Designation: F493 – 14

Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings[1]

This standard is issued under the fixed designation F493; 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 specification provides requirements for chlorinated poly(vinyl chloride) (CPVC) solvent cements to be used in joining chlorinated poly(vinyl chloride) pipe, tubing, and socket-type fittings.

1.2 CPVC solvent cements are used with CPVC 41 chlorinated poly(vinyl chloride) pipe, tubing, and fittings, which meet Class 23447 as defined in Specification D1784.

1.3 A recommended procedure for joining CPVC pipe and fittings is given in Appendix X1.

1.4 The text of this specification references notes, footnotes, and appendixes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.5 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.

1.6 The following safety hazards caveat pertains only to the test methods portion, Section 6, of this specification: *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1084 Test Methods for Viscosity of Adhesives

D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

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

D2846/D2846M Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems

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

F439 Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

2.2 *NSF Standards:*

Standard No. 14 for Plastic Piping Components and Related Materials[3]

Standard No. 61 for Drinking Water Systems Components—Health Effects[3]

3. Terminology

3.1 *Definitions*—The definitions in this specification are in accordance with Terminology F412.

4. General Requirements

4.1 The solvent cement shall be a solution of the base CPVC resin used to make Class 23447, chlorinated poly(vinyl chloride) molding or extrusion compound as defined in Specification D1784.

4.2 When rework material is used, the manufacturer shall use only his own clean rework material that is compatible with virgin material and produces a cement that meets the requirements of this specification.

4.3 The cement shall be free-flowing and shall not contain lumps, undissolved resin, or any foreign matter that will adversely affect the ultimate joint strength or chemical resistance of the cement.

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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.

[3] Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, http://www.nsf.org.

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

4.4 The cement shall show no gelation or stratification that cannot be removed by stirring.

4.5 When inert fillers and colorants are added, the resulting cement shall meet all requirements of this specification.

NOTE 1—It is recommended that CPVC solvent cement be orange in color to facilitate identification and minimize unintentional use of other cements that may fail at elevated service temperatures.

4.6 The particular solvent system to be used in the formulation of this solvent cement is not specified, since it is recognized that a number of adequate solvent systems for CPVC exist. Solvent systems consisting of blends of tetrahydrofuran and cyclohexanone have been found to make cements that meet the requirements of this specification.

5. Detail Requirements

5.1 *Resin Content*—The CPVC resin content shall be 10 % minimum when tested in accordance with 6.1.

5.2 *Dissolution*—The cement shall be capable of dissolving an additional 3 % by weight of CPVC 41 compound (either powder or granular) or equivalent CPVC resin at 73 ± 3.6°F (23 ± 2°C) without evidence of gelation.

5.3 *Viscosity*—Cements are classified as regular-, medium-, or heavy-bodied types, based on their minimum viscosity when tested in accordance with 6.2.

5.3.1 Regular-bodied cements shall have a minimum viscosity of 90 cP (90 MPa·s).

5.3.2 Medium-bodied cements shall have a minimum viscosity of 500 cP (500 MPa·s).

5.3.3 Heavy-bodied cements shall have a minimum viscosity of 1600 cP (1600 MPa·s).

NOTE 2—Refer to Appendix X2 for guidelines in selecting CPVC solvent cements for joining different pipe sizes.

5.4 *Shelf Stability*—The cement, in the container in which it is supplied, shall show no gelation or stratification that cannot be removed by stirring after aging 30 days at 120°F (49°C).

5.5 *Hydrostatic Burst Strength*—Joints made using 2-in. (63 mm) CPVC piping and this cement shall meet the requirements of Table 1 when tested in accordance with 6.3.

5.6 *Hydrostatic Sustained Pressure Strength*—Joints made using ½-in. CPVC tubing and this cement shall meet the requirements of Table 2 when tested in accordance with 6.4.

6. Test Methods

6.1 *Solid Contents:*

6.1.1 *Apparatus:*

6.1.1.1 *Ointment Tins,* Style No. 12, 1-oz (30-mL), all metal,

6.1.1.2 *Analytical Balance,*

6.1.1.3 *Vacuum Oven,*

TABLE 1 Minimum Hydrostatic Burst Strength Requirements for Nominal 2 in. CPVC Solvent-Cemented Joints After 2 h Drying at Test Temperature

Temperature, °F (°C)	Burst Pressure, psi (MPa)
73 (23)	400 (2.76)
180 (82)	200 (1.38)

TABLE 2 Minimum Hydrostatic Sustained Pressure Requirements for Nominal ½ in. CPVC Solvent-Cemented Joints Tested in Water or Air External Environment at 180 ± 3.6°F (82 ± 2°C)

Test Condition	Test Duration	Hydrostatic Test Pressure, psi (MPa)	
		Water Bath	Air Bath
A	6 min	521 (3.59)	551 (3.80)
B	4 h	364 (2.51)	403 (2.78)

6.1.1.4 *Desiccator,* and

6.1.1.5 *Centrifuge.*

6.1.2 *Procedure*—Stir the sample thoroughly with a spatula before weighing (Note 3). Weigh 0.106 ± 0.123 oz (3.0 ± 0.5 g) of the sample to the nearest 3.53×10^{-5} oz (1 mg) into a tared ointment tin with cover. Place the tin into the vacuum oven (Note 4), and heat at 248°F (120°C) for 45 to 60 min. Discard specimens left in for more than 60 min. The vacuum must be continually in operation to draw off flammable solvents and shall be maintained below 0.29 psi (15 mm Hg) pressure. Remove the tin from the oven and cap immediately. Place in a desiccator until cooled to room temperature. Weigh the tin and dried sample to the nearest 3.53×10^{-5} oz (1 mg).

