Advanced Polymer PushFit

System for Hot and Cold Water Inside Buildings

Technical Manual

Contents

1. General

SP – AP PushFit piping system for hot and cold water installations inside buildings incorporate multi-layer composite PEX-Al-PEX pipes and PPSU push-fit fittings.

The pipes are flexible but retain their shape when bent and the fittings enable reliable watertight joints to be made quickly and easily.

Materials that come into contact with water are certified according to KTW regulations for drinking water and DVGW W270 requirements for microbiological growth.

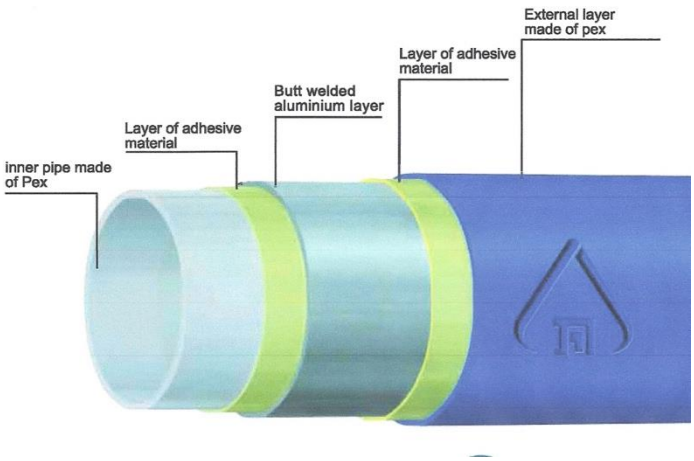
2. Service Conditions

Design pressure (water supply):	10bar
Working Temperature (water supply):	70°C (According to ISO 10508 Class 2)
Design pressure (radiators):	6bar
Working temperature (radiators):	80°C (According to ISO 10508 Class 5)
Maximum temperature:	95°C

3. Pipes

3.1 Structure and Materials

The pipes are manufactured from of a layer of aluminium sandwiched between two layers of cross-linked polyethylene. The aluminium layer provides strength and serves as an oxygen barrier preventing oxygen diffusion through the polymer matrix and also enables bends formed in the pipe to keep their shape. Between the PEX layers and the aluminium are layers of adhesive.



3.2 Pipe Specifications

Dimensions:

Nominal Diameter (mm)	16	20
Nominal Thickness (mm)	2.0	2.0
Aluminium Thickness (mm)	0.20	0.25
Length of coils (m)	100	100
Weight (g/m)	105	140
Water volume (l/m)	0.113	0.201

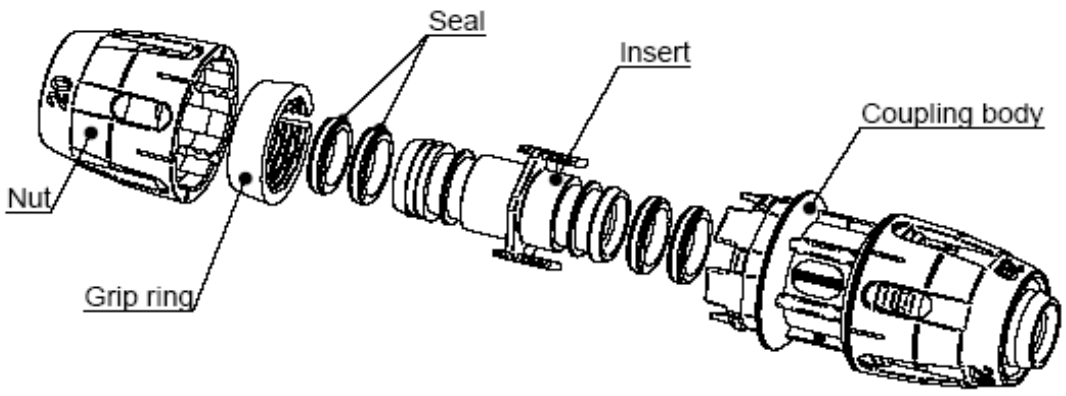
Thermal Properties:

Coefficient of thermal expansion: 0.026 mm/m/°C

Thermal conductivity: 0.43 W/mK

4. Fittings

4.1 Fitting Design



SP – AP PushFit fittings have a unique design.

