

# about: pvdf

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 stabilisers 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. PVDF does not support combustion after removal of a flame, and falls into the class V-0 according to UL94.

PVDF has excellent welding characteristics, and can be joined by either socket fusion welding, butt fusion welding, non-contact Infra-Red (IR) welding or electrofusion welding techniques. In addition, 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 pvdf

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 PVDF are:

- Low specific weight of 1.78g/cm<sup>3</sup>
- Long-term creep resistance very high
- Chemical resistance is excellent
- High resistance to thermal ageing
- Outstanding welding characteristics
- Excellent abrasion resistance
- Smooth internal surfaces
- Excellent resistance against UV ageing
- Wide temperature range (between -40°C to +140°C)

Properties of PVDF (Average values)	
Property	Value
Density	1.78 g/cm <sup>3</sup>
Tensile Strength	>50 MPa
Elongation at Break	80%
Notched Impact Strength at 23°C	11 kJ/ m <sup>2</sup>
Modulus of Elasticity (Young's Modulus)	2000 MPa
Coefficient of Linear Expansion	0.12 mm/m /°C
Maximum Operating Temperature	140°C
Minimum Operating Temperature	-40°C
Crystalline Melting Temperature	174°C
Surface Resistance	>10 <sup>12</sup> Ω
Thermal Conductivity	0.13 W/m · K
Flammability	V-0 UL94
Colour	Natural

## Characteristics

### Chemical resistance

PVDF has an outstanding resistance to inorganic and organic acids, oxidising 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 aprotic solvents, for example dimethyl formamide and dimethyl sulphide.

### Weathering resistance

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

### Electrical characteristics

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

### 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.

## Pressure ratings for pvdf systems

### Maximum continuous pressure ratings

Pipes, fittings and valves are designed to operate continuously for 50 years at their maximum rated pressure at 20°C as follows, unless otherwise stated.

The pressure ratings for PVDF pipes according to ISO 10931-2 and PVDF fittings according to ISO 10931-3 are defined by the 'nominal pressure' method, **whereby** pipes, fittings and valves are grouped together according to a single nominal pressure rating. 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. According to this method the pressure ratings of PVDF pipes and fittings according to the nominal pressure system is as follows:-

		Size Range	Max. Operating Pressure
Pipe	PN16	20mm to 280mm	16 Bar
	PN10	63mm to 400mm	10 Bar
Fittings			
Socket Fusion	PN20	20mm to 110mm	20 Bar
Spigot Fusion	PN16	20mm to 280mm	16 Bar
	PN10	90mm to 315mm	10 Bar
Threaded	PN12	1/2" to 2"	12 Bar

### 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:

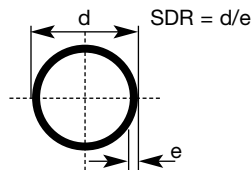
$$SDR = \frac{d}{e}$$

where:

SDR = Value to be calculated

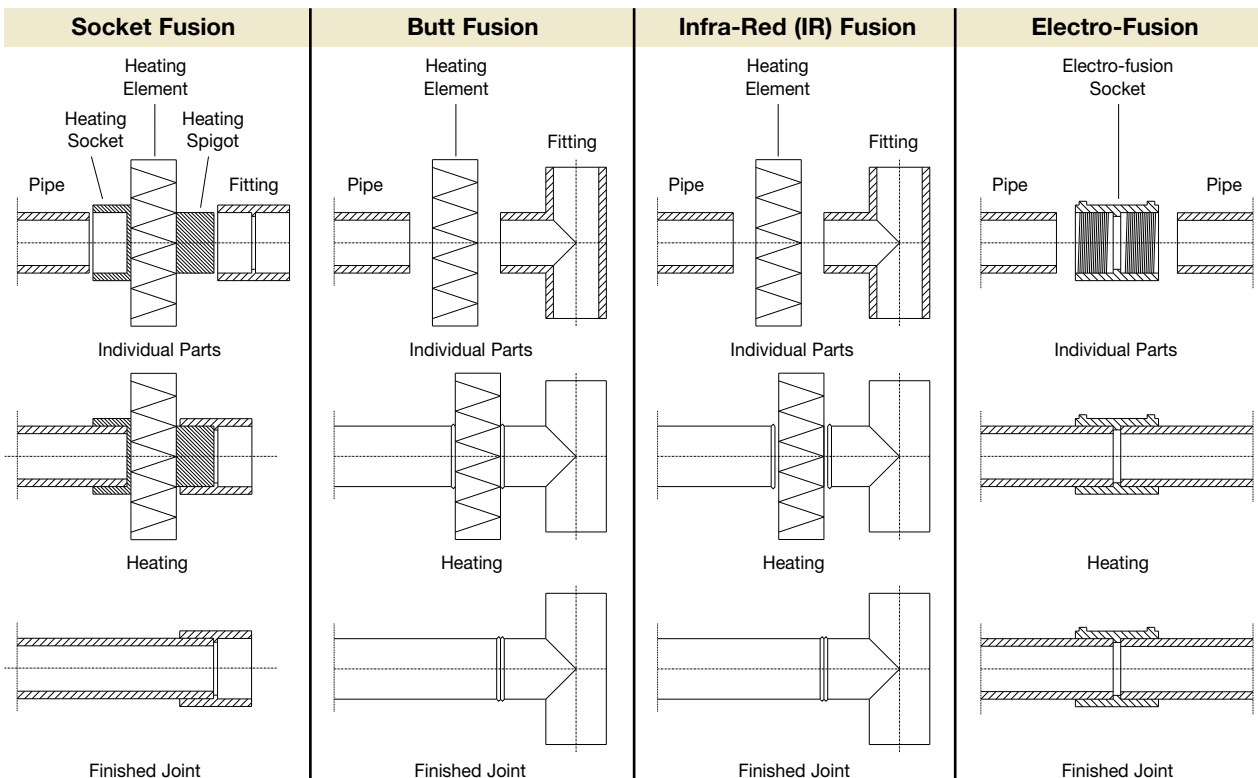
e = Thickness of the pipe wall (mm)

d = Pipe outside diameter (mm)



## Joining PVDF Systems

PVDF pipe to pipe and pipe to fitting joints are easy to make, using socket fusion, butt fusion, IR fusion or electrofusion welds. IR fusion is similar in method to butt fusion using non-contact IR heat to melt the pipe ends prior to welding. Non-contact welding produces cleaner, consistent weld characteristics.



Welding equipment is available for sale or hire - see Tools and Installation Equipment. Detailed installation instructions, as well as free training, is available on request.