



BEST PRACTICES FOR SOLVENT WELDING THERMOPLASTIC PIPING: PVC, CPVC, and ABS

By Stephen Gardiner, IPS[®] Corporation

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SUMMARY OF PRACTICE (refer to ASTM D 2855)

1. To consistently make good solvent welded joints, the following should be clearly understood and adhered to:

- The joining surfaces must be softened (dissolved) and made semi-fluid.
- Sufficient solvent cement must be applied to fill the gap between pipe and fitting.
- Assembly of pipe and fitting must be made while the surfaces are still wet and fluid.
- Joint strength develops as the solvent cement dries. In the tight part of the joint, the surfaces will tend to fuse together; in the loose part, the solvent cement will bond to both surfaces.

2. Penetration and dissolving can be achieved by the solvent cement itself, a suitable primer, or by the use of both primer and solvent cement. A suitable primer will penetrate and dissolve the plastic more quickly than solvent cement alone. In cold weather, more time and additional applications are required (see Figure 1).

3. More than sufficient to fill the loose part of the joint must be applied (see Figure 2). Besides filling the gap, adequate solvent cement layers will penetrate the surfaces and also remain wet until the joint is assembled.

4. If the solvent cement coatings on the pipe and fittings are wet and fluid when assembly takes place, they will tend to flow together and become *one* solvent cement layer. Also, if the solvent cement is wet, the surfaces beneath them will still be soft, and these dissolved surfaces in the tight part of the joint will tend to fuse together (see Figure 3).

5. As the solvent dissipates, the solvent cement layer and the dissolved surfaces will harden with a corresponding increase in joint strength. A good joint will take the required working pressure long before the joint is fully dry and final strength is obtained. In the tight (fused) part of the joint, strength will develop more quickly than in the looser (bonded) part of the joint. Completed joints should not be disturbed until they have cured sufficiently to withstand handling. Joint strength develops as the solvent cement dries. Information about the development of bond strength of solvent cemented joints is available (see Figure 4).

6. The techniques described herein can be used to produce strong pressure-tight joints between pipe and fittings of PVC, CPVC, and ABS., either in shop operations or in the field. However, skill and knowledge on the part of the welder are required to obtain a good quality joint. This skill and knowledge can be obtained by making joints under the guidance of skilled welders and testing them until good quality joints are obtained.