The initial interaction of the insert and grip ring and the free movement of this assembly within the fitting body are a unique design concept and provide advantages not found in other fittings. These include:

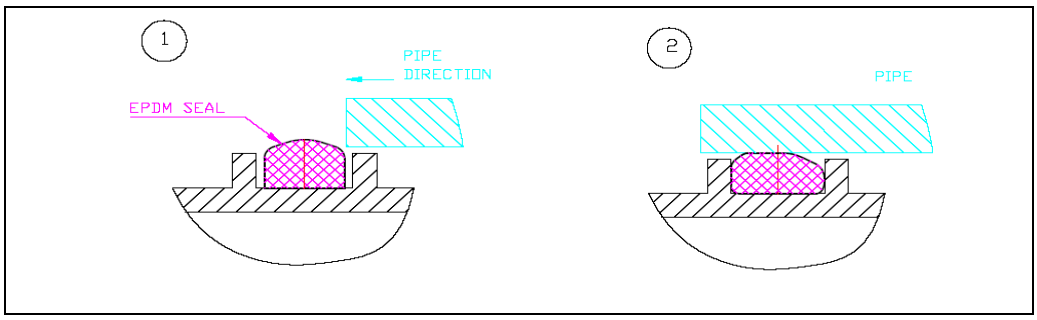
- - Stress reduction from temperature and pressure cycling
- - Superior griping forces without penetrating to the aluminum layer

The Insert - After initial pipe insertion the complete assembly moves in and out of the fitting body reducing stresses generally associated with hot and cold cycling systems.

The Grip Ring - Rows of concentric teeth hug the pipe over a large area without penetrating the aluminum layer. A concave outer surface allows self centering around the pipe compensating for minor misalignment in installation and contraction or expansion during temperature and pressure cycling.

The Seal - Incorporates a cross section that is flat on the bottom sealing with the body immediately following assembly. A special profile on the top gives an effective seal with the pipe while preventing the seal from "rolling out" of the channel.

There are two seals on each side of the insert providing an extra safety factor.



4.2 Ftting range

	Part No.	Description	Dimension
1	62016M0016	Straight Coupler	16x16
2	62016M0101	Transition coupler	16x½”
3	62016M0102	Transition coupler	16x¾”
4	62016Z0016	Elbow	16x16
5	62016T0016	Tee	16x16x16
6	62016T0020	Transition Tee	16x20x16
7	62016TA020	Transition Tee	16x16x20
8	62020M0020	Straight Coupler	20x20
9	62020D0016	Transition coupler	20x16
10	62020M0101	Transition coupler – male thread	20x½”m
11	62020M0102	Transition coupler – male thread	20x¾”m
12	62020Z0020	Elbow	20x20
13	62020Z0016	Transition Elbow	20x16
14	62020T0020	Tee	20x20x20
15	62020T0016	Transition Tee	20x16x20
16	62020TA020	Transition Tee	20x20x16
17	62020M0201	Transition coupler – female thread	20x½”f
18	62020M0202	Transition coupler – female thread	20x¾”f
19	62016M0201	Transition coupler – female thread	16x½”f
20	62016J0201	Wall connector – female thread	20x½”f

4.3 Fitting Materials

Parts that come into contact with water (bodies and inserts) are manufactured from PPSU (Polyphenylsulphone) material with excellent thermal stability and mechanical properties.

Nuts and grip rings are manufactured from a reinforced nylon material.

Seals are from EPDM peroxide synthetic rubber according to EN681-1,WB.

Body and Insert - PPSU technical properties:

