Designation: D2855 – 20

An American National Standard

Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets[1]

This standard is issued under the fixed designation D2855; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This practice describes a two-step (primer and solvent cement) method of joining poly(vinyl chloride) (PVC) or chlorinated poly(vinyl chloride) (CPVC) pipe and piping components with tapered sockets.

NOTE 1—Simplified procedures may be allowed in non-pressure applications where local codes permit.

NOTE 2—Where conflicts occur between the code and the manufacturer's installation instructions, the more restrictive provisions apply.

1.2 The products covered by this practice are intended for use with the distribution of pressured liquids only, which are chemically compatible with the piping materials. Due to inherent hazards associated with testing components and systems with compressed air or other compressed gases, some manufacturers do not allow pneumatic testing of their products. Consult with specific product/component manufacturers for their specific testing procedures prior to pneumatic testing.

NOTE 3—Pressurized (compressed) air or other compressed gases contain large amounts of stored energy which present serious safety hazards should a system fail for any reason.

1.3 This standard practice does not address the one-step method of joining pipe and piping components with tapered sockets with solvent cement without the use of primer. For the one-step method see Practice F3328.

1.4 The techniques covered are applicable to joining PVC to PVC or CPVC to CPVC pipe and piping components with tapered sockets. In the remainder of this standard practice, the term "piping components with tapered sockets", whether it be bell end pipe, spigot connections, or any other type of tapered connections, will be referred to as "fittings."

1.5 A partial list of standards for PVC and CPVC pipe, piping components, and solvent cements suitable for use in joining pipe and fittings is given in Appendix X1.

1.6 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.7 The text of this practice references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the practice.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1600 Terminology for Abbreviated Terms Relating to Plastics

D1784 Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

D1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

[1] This practice is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.20 on Joining.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

D2241 Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
D2466 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
D2467 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D2564 Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
D2665 Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
D2672 Specification for Joints for IPS PVC Pipe Using Solvent Cement
D2729 Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D2949 Specification for 3.25-in. Outside Diameter Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
D3034 Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
F402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
F412 Terminology Relating to Plastic Piping Systems
F438 Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
F439 Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
F441/F441M Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
F442/F442M Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR–PR)
F480 Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80
F493 Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
F512 Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation
F656 Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
F758 Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
F789 Specification for Type PS-46 and Type PS-115 Poly(Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings (Withdrawn 2004)[3]
F891 Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core
F1866 Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings
F3328 Practice for the One-Step (Solvent Cement Only) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets

[3] The last approved version of this historical standard is referenced on www.astm.org.

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600, unless otherwise specified.

4. Summary of Practice

4.1 In order to achieve consistently strong and leak-free joining of poly(vinyl chloride) (PVC) or chlorinated poly(vinyl chloride) (CPVC) pipe and fittings, the following principles need to be clearly understood and followed:

4.1.1 The joining surfaces must be softened (dissolved) and made semi-fluid. (See Fig. 1.)

4.1.2 Solvent cement must be applied to the pipe end to fill the gap between pipe and fitting socket. (See Fig. 2.)

4.1.3 Assembly of pipe and fittings must be made while the surfaces are still wet and semi-fluid. (See Fig. 3.)

4.1.4 Joint strength develops as the solvents evaporate from the joint. At the bottom of the socket where there is an interference fit, the surfaces will fuse together; at the socket entrance where there is a gap, the solvent cement will fill the gap and bond to both surfaces. (See Fig. 4.)

4.2 Penetration and dissolution of the pipe and socket surfaces are achieved by use of both primer and solvent cement.

4.3 Solvent cement must be applied to the pipe end to fill the gap between the pipe and fittings.

4.4 During assembly, while the layers on the pipe and fittings are wet and semi-fluid, the surfaces will intermingle together and become *one* layer

4.5 As the solvents evaporate, the dissolved surfaces will harden with a corresponding increase in joint strength over time. A properly made joint will withstand the required working pressure long before the joint has fully cured. Assembled joints should not be disturbed until they have cured to withstand handling in accordance with primer and solvent cement manufacturers' recommendations.