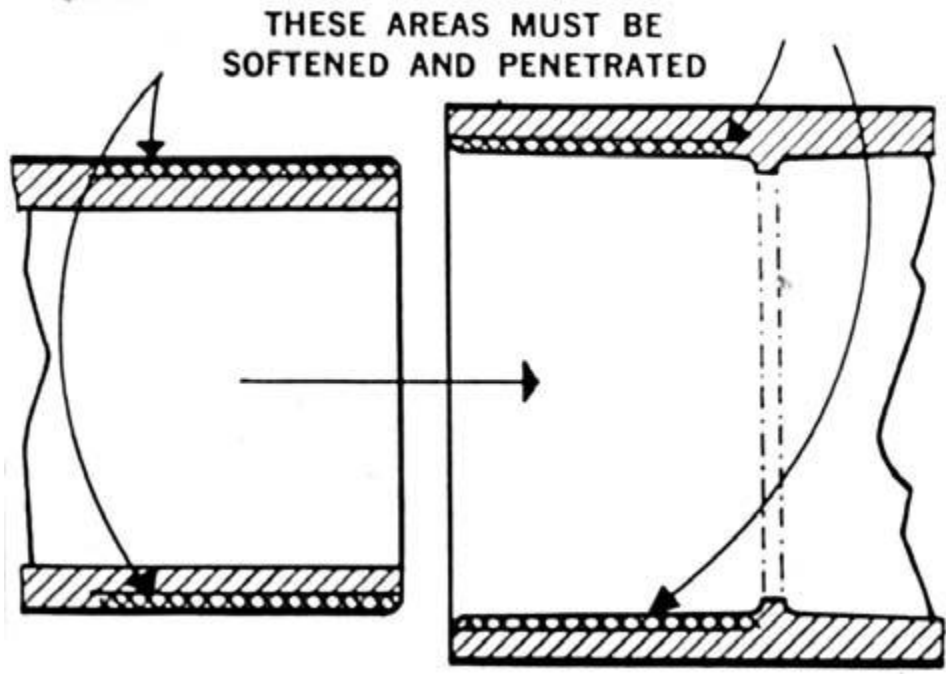


Figure 1: Areas of Pipe and Fitting to be Softened (Dissolved) and Penetrated

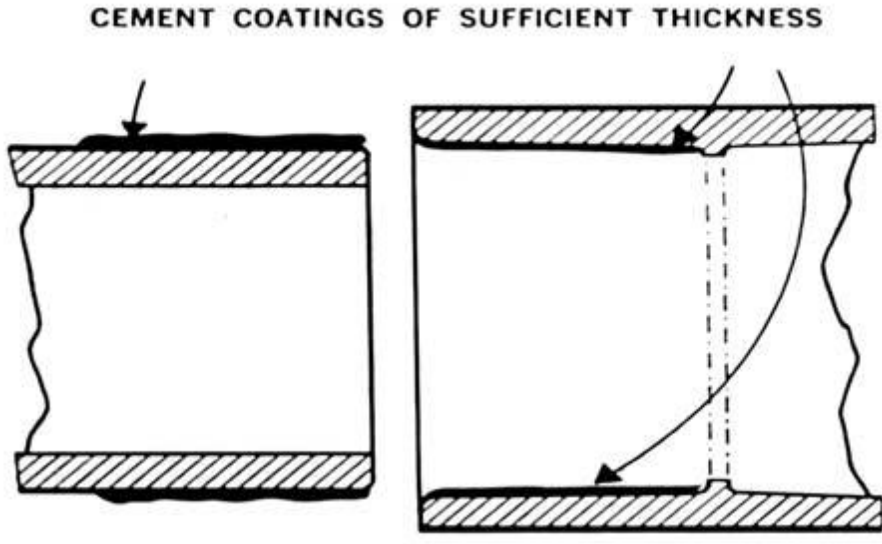


Figure 2: Solvent Cement Coatings of Sufficient Thickness

**SURFACES MUST BE ASSEMBLED
WHILE THEY ARE WET AND SOFT**

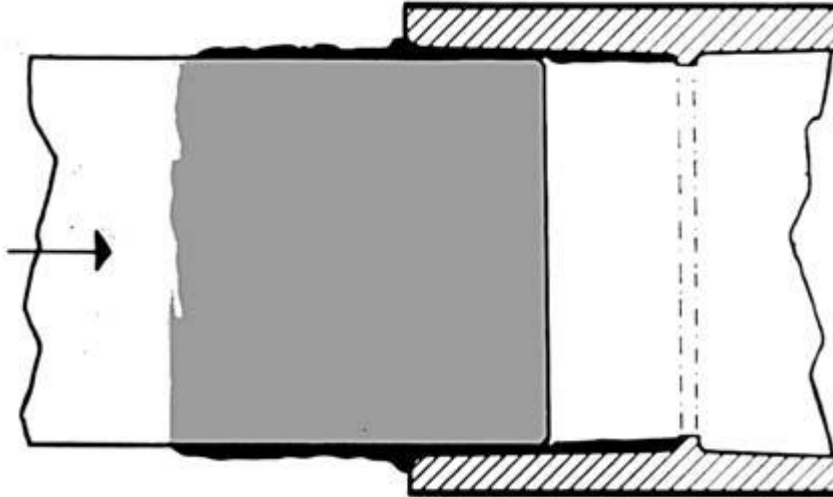


Figure 3: Assembly of Surfaces While They Are Wet and Soft

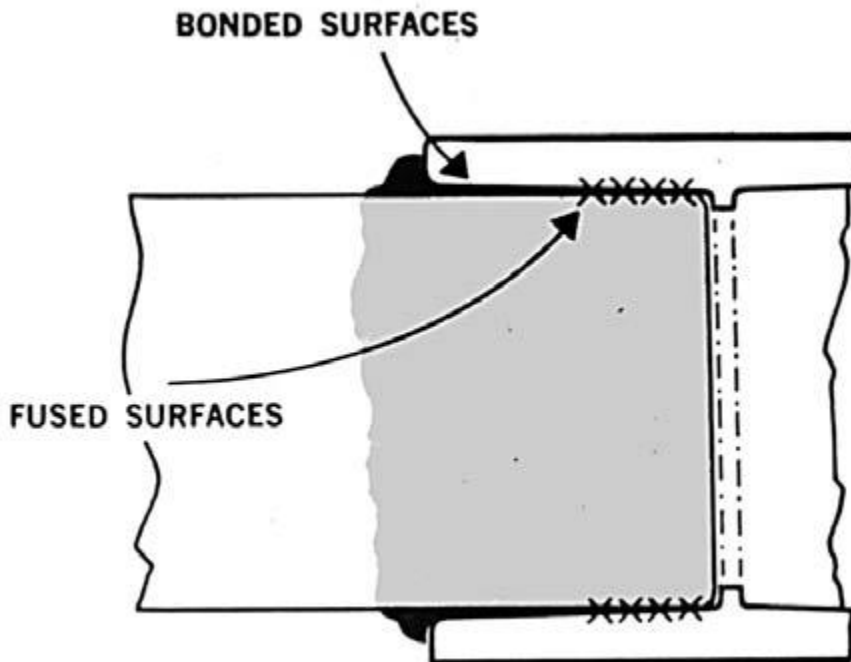


Figure 4: Fused and Bonded Surfaces of Joined Pipe and Fitting



MATERIAL PREPARATION

- 1. *Cutting the Pipe.*** It is important to cut the pipe square. A square cut provides the surface of the pipe with the maximum bonding area. Pipe can be easily cut with a ratchet cutter, wheel-type plastic tubing cutter, power saw, chop saw, or fine toothed saw. Tools used to cut pipe must be designed for plastic use and must be in good condition in accordance with the tool manufacturer's recommendations. If there is any indication of damage or evidence of cracking, cut off at least 2 inches (50mm) beyond any visible crack. Care must be exercised if using ratchet cutters, especially at low temperatures, as they may split the pipe if not properly used and maintained.
- 2. *Deburring and Beveling.*** Burrs and filings can prevent proper contact between pipe and fitting during assembly, and must be removed from the outside and the inside of the pipe. A chamfering tool or a file is suitable for this purpose. A slight bevel (approximately 10°-15° chamfer and a minimum width of 3/32 of an inch) shall be placed at the end of the pipe to ease entry of the pipe into the fitting socket. This will minimize the chance that the edges of the pipe will wipe solvent cement or will scrape softened surface material from the fitting socket during the insertion of the pipe.