Property	Test Method	Unit	Value
Physical			
Specific Gravity	ASTM D792		1.29
Water Absorption @24 hours	ASTM D570	%	0.37
Mechanical			
Tensile Strength @yield	ASTM D638	psi	10,100
Tensile Modulus	ASTM D638	psi	340,000
Tensile Elongation @yield	ASTM D638	%	7.2
Tensile Elongation @break	ASTM D638	%	60.0-120.0
Flexural Strength @yield	ASTM D790	psi	13,200
Flexural Modulus	ASTM D790	psi	350,000
Compressive Strength @yield	ASTM D695	psi	14,350
Compressive Modulus	ASTM D695	psi	251,000
Izod Impact Strength Un-Notched	ASTM D256	ft-lb/in	No Break
Izod Impact Strength Notched @73°F	ASTM D256	ft-lb/in	13.0
Hardness	ASTM D785	—	R122
Thermal			
Heat Deflection Temperature @66 psi	ASTM D648	°F	417
Heat Deflection Temperature @264 psi	ASTM D648	°F	405
Coefficient of Thermal Expansion	ASTM D696	in/in/°	F 3.1x10^-5
Flammability Rating - UL94@.031”	—	—	V-0
Thermal Conductivity	ASTM C177	BTU (in)/(hrft^2-°F)	2.42
Limiting Oxygen Index	ASTM D2863	%	38.0
Electrical			
Dielectric Strength	ASTM D149	V/mil	360
Dielectric Constant @1kHz	ASTM D150	—	3.45
Dissipation Factor @1kHz	ASTM D150	—	0.0009
Volume Resistivity	ASTM D257	ohm-cm	>10^15
Optical			
Haze	ASTM D1746	%	15.0
Transparency	ASTM D1746	%	50

Seals - EPDM Peroxide technical properties

Property	Test Method	Unit	Value
Specific gravity	ASTM D297	g/cm3	1,12
Tensile strength	ASTM D412 C	N/mm2	16
Elongation	ASTM D412 C	%	160
Tear resistance	ASTM D624/B	N/mm	27
Low temp. tests TR Test-TR 10	ASTM D1329	°C	-36
Low temp. tests Brittleness	ASTM D2137/A	°C	-58
Compression-Set after deformation		%	25
Compression-Set after 22h at 150°C	ASTM D395/B	%	9
Compression-Set after 70h at 150°C	ASTM D395/B	%	15
Compression-Set after 3000h at 110°C	ISO 815/B in water	%	10.3
Ozone test time 48h – concentration		pphm	200
Ozone test temp. 40°C - elongation		%	50

5. Assembly

5.1 Tools

Due to the push-fit design installation is quick and easy. The only tools necessary are a pipe cutter, calibrator and bending springs.

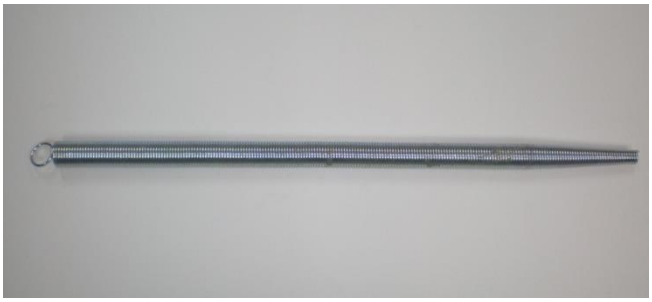
- Pipe Cutter

Pipe cutters should preferably be designed with extended jaws for pipe support ensuring that the pipe is cut at 90°.

- Re-rounding (Calibration) Tool

A calibration tool should be used after cutting to ensure that the pipe is round before assembly. It is important to check that the calibration tool fits the diameter and wall thickness of the pipe.

- Bending Springs



5.2 Assembling the Fitting

Assembly is achieved using the following easy steps:

a) Cut the pipe to the length required using a pipe cutter ensuring a 90° angle

b) If necessary bend the pipes by hand using a bending spring of the correct diameter.

c) Re-round (calibrate) the pipe using a suitable re-rounding tool.

- Before use ensure that the tool is suitable for the pipe diameter and thickness.
- Calibrators that create a chamfer may be used but are not necessary.
- After calibration, check that there is no damage to the aluminum layer and that the pipe is clean and free of burrs.

d) Select the correct fitting (diameter and wall thickness)

e) Push the fitting onto the pipe as far as it will go.

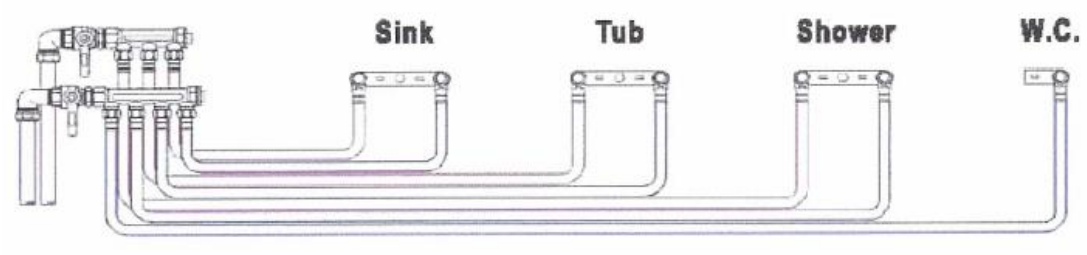
Important! Check that the pipe has been completely inserted into the fitting. The pipe should be visible through the windows in the nut.

