8	-	16	10	10
17,6	7.6	9.7	6	-	-	-
17	8	10	-	-	-	-
13,6	10	12.5	-	-	16	16
11	12.5	16	10	-	-	-
9	16	20	-	-	25	25
7,4	20	25	16	-	-	-
6	25	-	-	-	-	-

Calculating the allowable pressure and pipe wall

The vessel formula

The vessel formula is used to calculate the minimum pipe wall thickness for a thermoplastic pipe subject to a given internal pressure:

$$e = \frac{p \cdot d}{20 \cdot \sigma + p}$$

where:
e = Thickness of the pipe wall (mm)
d = Pipe outside diameter (mm)
p = Permissible operating pressure at 20°C (bar)
o = Permissible hoop (circumferential) stress with safety factor (N/mm2)
20 = Constan

This formula can be used to calculate the pipe wall thickness for a variety of thermoplastic materials, however in smaller dimensions the actual production sizes of pipes may have increased wall thickness because of manufacturing constraints.

Plastic pipes for vacuum or external pressure

When subjected to vacuum or to an external fluid pressure, plastic pipes are subjected to stresses that can lead to the collapse of the pipe.

As a general guide, the following formula can be used to determine the collapse pressure dependent an the pipe size and operating temperature:

$$P_C = \frac{20 \times E \times (e/D)_3}{0.84}$$

where
P_C = Collapse Pressure (bar)
E = Modulus of Elasticity (N/mm2)
e = Wall Thickness (mm)
D = Nominal Pipe Size - usually taken as the outside diameter (mm)
0.84 - Constant

The modulus of elasticity can be obtained from the E modulus diagrams. Note that account must be taken of the operating temperature and service life. Pipe dimensions may be found in each material section.

Using the result from this calculation, the maximum allowable negative pressure can now be calculated using the following formula:

$$P_e = \frac{P_C}{C}$$

where
Pc = Collapse Pressure (bar) from calculation above
P_e = Maximum Allowable Negative Pressure (bar)
C = Safety Factory (usually 2)

If P_e is greater than 1, the pipe is suitable for full vacuum under the calculated conditions.

Calculating the allowable pressure and pipe wall

Example: Can a 200 mm O.D. DIN 8061/2 PVC-U PN10 pipe withstand a vacuum at 20°C and 50°C?

Pipe size (D): 200 mm
Wall thickness (e): 9.6mm
Modulus of elasticity (E): 1420 N/mm² at 20°C (from diagram)
580 N/mm² at 50°C (from diagram)

At 20°C: Collapse pressure $P_c = \frac{20 \times 1420 \times (9.6/200)^3}{0.84} = 3.74$ bar

Maximum negative pressure $P_e = \frac{3.74}{2} = 1.87$ bar

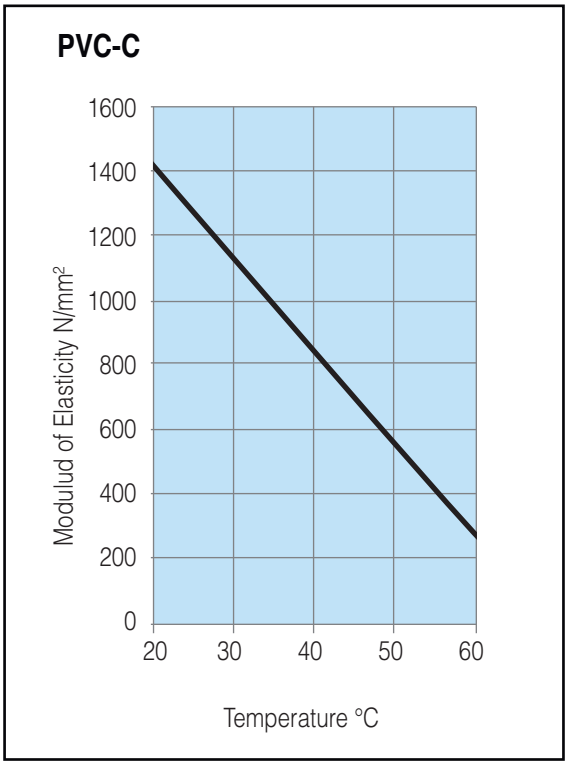
Answer: $P_e = 1.87 > 1$ so the pipe will support full vacuum at 20°C.