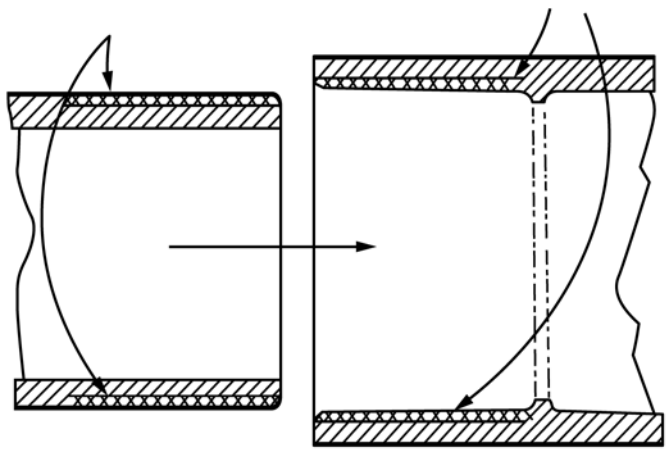

FIG. 1 Joint Surface Areas that must be Penetrated and Softened

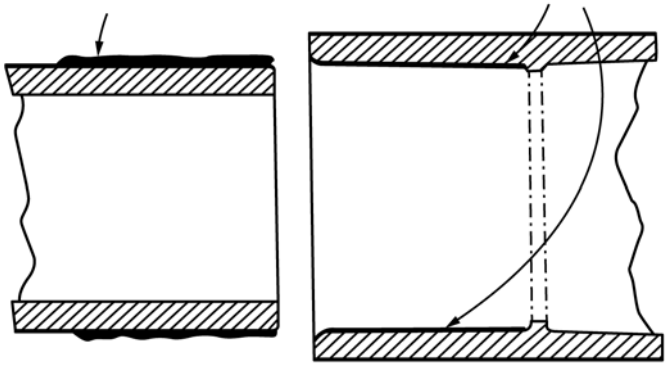

FIG. 2 Solvent Cement Coatings of Appropriate Thickness

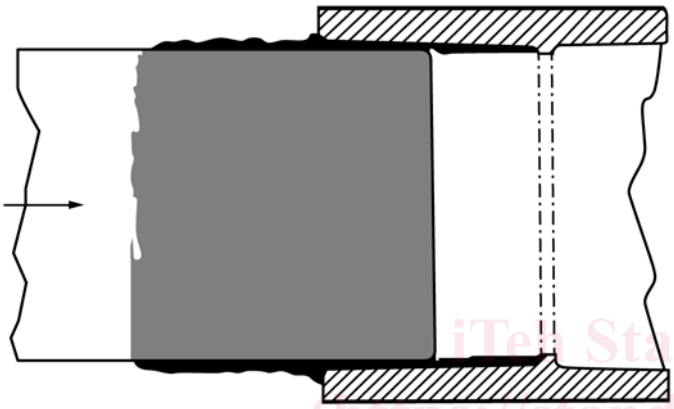

FIG. 3 Components must be Assembled while all Surfaces are Wet and Soft

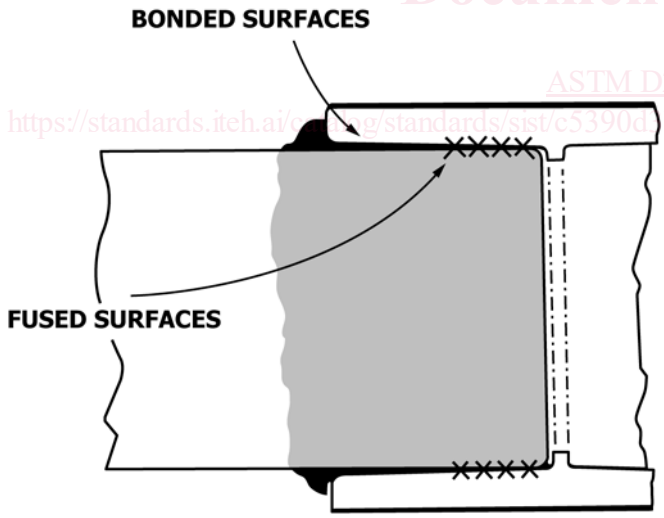

FIG. 4 Bonded and Fused Surfaces of Joined Pipe

5. Significance and Use

5.1 A solvent cement bonder/installer must follow all procedures to produce consistently strong and leak-free joints, either in shop operations or in the field.

6. Materials

6.1 *Pipe and Fittings*—The pipe and fittings shall meet the requirements of current applicable PVC or CPVC pipe and piping components standards. A partial list of these standards is given in Appendix X1.