6. Installation Guidelines

6.1 Suggested Layouts

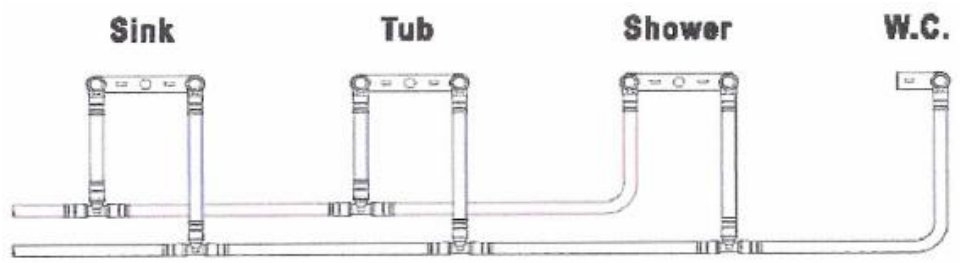
Distribution Manifold:

Each terminal is individually connected to the manifold.



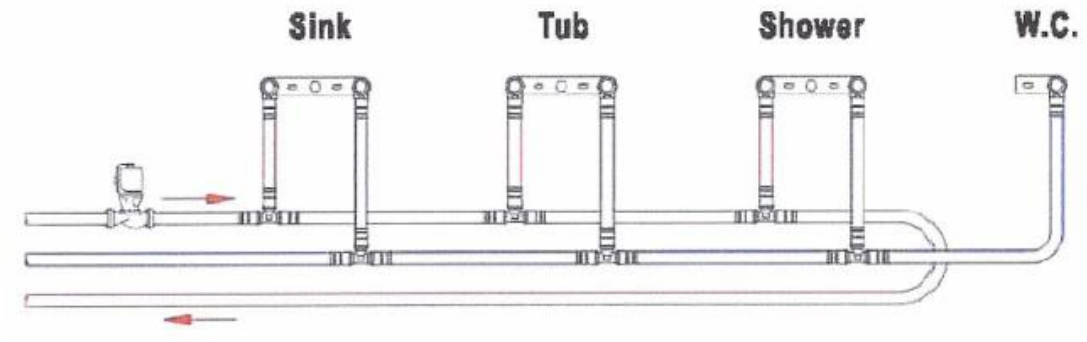
Tee Branch:

Each terminal is connected by a Tee fitting to the main pipe.



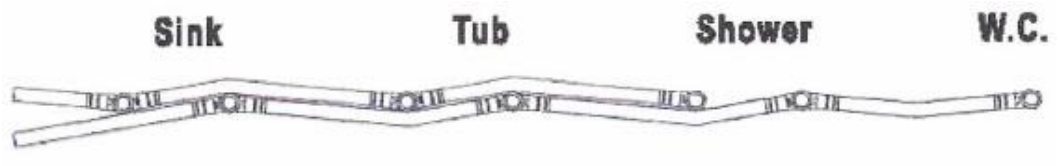
Closed Loop:

The hot water is circulated by means of a pump and the terminals are connected to the main pipe by means of Tee fittings.



Direct Connection:

The terminals are connected directly to the main pipe



6.2 Pipe Fixing

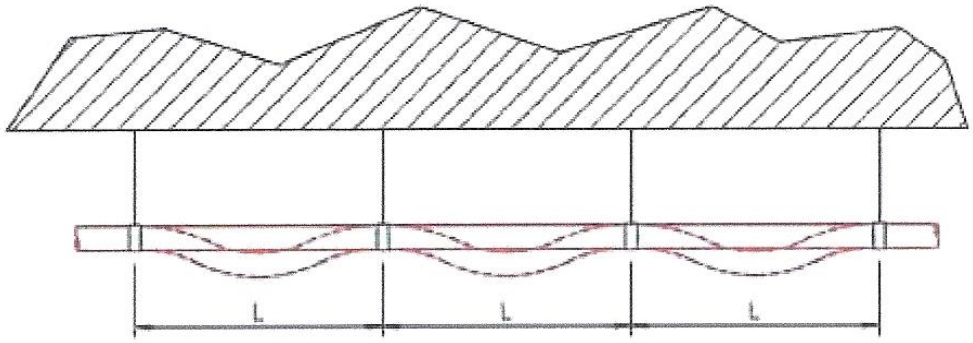
6.2.1 Before you start

The following precautions should be taken when fixing hot and cold water systems:

- Hot pipes should not come into contact with cold pipes
- Pipes should not come into contact with sharp or abrasive surfaces that may damage the pipe.
- Pipes should not come into contact with hot surfaces.
- Pipes should not come into contact that may suffer damage due to heat.

6.2.2 Ceiling installation /horizontal supported pipe

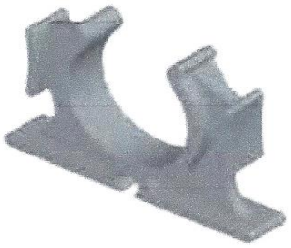
Pipes can be installed on floors, walls and ceilings but due to thermal expansion of the pipes they should be supported with clips or clamps. Refer to the following table for clamping distances.



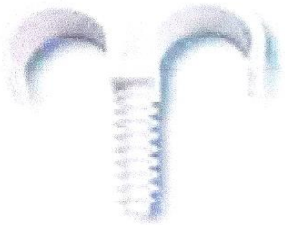
Pipe Diameter	16 mm	20 mm
Clamping distances - L	100 cm	125 cm

6.2.3 Pipe anchoring accessories

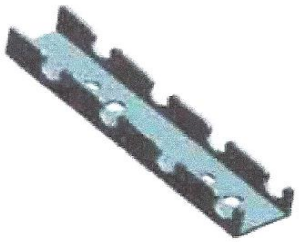
Pipes can be anchored using various types of clamps.



Pipe quick clamps



Two pipes anchor



UFH pipe anchor

6.2.4 Bending

Pipes should be bent with the help of internal or external bending springs.

Minimum bending radii:

Pipe Diameter	16 mm	20 mm
Bending Radius	80 mm	100 mm

6.2.4 Connecting to existing systems

Connection to systems that already exist inside the building and incoming service connections are made by means of threaded fittings. **SP – AP PushFit** PPSU fittings have standard threads in accordance with ISO7-1.

6.3 Insulation

6.3.1 Temperature Insulation

Insulation against freezing

Plastic systems do not provide any resistance to freezing which may prevent the system from functioning and can cause damage to metallic parts.

Insulation in accordance with Local Building Regulations in situations where there is any likelihood of freezing is advised.

Insulation against loss of heat

Hot water pipes should be insulated in accordance with Annex 5 of the German Energy Conservation Ordinance (EnEV).

In all cases only approved Insulation materials for plastic pipes should be used.

6.3.2 Insulation Against Noise

Plastic piping systems do not generally tansmit noise like those associated with metal systems. If necessary insulation against noise may be achieved by using appropriate insulating materials.

Metal clamps and fixtures should be lined with suitable rubber materials. Ceiling mounted pipe passages should be insulated according to approved fire-protection measures.

Sound insulators may be used for wall connections.

Reference may be made to the DIN Standard 4109 which specifies the application of fittings complying with fitting group 1LAP ≤ 20 dB(A)

7 Commisioning

Before the system can be used it must be flushed out to remove dirt and deposits that may have accumulated during installation and to prepare the system for safe use according to recognized hygienic safety standards. The system must also be tested to ensure that there are no leaks.

7.1 Flushing the System

The system is manufactured from materials generally recognized as resistant to corrosion. Consequently, it is sufficient to carry out cleaning processes that meet the hygienic safety standards of the KTW (Plastic Drinking Water Systems) guidelines of the German Federal Health Agency and according to DVGW (German Technical and Scientific Association on Gas and Water) worksheet W270.

7.2 Pressure Test

Following installation and before commissioning the system, it should be tested for leaks.

The system test is performed as follows:

- Fill the system with water ensuring that all of the air is bled from the system.
- Inspect the system for leaks.
- Attach a pump, valve and a pressure gauge capable of maintaining a constant pressure of 15bar.
- Pressurize the system to 15bar and close the valve.
- The pressure should be kept constant for one hour.
- A maximum pressure drop of 0.6bar is allowed following one hour at 15bar.
- Inspect the system for leaks or moisture.