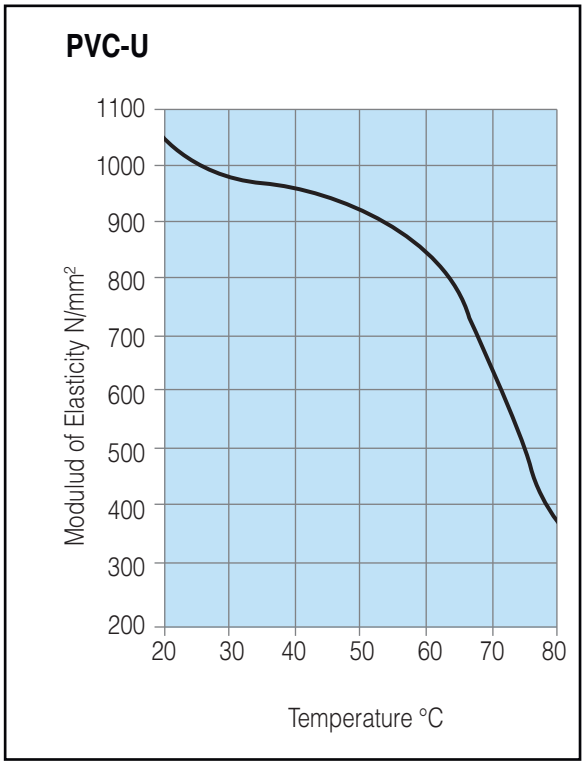
At 50°C: Collapse pressure $P_c = \frac{20 \times 580 \times (9.6/200)^3}{0.84} = 1.60$ bar

Maximum negative pressure $P_e = \frac{1.60}{2} = 0.80$ bar

Answer: $P_e = 0.80 < 1$ so the pipe will not support full vacuum at 50°C.

E-modulus diagrams

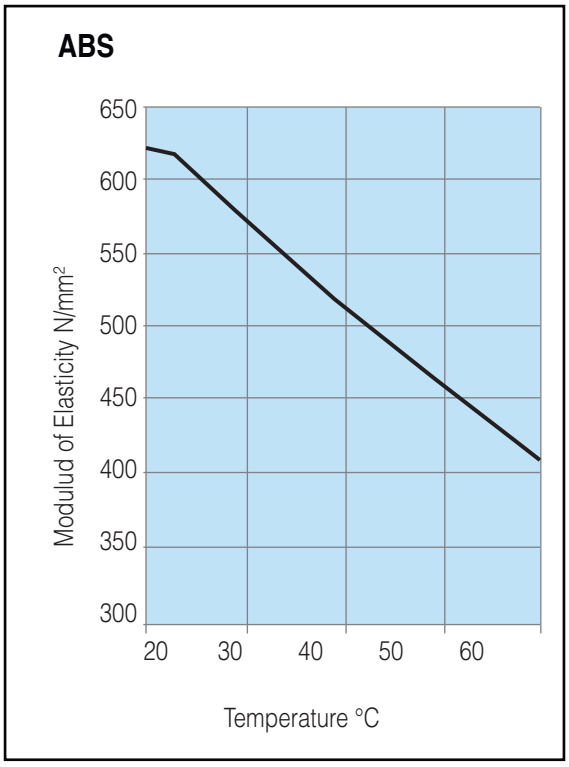




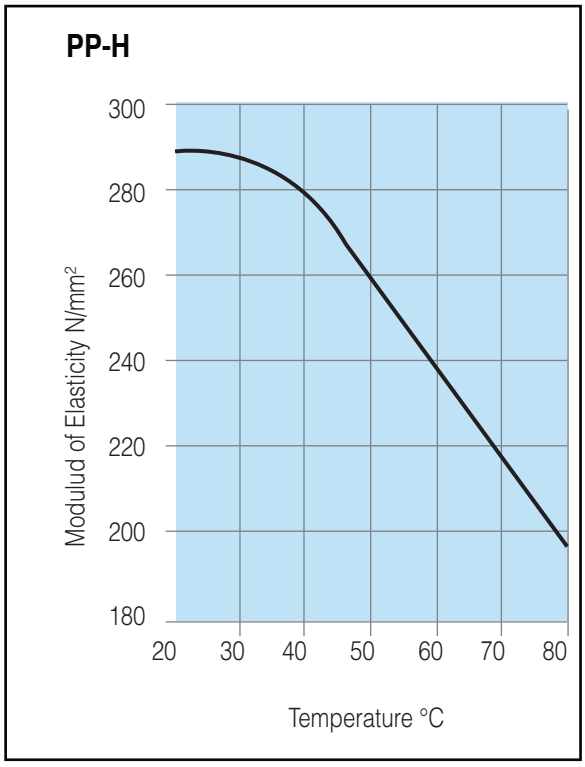
Calculating the allowable pressure and pipe wall