6.2 *Solvent Cement:*

6.2.1 *Specification*—The solvent cement should meet all the requirements of Specification D2564 for PVC solvent cement or Specification F493 for CPVC solvent cement.

6.2.2 *Selection*—Solvent cements are available in a variety of viscosities and wet film thicknesses to cover the range of pipe sizes from ¼-in. to 30-in. (6.3 to 762 mm) for interference fit joints.

6.2.2.1 The ability of a solvent cement to fill a gap in a pipe joint can be determined by considering its viscosity and wet-film thickness (see Note X2.1).

6.2.3 *Storage*—Solvent cements must be stored in a cool, dry place. All solvent cements have a limited shelf life. Consult the solvent cement manufacturer for specific recommendations on storage conditions and shelf life. The solvent cement is unsuitable for use if it exhibits an appreciable change from the original viscosity, or if signs of gelation (jelly-like) are apparent. Restoration of the original viscosity or removal of gelation by adding solvents or thinners is not recommended.

6.3 *Chemical Cleaners*—Chemical cleaners are used to remove surface debris only (for example, oil, dirt, grease, hydraulic fluid, paint, etc.). Chemical cleaners are not primers and therefore, do not soften the plastic surfaces. Chemical cleaner does not meet the 10% dissolution rule specified in Specification F656. A chemical cleaner is as follows:

6.3.1 Cleaner recommended by the pipe, fittings, or solvent cement manufacturer.

6.3.2 Sandpaper or similar abrasive clothes or grinders shall not be used to clean pipe or fittings.

NOTE 4—This practice can remove significant amount of material from the surfaces to be joined which will adversely affect the interference fit of the pipe and fitting and reduce the joint strength.

NOTE 5—Consult with pipe, fittings, and solvent cement manufacturers for their specific recommendations for mechanical abrading.

6.4 *Primers*—Primers are used to soften and dissolve the surfaces in order to better prepare them for joining. Refer to specific recommendations of the manufacturer

6.4.1 *Primer Specification*—primer shall meet the requirements of Specification F656.

7. Procedure

7.1 *Cutting the Pipe*—Using a suitable cutter, cut the pipe perpendicular to the pipe axis.

NOTE 6—It is important to cut the pipe perpendicular (square) to the pipe axis. A square cut provides maximum bonding area on the surface of the pipe. Tools used to cut plastic pipe must be in good condition and used in accordance with the tool manufacturer's recommendations. If there is any indication of damage or evidence of cracking after cutting the pipe, cut off at least 2 in. (50.8 mm) beyond any visible crack. Care must be exercised if using ratchet cutters, especially at 50°F (10°C) or lower temperatures, as they may split the pipe if not properly used and maintained. Care must also be exercised if using wheel-type plastic tubing cutters with a blade made for cutting plastic pipe, as they will create raised ridges which are caused by material displacement from the downward force of the cutting wheel and must be removed.

7.2 *Chamfering and Deburring:*

FIG. 5 Cut the pipe straight at a 90° angle.

7.2.1 *Chamfering*—Chamfer the exterior pipe edge with a file or a chamfering tool specifically designed for plastic pipe. The chamfer angle shall be between 10° and 22½° with a width range of a minimum 3⁄32 to a maximum 5⁄16 of an inch (2.5 to 7.9 mm) depending upon the pipe diameter (See Fig. 6 for tolerances). It is necessary to chamfer the exterior pipe edge to remove the burrs, raised ridges or sharp edges. or both, from the exterior pipe edge created by the pipe cutting process. (See Fig. 6.)

NOTE 7—Burrs, raised ridges or sharp edges or any combination thereof, if not removed, will scrape away softened socket material and deposit it and solvent cement into the fitting or pipe waterway creating a potential leak path in the joint. This accumulation of softened socket material and solvent cement inside the waterway of the pipe and fitting must be avoided. Chamfering allows the pipe to enter the fitting socket cleanly and uniformly. Chamfering minimizes the potential for a leak path. A chamfering tool or a file is suitable for this purpose. Do not use handheld disc type side grinders to chamfer pipe.

7.2.2 *Deburring*—If burrs are present on the inside edge of the pipe, remove with a deburring tool.

NOTE 8—It is important to remove the burrs from the interior (waterway) to prevent obstructions and to enhance fluid flow.