- 3. *Test Dry Fit of the Joint.*** The pipe should enter the fitting socket easily $\frac{1}{3}$ to $\frac{2}{3}$ of the way for a tight interference fit. Contact between pipe and fitting is essential in making a good joint. This contact allows the solvent cement to effectively join the pipe and fitting.
- 4. *Cleaning.*** Using a clean dry rag, wipe any dirt and moisture from the fitting socket and the pipe end. Moisture will slow the cure time, and at this stage of assembly, excessive water can reduce joint strength.
- 5. *Applicator Size.*** Use an applicator that is properly sized for the pipe and will completely coat the surfaces of the pipe and fittings with primer and solvent cement. Dauber-type applicators will give adequate coverage on pipe diameters that are approximately twice the diameter of the dauber-ball. Swab or roller-type applicators are preferable on larger diameter pipe surfaces of 4" and above.



SOLVENT WELDING PROCEDURES FOR PLASTIC PIPE AND FITTINGS

A. TWO-STEP SOLVENT WELDING METHOD FOR PVC AND CPVC PLASTIC PIPE AND FITTINGS

1. Apply primer to the inside of the fitting socket. Be aggressive and work the solvents into the surface to break down the surface tension and to soften the surfaces.
2. Apply primer to the pipe end, equal to the depth of the fitting socket. Be aggressive.
3. Apply primer to the inside of the fitting socket.
4. While the primer is still wet and the surfaces are soft, apply a full, even layer of solvent cement, equal to the depth of the fitting socket, to the pipe end. Like the primer, be aggressive. Remember to apply enough solvent cement to fill the gap between the pipe and fitting.

Use PVC solvent cement that meets ASTM D 2564 on PVC plastic pipe and fittings.

Use CPVC solvent cement that meets ASTM F 493 on CPVC plastic pipe and fittings.

