about: pvc-c

Post-chlorinated Polyvinylchloride (PVC-C) is a highly versatile material that is used for both pressure and drainage piping systems for above and below ground applications. It is a rigid 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.

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.

IPS supplies a comprehensive range of PVC-C piping systems in both inch and metric dimensions, according to ASTM and DIN standards. Systems are available in inch sizes up to 24" for use as both pressure and ventilation piping systems, and in metric sizes up to 160mm.

General properties of PVC-C

PVC-C is thermally stable 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

Properties of PVC-C (Average values)	
Property	Value
Density	1.55 g/cm^3
Tensile Strength	55 N/mm^2
Elongation at Break	3 %
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. $10^{13}\,\Omega$
Thermal Conductivity	0.066 W/m · K
Flammability	V-0 UL94
Colour	Light Grey

Characteristics

Chemical resistance

PVC-C has excellent chemical resistance to common 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.

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-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

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.

Pressure ratings for pvc-c 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.

Inch sizes - ASTM Standard

PVC-C piping systems manufactured in accordance with ASTM requirements use a 'schedule' system of pressure ratings. Pipes are produced in two different 'schedules', 40 & 80. Under this system the pressure rating of the pipe changes according to the pipe nominal bore size. Reference should be made to the pipe availability guide to verify the pressure ratings available for the sizes required.

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 the pipe. In common with the pipe, the pressure rating of the fittings decreases as the nominal pipe sizes increases. The advisory pressure ratings for ASTM fittings is as follows:-

Moulded Fittings	Size Range	Max. Operating Pressure
	1/4" to 8"	16 Bar
	10" to 12"	10 Bar
Fabricated Fittings	4" to 16"	10 Bar
SR Threaded Fittings	1/4" to 4"	16 Bar
	6"	12 Bar
Unreinforced Threaded Fittings	1/4" to 6"	10 Bar

Metric sizes

The pressure ratings for PVC-C pipes according to DIN 8079 and PVC-C fittings according to DIN 8063 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 metric sized PVC-C pipes and fittings according to the nominal pressure system is as follows:-

Pipe		Size Range	Max. Operating Pressure
	PN16	16mm to 110mm	16 Bar
	PN10	160mm	10 Bar
Fittings	PN16	16mm to 160mm	16 Bar
Threaded Fittings		3/8" to 2"	16 Bar

solvent cement welding of pvc-c

Making a solvent welded joint - joint preparation

1. Bring the pipes, fittings and solvent cements to the same temperature condition. Ensure that the items to be joined are clean and dry prior to use. Inspect the components for any signs of damage or irregularities. Do not use items that appear not to be correct.

2. Cut the pipe ends squarely using tool suitable for plastic pipe. A wheel-type cutter is ideal. If a saw is used, a mitre box is recommended to ensure a square cut. Power saws may be used with care.

3. Using a chamfering tool cut a 10° to 15° chamfer on the outside of the pipe. This will help ease the pipe into the fitting and minimise the risk of cement being wiped from the fitting during assembly.

4. Remove the internal burr from the pipe, and clean up any cutting debris or swarf.

5. Check the dry fit by entering the pipe into the fitting. The pipe should enter the socket of the fitting to between 1/3 to 3/4 of its depth. This is regarded as a good “interference fit”. If the pipe bottoms in the fitting with little interference, extra solvent cement should be used during assembly.

6. Measure the insertion depth of the socket and mark it on the pipe end. This makes it possible to verify later that the pipe has completely “bottomed out” in the fitting.

7. Open cans of cleaner, primer and cement ready for use and loosely replace lids to minimise the evaporation of the solvents. Check that the products are in good condition and not “gelled”. Cements that are gelled must not be used. Never thin cements.

8. If needed, remove dirt with C-65 cleaner applied using a clean, lint-free cloth or paper towel.

9. Using a natural bristle brush or an applicator, apply P70 primer to the inside of the fitting socket then to the outside of the pipe, then apply a further coat to the fitting socket. The primer should be worked into the surfaces of the material. Avoid 'puddling' the primer in the fitting socket. Do not apply with a rag.