7.3 *Dry Joint Tightness Test*—Prior to applying primer and solvent cement, insert the pipe gently and slowly into the socket until the first sign of resistance is detected to determine the point of interference. Check that an interference fit between the pipe and fitting occurs at approximately ⅓ to ⅔ of the socket depth. Do not force components together.

FIG. 7 Debur and Chamfer the Pipe End

NOTE 9—Pipe and fittings are designed to have an interference fit. An interference fit occurs when the outside pipe diameter contacts (interferes) with the inside diameter of the fitting. An interference fit is essential to make a strong and leak-free joint and indicates an acceptable dimensional conformance between the components. If the fit between the pipe and fittings is loose, replace the pipe or fittings in order to obtain a proper interference fit between the components. Do not attempt to join pipe and

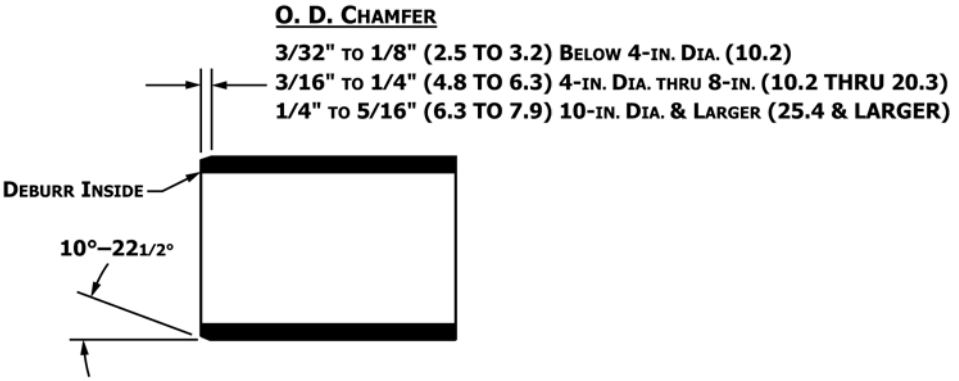

FIG. 6 Chamfer and Debur the Pipe End

fittings that do not have an interference fit.

7.4 *Cleaning*—Use a clean, dry cloth to clean the surfaces of pipe and fittings and to remove all foreign materials.

NOTE 10—Proper surface preparation is required to maximize the integrity of the joint. Foreign materials can impede the chemical joining process. Surfaces to be joined must be free of foreign materials (for example, oil, dirt, grease, hydraulic fluid, paint, etc.). If joining surfaces cannot be cleaned by wiping with a clean, dry cloth, a chemical cleaner must be used.

NOTE 11—Check chemical cleaners for compatibility with plastic material. Chemical cleaners only clean the pipe and fittings and will not soften the joining surfaces. Softening of surfaces is only accomplished by primer and solvent cement. If pipe and fittings are not properly cleaned, primer and solvent cement will not soften the joining surfaces. Follow the proper handling procedures provided by the chemical cleaner manufacturer.

7.5 *Mark the Pipe:* Measure the socket depth and transfer this measurement to the pipe O.D. with a mark. From this mark, place a second mark 2 in. (50.8 mm) further up the pipe, where possible.

NOTE 12—The first mark is the primer and solvent cement application area. The second ("witness") mark is a reference point used after joint assembly to verify that the pipe has fully bottomed out in the socket and has not backed out.

7.6 *Applicator Size*—Use an applicator that is approximately half (½) the size of the nominal pipe diameter being joined. (Example: Use a 1-½ in. (38.1 mm) applicator on nominal pipe size 3 and fittings.)

NOTE 13—Use of an applicator that is properly sized for the pipe will completely coat the surfaces of the pipe and fittings with primer and solvent cement in a timely manner. Dauber-type applicators will give adequate coverage on pipe diameters that are approximately twice the diameter of the dauber-ball up to nominal pipe size 3. Swab applicators are required on larger diameter pipe surfaces of nominal pipe size 4 and above (See 7.7.1.10 for large diameter).

NOTE 14—The can-lid dauber included in the can may not be of appropriate size for the specific diameter of pipe and fittings being joined. A variety of applicator sizes are commercially available.

NOTE 15—The purpose of a primer is to penetrate and soften the surfaces so they can properly fuse together. Ambient temperature has a large effect on the ability of primer to soften and penetrate. Colder temperatures require longer application time for primer, whereas warmer temperatures require less application time. Because ambient temperature plays a large role in the amount of time required for primer penetration it is a good idea to test under actual conditions prior to making the first joint.