For CPVC potable water systems, use a **purple** primer and **orange** CPVC solvent cement in accordance with UPC 605.16.2.

5. Apply a thin layer of solvent cement to the inside of the fitting socket.
 - 5.1 This will prevent puddling of the solvent cement inside of the pipe or fitting. Excessive solvent cement applied to the fitting socket can cause the joint to clog and the wall of the pipe or fitting to weaken due to softening by the trapped solvents.
6. Apply a second full, even layer of solvent cement to the pipe end. Excessive solvent cement on the pipe outer diameter (O.D.) can be easily wiped away after assembly.
7. Without delay, while the solvent cement is still wet, assemble the pipe and fitting, and twist a $\frac{1}{4}$ turn as the pipe is being inserted, if possible. Once the pipe end has reached the fitting socket stop, do not turn any further; doing so could break any fusion that is starting to occur.
8. Hold the pipe and fitting together for approximately 30 seconds to avoid push out.
9. A bead of solvent cement must be around the entire socket fitting entrance. With a clean, dry cloth, remove the excess solvent cement from the pipe and fitting socket entrance. This will allow the solvent to evaporate from within the joint.



B. ONE-STEP SOLVENT WELDING METHOD FOR CPVC PLASTIC PIPE AND FITTING (COPPER TUBE SIZE ½" TO 2" DIAMETER) – HOT AND COLD WATER DISTRIBUTION SYSTEMS

1. Apply **yellow** CPVC solvent cement to the pipe end. Be aggressive to break down the surface tension and to soften the surfaces.

Use CPVC solvent cement that meets ASTM F 493 on CPVC plastic pipe and fittings.

For CPVC potable water systems, use **yellow** CPVC one-step solvent cement in accordance with UPC 605.16.2.

2. Without re-dipping the dauber, apply a very light layer of solvent cement to the inside of the fitting socket.

2.1 This will prevent puddling of the solvent cement inside of the pipe or fitting. Excessive solvent cement applied to the fitting socket can cause the joint to clog and the wall of the pipe or fitting to weaken due to softening by the trapped solvents.

3. Without delay, while the solvent cement is still wet, assemble the pipe and fitting, and twist a ¼ turn as the pipe is being inserted, if possible. Once the pipe end has reached the fitting socket stop, do not turn any further; doing so could break any fusion that is starting to occur.

4. Hold the pipe and fitting together for approximately 30 seconds to avoid push out.

5. A bead of solvent cement must be around the entire socket fitting entrance. With a clean, dry cloth, remove the excess solvent cement from the pipe and fitting socket entrance. This will allow the solvent to evaporate from within the joint.



C. ONE-STEP SOLVENT WELDING METHOD FOR CPVC PLASTIC PIPE AND FITTING – FIRE SPRINKLER SYSTEMS

- 1.** Apply **red** CPVC solvent cement to the pipe end. Be aggressive to break down the surface tension and to soften the surfaces.
 - 1.1** Use CPVC solvent cement that meets ASTM F 493 on CPVC plastic pipe and fittings.
 - 1.2** For CPVC fire sprinkler systems, use **red** CPVC one-step solvent cement that have been specifically investigated and tested for this use, and approved by the pipe and fittings manufacturers.
- 2.** Without re-dipping the dauber, apply a light layer of solvent cement to the inside of the fitting socket.
 - 2.1** This will prevent puddling of the solvent cement inside of the pipe or fitting. Excessive solvent cement applied to the fitting socket can cause the joint to clog and the wall of the pipe or fitting to weaken due to softening by the trapped solvents.
- 3.** Apply a second full, even layer of solvent cement to the pipe end. Excessive solvent cement on the pipe O.D. can be easily wiped away after assembly.
- 4.** Without delay, while the solvent cement is still wet, assemble the pipe and fitting, and twist a ¼ turn as the pipe is being inserted, if possible. Once the pipe end has reached the fitting socket stop, do not turn any further; doing so could break any fusion that is starting to occur.
- 5.** Hold the pipe and fitting together for approximately 30 seconds to avoid push out.
- 6.** A bead of solvent cement must be around the entire socket fitting entrance. With a clean, dry cloth, remove the excess solvent cement from the pipe and fitting socket entrance. This will allow the solvent to evaporate from within the joint.
- 7.** Sprinkler heads shall be installed only after all of the CPVC pipe and fittings, including the sprinkler head adapters, are solvent welded and allowed to cure for a minimum of 30 minutes.