10. **While the primer is still wet**, apply the solvent cement using a natural bristle brush of the correct diameter, or a correctly sized applicator. The solvent cement coating on the pipe end should be liberally yet evenly applied to a distance equal to the depth of the fitting socket. A medium even coat should be made on the fitting socket surface. For diameters 4” (100mm) and above, or if the fit was loose, a second coat should be applied to the pipe.

11. **While both surfaces are still wet**, insert the pipe into the fitting until the pipe bottoms out fully in the socket. Check that alignment is correct. Hold the joint to prevent pull out for around 20 to 30 seconds (larger sizes may require more time). A bead of solvent cement should be evident around the pipe and fitting juncture. If the bead is not continuous it may indicate that insufficient solvent cement was applied. If this is the case the joint must be cut out, discarded and begun again with new product. Excess solvent cement should be removed from the mouth of the socket using a clean, dry cloth. Replace lids on cleaner, primer and cement cans to prevent the solvent from evaporating.

12. Handle the newly assembled joint with care until the initial set time has elapsed (see set and cure times table). Following the initial set period the assembly can be handled carefully, avoiding stresses on the joint. **All solvent cemented joints must be allowed to cure fully prior to pressure testing.**


Chamfering the pipe


Removing the internal burr


Measuring the insertion depth

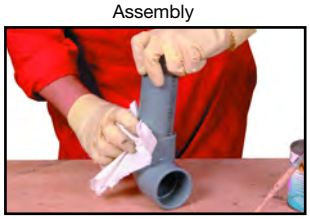

Marking the pipe end


Applying the primer to the pipe


Brush applying cement to the fitting


Brush applying cement to the pipe


Assembly


Wiping away excess cement

Set and cure times

The initial set between the pipe and the fitting takes place in a matter of minutes, and joints can therefore safely be handled in a very short time. However, the joint needs to cure before it can be used as part of a pressurised assembly. The time taken to achieve this can depend upon a number of factors, including the tightness of fit as well as the ambient temperature and humidity. In general terms, joints will cure faster on tighter fitting assemblies in warmer, drier conditions, whereas looser fit joints made in cooler and/or humid conditions will cure slower.

As a general guide it is recommended that (wherever possible) joints be left for 24 hours to cure before pressure is applied. However, where this is not possible, consideration may be given to the above factors before determining when joints are put into service. Given average conditions and a working temperature not exceeding 20°C, a safe guide is to allow a cure time of not less than 1 hour for each bar of working pressure for pipe sizes up to 4" (100mm), and $1^{1}/_{2}$ hours for each bar of working pressure for larger sizes.

Large diameter jointing

Solvent cement jointing on pipe sizes 6" (DN 150mm) and larger is a two-person operation. To ensure that primers and solvent cements are applied at the correct speed they should be simultaneously applied to both pipe and fitting. Applying a thorough coating of cement is critical at these sizes both to ensure a good weld and to ease the pipe into the fitting.

For sizes 10" and larger it is recommended to use a ratchet driven pipe puller to ensure that the pipe fully penetrates the fitting. These tools may be hired if required.

One-step cements

Specially formulated PVC-C solvent cements are available to provide solutions to specific applications or to solve installation difficulties. Examples include transition cements to make joints between flexible and rigid PVC, and Wet 'R Dry, a product designed to make solvent welded joints in wet conditions and/or where quick pressurisation of the system is required.

One-step cements do not require the use of a primer in the welding process and generally work best on pipe sizes up to 3" (DN 65). In all cases, strictly follow the instructions supplied with the product.

Chemical resistance of solvent welded joints

A well-made solvent cement welded joint will provide excellent chemical resistance characteristics, in the same way as that of the parent piping material. However 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

Solvent welding of dissimilar materials

As a general guide, solvent welded joints between dissimilar materials are not recommended. Where possible, a mechanical transition joint should be used, such as a union, flange or threaded connection.

If a solvent welded joint is unavoidable, it may (depending upon the conditions) be possible to make a reliable joint provided that a suitable solvent cement is used:

Materials To Be Joined	Recommended Solvent Cement
PVC-C to PVC-U	Weld-On 724
PVC-C to ABS	Weld-On 724

Please note that in all cases we recommend contact with our technical department who will be able to provide assistance with specific applications and on recommended jointing methods.