FIG. 8 Dry Joint Tightness Test for an Interference Fit

FIG. 9 Clean the pipe end and the fitting socket.

FIG. 10 Mark the socket depth on the pipe end and place a second mark 2 inches (50.8 mm) from the first mark

This will tell the operator if a primer has been applied for a long enough period of time to soften the pipe and fitting. Apply primer to a spare piece of pipe. Use a knife or other sharp object to drag its edge over the primed surface. Proper penetration has been achieved if a few thousandths of an inch (a few tenths of a millimeter) of the softened surface is seen to 'ball up" on the blade. Under warm conditions it may only require 10-15 seconds of primer application to obtain proper softening. Conversely, under cold conditions it may require a minute or more to achieve the same depth of softening and penetration. Once the proper amount of application time for the primer has been determined under the given conditions, a clock or timer can be utilized to obtain consistent results.

7.7 *Methods of Assembly for Joining Plastic Pipe and Fittings with Primer and Solvent Cement:*

7.7.1 *Application Method for Joining PVC or CPVC Plastic Pipe and Fittings:*

7.7.1.1 Apply primer to the inside of the socket (see Fig. 11). Use an aggressive scrubbing motion to work the solvents into the socket surface to break down the surface tension and to soften the surfaces.

(1) Use a primer that meets Specification F656.

7.7.1.2 Apply primer to the pipe end, beyond the mark delineating the depth of the fitting socket. (See Fig. 12.) Again, use an aggressive scrubbing motion.

7.7.1.3 Again apply primer to the inside of the socket. (See Fig. 11.)

FIG. 11 Apply primer to the fitting socket.

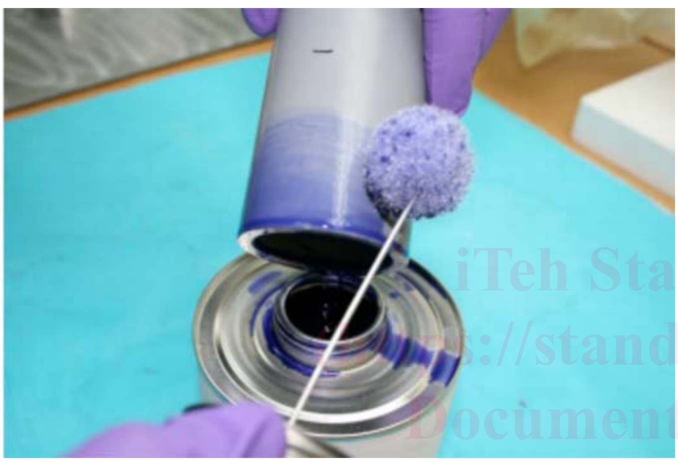

FIG. 12 Apply primer to the pipe end beyond the mark delineating the depth of the fitting socket.

7.7.1.4 While the primer is still wet and the surfaces are soft, apply a full, even layer of solvent cement, beyond the mark delineating the depth of the fitting socket, to the pipe end. Be sure to apply enough solvent cement to fill the gap between the pipe and fittings. (See Fig. 2 and Fig. 13.)

(1) Use PVC solvent cement that meets Specification D2564.

(2) Use CPVC solvent cement that meets Specification F493.

7.7.1.5 Apply a thin and even layer of solvent cement to the inside of the socket. (See Fig. 2 and Fig. 14.)

(1) This will prevent puddling of the solvent cement inside of the pipe or fittings. Excessive puddling of solvent cement can cause unwanted waterway restriction and can weaken the wall of the pipe or fittings.

7.7.1.6 Apply a second layer of solvent cement to the pipe end. (See Fig. 2 and Fig. 13.)

7.7.1.7 Without delay and while the solvent cement is still wet, assemble the pipe and fitting by forcefully bottoming the male end of the pipe in the socket.

NOTE 16—Where possible, rotate the pipe or fitting a ¼ turn during the assembly, but not after pipe has bottomed. Sometimes assembly constraints (that is, pipe pullers) prohibit the ability to rotate the pipe or fitting. In addition, rotation is often not possible on diameters of 3 in. (76.2 mm) and larger. With diameters of 3 in. (76.2 mm) and larger, it is more important to bottom the pipe in the socket than it is to attempt to rotate.