D. ONE-STEP SOLVENT WELDING METHOD FOR ABS PLASTIC PIPE AND FITTINGS

1. Apply ABS solvent cement to the pipe end. Be aggressive to break down the surface tension and to soften the surfaces.
 - 1.1 Use ABS solvent cement that meets ASTM D 2235 on ABS plastic pipe and fittings.
 - 1.2 **Primer shall NEVER be used when solvent welding ABS pipe and fittings.**
2. Without re-dipping the dauber, apply a very light layer of solvent cement to the inside of the fitting socket.
 - 2.1 This will prevent puddling of the solvent cement inside of the pipe or fitting. Excessive solvent cement applied to the fitting socket can cause the joint to clog and the wall of the pipe or fitting to weaken due to softening by the trapped solvents.
3. Apply a second full, even layer of solvent cement to the pipe end. Excessive solvent cement on the pipe O.D. can be easily wiped away after assembly.
4. Without delay, while the solvent cement is still wet, assemble the pipe and fitting, and twist a ¼ turn as the pipe is being inserted, if possible. Once the pipe end has reached the fitting socket stop, do not turn any further; doing so could break any fusion that is starting to occur.
5. Hold the pipe and fitting together for approximately 30 seconds to avoid push out.
6. A bead of solvent cement must be around the entire socket fitting entrance. With a clean, dry cloth, remove the excess solvent cement from the pipe and fitting socket entrance. This will allow the solvent to evaporate from within the joint.



SYSTEM ACCEPTANCE (HYDROSTATIC PRESSURE) TEST

1. **Set time** is the time required before the joint can be carefully handled. Refer to the solvent cement manufacturer for recommended set times.
2. **Cure time** is the time required before the system can be hydrostatically pressure tested. Refer to the solvent cement manufacturer for recommended cure times.

Cure time is dependent upon pipe diameter, solvent cement viscosity, ambient temperature, humidity, and the dry-joint tightness (interference fit). As a general rule, relatively short cure periods are satisfactory for high-ambient temperatures with low humidity, small pipe sizes, quick-drying solvent cements, and tight-fitting joints. Longer cure periods are required for low temperatures, large pipe sizes, slow-drying solvent cements, loose joints, and relatively high humidity.

3. **Hydrostatic pressure test** should be 150% of the system design pressure and held at this pressure until the system is checked for leaks, or follow the requirements of the applicable code, whichever is higher.

3.1 Shade backfill, leaving all joints exposed so that they can be examined during pressure tests.

3.2 On long runs, pressure tests should be performed on sections not longer than 5000 feet (1500 meters).

3.3 **DANGER! Air or compressed gas must never be used for system acceptance testing. Use HYDROSTATIC PRESSURE TEST ONLY. System failure when using compressed air or gas for system acceptance testing can result in bodily injury, death and/or property damage.**

3.4 If a leak is found, the joint must be cut out and discarded. A new section can be installed using coupling, mechanical repair joint, or a union. Mechanical repair joints or unions should be used in accessible areas only.

NOTE: SOLVENT WELDING IN LOW TEMPERATURE

Using a little extra care, successful solvent welded joints can be made at temperatures as low as -15°F (-26°C). In cold weather, solvents penetrate and soften the thermoplastic pipe and fitting surfaces more slowly than in warm weather. The thermoplastic is also more resistant to solvent attack. Therefore, it becomes even more important to pre-soften surfaces of the pipe and fittings with an aggressive primer. Because of slower evaporation of the solvents, a longer cure time is necessary.

NOTE: SAFE HANDLING OF SOLVENT CEMENT, PRIMER AND CLEANER

1. Solvent cement, primer, and cleaner for plastic pipe are made from flammable liquids and should be kept away from all sources of ignition. Good ventilation should be maintained to reduce fire hazard and to minimize the breathing of solvent vapors. Avoid contact with skin and eyes.
2. Refer to ASTM F 402, *Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings*, plus the cautionary notes contained in the Material Safety Data Sheets (MSDSs) supplied by the material supplier.