8. Corrosion

The system is resistant to corrosion and the build up of fur or scale deposits.

9. Fire Precautions

The following guidelines should be refered to:

- VKF (Swiss Assoc. of Cantonal Fire Insurances)
- MLAR (Model PipelineConfiguration Regulations).

Pipes are in Fire Class B2 according to DIN 4102, Part 1.

APPENDIX A

CHEMICAL RESISTANCE

A1 PEX Chemical Resistance

The inner and outer surfaces of the pipes are manufactured from High Density Polyethylene with a high molecular weight which is cross-linked – PEX. This process strengthens the connections between the strings of the polymer creating a material which has enhanced resistance to chemicals and heat.

The following tables show the resistance to many common chemicals.

Key to abbreviations

S: Satisfactory resistance

L: Limited resistance

NS: Resistance not satisfactory

Note: The above does not apply to pipes that are subjected to pressure.

Sol:	Aqueous solution at a concentration higher than 10% (not saturated)
Sat.Sol:	Saturated aqueous solution at 20°C
tg-g:	Technical grade - gas
tg-l:	Technical grade - liquid
Work.Sol:	Working solution generally used

PEX Chemical Resistance

Chemical	Concentration	Temperature	
	%	20 °C	60 °C
Acetaldehyde	40	S	L
Acetic acid	60	S	S
Acetic anhydride	Tg-l	S	L
Acetone	Tg-l	S	L
Acrylonitrile		S	S
Allyl alcohol	Tg-l	S	S
Aluminium chloride	Sat.Sol	S	S
Aluminium sulphate	Sat.Sol	S	S
Ammonia	tgg	S	S
Amyl acetate	Tg-l	S	L
Amyl alcohol	Tg-l	S	L
Aniline	Tg-l	S	L
Aqua regia		NS	NS
Beer	Work.Sol	S	S
Benzene	Tg-l	S	-
Benzoic acid	Sat.Sol	S	S
Bromine		NS	NS
Butanol	Tg-l l	S	S
Butter		S	S
Butyl acetate	100	S	L
Butyric acid	100	S	L

PEX Chemical Resistance (continued)

Chemical	Concentration	Temperature	
	%	20 °C	60 °C
Calcium chloride	Sat.Sol	S	S
Calcium hypochlorite sol		L	L
Calcium nitrate	Sat.Sol	S	S
Carbon disulphide	Tg-l	L	NS
Carbon tetrachloride	Tg-l	L	NS
Chlorine 0.5 ppm		S	S
Chlorobenzene	Tg-l	S	L
Chloroform		NS	NS
Chromic acid	Sat.Sol	S	L
Citric acid	Sat.Sol	S	S
Coconut oil, alcoholic		S	S
Cyclohexane		NS	NS
Cyclohexanol	Sat.Sol	S	L
Cyclohexanone	Tg-l	S	L
Decalin	Tg-l	S	L
Detergents, synthetic		S	S
Dibutyl phthalate		S	L
Dichloroethylene		NS	NS
Diesel oil		L	L
Diglycolic acid		S	S
Dimethyl formamide		S	L
Dimethylamine		NS	NS
Dioxane	Tg-l	S	S

PEX Chemical Resistance (continued)

Chemical	Concentration	Temperature	
	%	20 °C	60 °C
Ethanol	Tg-l	S	S
Ethyl acetate	Tg-l	S	NS
Ethyl ether	Tg-l	S	-
Ethylene chloride	100	NS	NS
Ethylene diamine	100	S	S
Ethylene glycol	Tg-l	S	S
Fat	Tg-l	S	L
Fluorine		NS	NS
Formaldehyde	40	S	S
Freon, F12	Work.Sol	S	-
Glycerine	Tg-l	S	S
Heptane	Tg-l	S	S
Hydrochloric acid con		S	S
Hydrofluoric acid	10	S	S
Hydrofluoric acid	60	S	L
Hydrogen sulphide	Tg-g	S	S
Ink		S	S
Iodine in alcohol		NS	NS
Iodine in potassium		NS	NS
Lactic acid	Tg-l	S	S
Lead acetate	Sat.Sol	S	S