7.7.1.8 Hold the pipe and fitting together, taking care not to move or disturb the joint, for an adequate length of time to avoid push out of the pipe from the socket. (See Fig. 15.) Hold times will vary with pipe diameter and ambient temperature.

7.7.1.9 A properly made joint will display a continuous bead of solvent cement around the entrance of the socket. This is an indication that an appropriate amount of solvent cement was applied to the pipe end. Once a continuous bead of solvent cement is observed at the entrance of the socket, immediately remove excess solvent cement by wiping with a clean, dry cloth. (See Fig. 16.)

7.7.1.10 *Instructions for Large Diameter Pipe and Fittings*—The procedure in 7.7.1.1 – 7.7.1.9 must be followed in the case of large diameter joining (4-in. diameter (101.6 mm) and above) bearing in mind that the following instructions are necessary.

(1) The use of proper size applicator (swab) is necessary to ensure that enough solvent cement is applied to fill the larger gap that exists between the pipe and fittings.

FIG. 13 Apply a full, even layer of solvent cement to the pipe end beyond the mark delineating the depth of the fitting socket.

FIG. 14 Apply a thin and even layer of solvent cement inside the socket.

FIG. 15 Insert the pipe to the socket bottom, hold for an adequate length of time to avoid push out, and verify that there is a continuous bead of solvent cement around the entrance of the socket

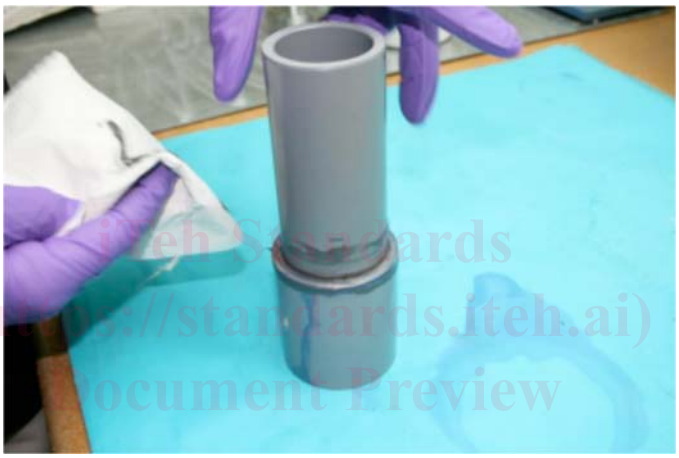

FIG. 16 Remove the bead of solvent cement from the entrance of the socket.

(2) A heavy-bodied solvent cement must be used on sizes up through 12-in. (304.8 mm) diameter and an extra heavy-bodied solvent cement must be used on sizes greater than 12-in. (304.8 mm) diameter (See Table X2.1).

(3) The end of the pipe must be cut square and chamfered as described in 7.2.1.

(4) For pipe joints of 6 to 8-in. (152.4 to 203.2 mm) diameter, use 2 to 3 people per joint and for pipe joint of 10 to 30-in. (254 to 762 mm) diameter, use 3 to 4 people per joint, excluding factory or mechanically assembled joints.

(5) It is important in large diameter joining that a multi-person crew must synchronize the application the primer to the pipe and fittings, then the application of solvent cement immediately to the pipe and fittings.

(6) Large diameter pipe is heavy and bulky. It can develop significant resistance during insertion before reaching the socket bottom. Therefore, the use of a pipe puller or other mechanical assist device shall be used to assemble joints of 4-in. (101.6 mm) diameter and above.

(7) Large diameter pipe and piping components require longer set times and cure times. In cold temperatures, an industrial heating blanket may be used to speed up the set times and cure times. Adhere to 8.4 and 8.5 for cold and hot temperature joining.

(8) Prefabricate as many joints as possible.

(9) If pipe is to be buried, make as many joints as possible above ground, then after the joints have cured, carefully lower it in to the trench.

(10) Follow the manufacturers' recommendation for joining their particular products.

7.7.1.11 *Instructions for Bell End Pipe*—The procedure in 7.7.1.1 – 7.7.1.9 must be followed in the case of bell end pipe. Care must be taken not to apply an excess of solvent cement in the bell socket. Solvent cement must not be applied to the transition area of diameter change from the socket to the inside diameter of the pipe at the socket bottom. This precaution is particularly important for installation of bell end pipe with a wall thickness of less than ⅛- in. (3.1 mm).