E-modulus diagrams

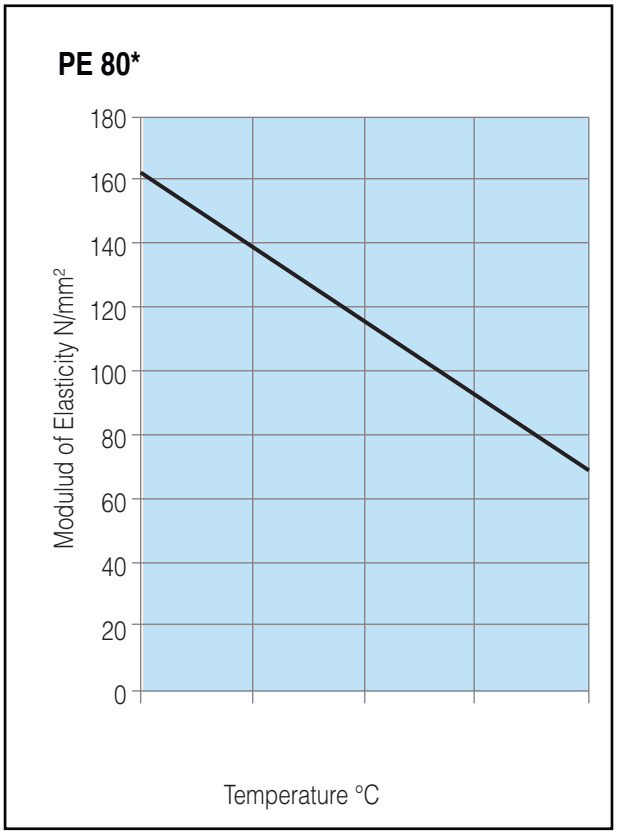
ABS



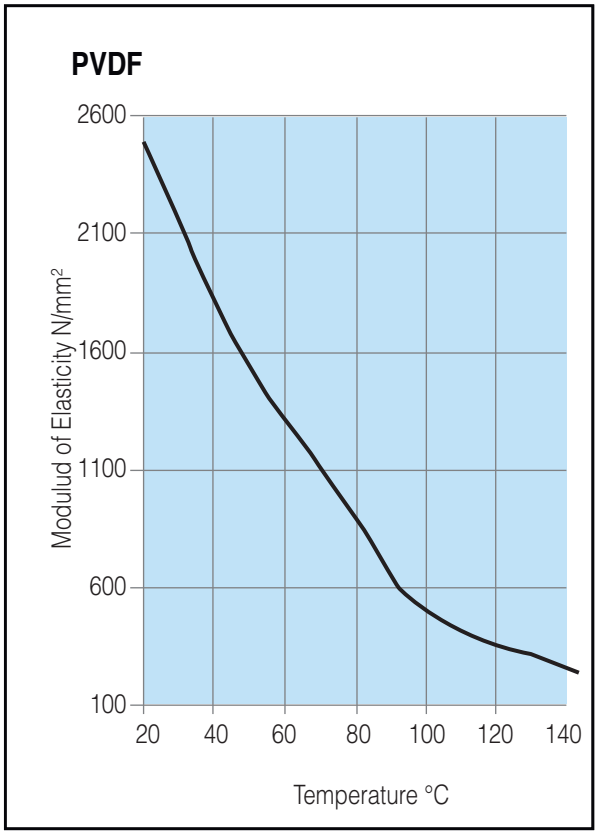
PP-H



PE 80*



PVDF



* PE100: There are no e-modulus diagrams available yet for PE100, however as a guide it is recommended to raise the values of PE80 by 10%.

45. Adjusting the allowable pressure for increasing temperature

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 of the pipe. Because of this, the pressure rating of the system must be reduced as the temperature rises to allow for safe operation. The temperature correction (de-rating) factors for each material is shown in the following table:-

Temperature correction (de-rating) factors

	Working Temperature						
Material	20°C	40°C	60°C	80°C	100°C	120°C	140°C
PVC-U	1.00	0.58	0.22	-	-	-	-
PVC-C	1.00	0.81	0.50	0.26	-	-	-
ABS	1.00	0.72	0.45	-	-	-	-
Polyproplene	1.00	0.82	0.50	0.25	0.05	-	-
Polyethylene	1.00	0.53	-	-	-	-	-
PVDF	1.00	0.82	0.66	0.51	0.39	0.29	0.19

46. Plastic pipes for compressed air or gases

Although plastics can be used to transport compressed air, the selection of the correct material for this application is particularly important. The compressibility of air and/or other gases results in tremendous amounts of stored energy, even at low pressures.
PVC-U and PVC-C have a brittle mode of failure, and should a fracture occur in a pipe handling compressed air or gas, the immediate release of the stored energy can cause extreme danger. Under these conditions, the velocity created by the rapidly escaping air and the resulting failure mode can throw shards of material in all directions. For this reason PVC-U or PVC-C must never be used for this application.
Certain compressor oils are known to cause stress cracking of ABS and Polypropylene, and for this reason they are also not recommended for this application.

AGRUAIR PE compressed air piping installed at a chemical plant

Polyethylene (PE) has good resistance to compressor oils, and has high ductility and impact strength. This material may be used for compressed air or gases (subject to the chemical suitability of the gas with the material).