PEX Chemical Resistance (continued)

Chemical	Concentration	Temperature	
	%	20 °C	60 °C
Maleic acid	Sat.Sol	S	S
Mercury	Tg-l	S	S
Methyl alcohol	Tg-l	S	S
Methyl chloride		NS	NS
Methyl ethyl ketone	Tg-l	S	S
Milk	Work.Sol	S	S
Mineral oil	Work.Sol	S	S
Motoroil	Work.Sol	S	L
Naphtha	Work.Sol	S	S
Nitric acid	25	S	L
Nitric acid	50	NS	NS
Nitrobenzene	100	NS	NS
Oil	Tg-l	S	L
Oleum	-	NS	NS
Olive oil	Work.Sol	S	NS
Oxalic acid	Sat.Sol	S	S
Ozone	Tg-g	L	NS
Paraffin oil	-	S	S
Perchloric acid	20	S	S
Perchloric acid	70	S	NS
Phenol sol		S	S
Phosphoric acid	50	S	S

PEX Chemical Resistance (continued)

Chemical	Concentration	Temperature	
	%	20 °C	60 °C
Phthalic acid	50	S	S
Potassium permanganate	20	S	S
Propionic acid	Tg-l	S	L
Pyridine	Tg-l	S	L
Silicone oil	-	S	S
Sodium hydroxide	Sat.Sol	S	S
Sodium hypochlorite	15	L	L
Stearic acid	Sat.Sol	S	-
Sulphuric acid	75	S	S
Sulphuric acid	98	L	L
Tallow	-	S	L
Tannic acid	Sol	S	S
Tartaric acid	Sat.Sol	S	S
Tetrachloromethane	100	L	NS
Tetrahydrofuran	Tg-l	L	NS
Toluene	Tg-l	L	NS
Trichloroethylene	Tg-l	L	NS
Turpentine	-	NS	NS
Urea	Sol	S	S
Vaseline	-	S	S
Water	-	S	S
Wine	Work.Sol	S	S
Zinc chloride	Sat.Sol	S	S
Zinc nitrate	Sat.Sol	S	S

Source:

ISO/TR10358 Plastic pipes and fittings – Combined chemical-resistance classification table

A2 PPSU Chemical Resistance

Screening tests have indicated that polyphenylsulfone has exceptional chemical resistance. The following table shows the results of samples manufactured from polyphenylsulfone that were immersed in a variety of reagents for seven days at room temp.

Reagent	Concentration %	Weight Change %	Comments
Organic Chemicals			
Trichloroethane	100	+0.0	no change
Acetone	100	+9.0	surface softened
Benzene	100	+0.7	cloudy
Butanol	100	-0.0	no change
Butyl Acetate	100	+0.0	no change
Carbitol Solvent	100	-0.0	no change
Carbon Tetrachloride	100	+0.0	no change
Cyclohexane	100	+0.0	no change
Ethanol	100	+0.3	dark spots
Ethyl Acetate	100	+3.7	edges whitened
Ethylene Glycol	100	-0.4	no change
Formaldehyde	40	+0.4	no change
Glycerol	100	-0.0	no change
Methanol	100	+0.9	cloudy
Toluene	100	+0.8	whitened
Acetic Acid- Glacial	100	+0.0	slight attack
Acetic Anhydride	100	+1.0	crazed
Citric Acid	100	+0.5	no change
Formic Acid	10	+0.6	no change
Inorganic Chemicals			
Hydrochloric Acid	20	+0.2	no change
Hydrochloric Acid	37	+0.2	bleached
Nitric Acid	20	+0.5	no change
Nitric Acid	71	+26.9	opaque cracked
Oleic Acid	100	0.0	no change
Potassium Hydroxide	10	+0.5	no change
Sodium Hydroxide	10	+0.5	no change
Sulfuric Acid	50	+0.1	no change
Sulfuric Acid	97	-11.3	etched
Functional Fluids	100	-0.2	cloudy
Gasoline	100	+0.1	no change
Hydraulic Oil LO-1	100	+0.0	no change
Jet Fuel JP-4	100	+0.0	cloudy
Kerosene	100	+0.0	no change
Motor Oil 10W-40	100	+0.0	cloudy

Source: RADEL® R Polyphenylsulfone ACUDEL® Polyphenylsulfone Blends. Design Guide, Solvay