NOTE 3—This material is usually nonhomogeneous and shall be thoroughly stirred before weighing. The weighing shall also be accomplished quickly to avoid loss of solvent by evaporation.

NOTE 4—The use of a vacuum oven is mandatory for drying the specimen, because this oven has neither an exposed heating surface nor an open flame, thus avoiding the danger of flashing. The oven also provides an open vacuum to exhaust solvent fumes.

6.1.3 *Inert Filler Determination*—Dissolve most of the dried sample by adding 0.507 oz (15 mL) of tetrahydrofuran (THF) to the sample in the ointment tin and stirring with a glass rod for 15 min. Collect the liquid decanted from this step, plus the liquid from the next two steps. Dissolve the remainder with a second addition of 0.507 oz (15 mL) of THF, followed by a third addition of 0.17 oz (5 mL) of THF to rinse the ointment tin. Centrifuge the entire volume at 20 000 rpm for 15 min. Discard the supernatant liquid. Add 0.507 oz (15 mL) of THF to the tube, mix thoroughly, and transfer the tube contents to the ointment tin. Use 6.76×10^{-2} (2 mL) more of THF to wash down the tube, and pour into the ointment tin. Evaporate off the THF in the vacuum oven at 248°F (120°C) for 45 min. Cool in desiccator, weigh the tin to the nearest 3.53×10^{-5} oz (1 mg), and determine the weight of inert filler present in the cement.

6.1.4 *Calculation*—Calculate the percentage of CPVC resin as follows:

$$Resin, \% = (B - A - D)/(C - A) \times 100$$

where:

A = weight of ointment tin,
B = weight of tin and specimen after drying,
C = weight of tin and specimen before drying, and
D = weight of inert filler, if present.

NOTE 5—Other methods for determination of resin and inert filler content may be used provided that the results of the alternative method are as accurate and consistent as the above method.

6.2 *Viscosity:*

6.2.1 Measure the viscosity in accordance with Method B of Test Methods D1084, except that conditioning to temperature

equilibrium only is required. For qualification purposes, use a Model RVF viscometer, a speed of 10 r/min, and the spindle that, by trial, gives the closest reading to center range of scale for the cement being tested. Other speeds may be used for quality control purposes.

6.3 *Hydrostatic Burst Strength:*

6.3.1 Test in accordance with Test Method D1599, except as herein specified.

6.3.2 Prepare a test assembly containing at least six nominal 2-in. (63 mm) solvent-cemented joints using CPVC 41 SDR 11 pipe and fittings meeting the requirements of Specification D2846/D2846M. Cut the pipe into suitable lengths. The socket depth of the fittings shall be 1½ to 1⁹⁄₁₆ in. (38.1 to 38.50 mm) (Schedule 80 in accordance with Specification F439).

6.3.3 The dimensions of the pipe and fitting socket shall be such that the pipe will enter the socket from one third to two thirds of the full socket depth dry when assembled by hand.

6.3.4 Cement the joints in accordance with the recommended solvent cementing procedure given in Appendix X1 except for X1.7.

6.3.5 Attach suitable end closures and fill the test assembly with water, purging all air, and condition in water or air at the test temperature for 120 ± 5 min, then test immediately.

6.3.6 Increase the internal pressure at a constant rate so as to reach the minimum burst requirement in 60 to 70 s.

6.3.7 Leakage or separation at any of the joints tested at less than the minimum hydrostatic burst strength requirements specified in Table 1 shall constitute failure in this test.

6.4 *Hydrostatic Sustained Pressure Strength:*

6.4.1 Test in accordance with Test Method D1598, except as herein specified.

6.4.2 Prepare a test assembly containing six nominal ½-in.(15.24 cm) solvent-cemented joints using CPVC 41 SDR 11 tubing and fittings meeting the requirements of Specification D2846/D2846M. Cut the tubing into 6-in. lengths and use two couplings and two male adapters.

6.4.3 The dimensions of the tubing and fitting socket shall be such that the tubing will enter the socket from one third to two thirds of the full socket depth dry when assembled by hand.

6.4.4 Prepare the pipe and fittings for joining in accordance with X1.1, X1.2 and X1.3 of the recommended solvent cementing procedure given in Appendix X1. Do not apply cleaner or primer and do not sand. Apply a very light coat of CPVC cement to the socket and a heavy coat to the pipe end. Immediately insert the pipe into the fitting with a slight twisting motion until it bottoms in the socket. Hold the joint together until the cement has set. Remove any excess cement from the joint.

NOTE 6—The purpose of the test method is to evaluate the performance of the CPVC cement alone, and therefore applying cleaner or primer or sanding, in accordance with X1.4, is not required for this purpose.

6.4.5 Dry the solvent-cemented joints in air at 73.4 ± 3.6°F (23 ± 2°C) for 336 ± 2 hr. Then dry the solvent-cememted joints at 180 ± 3.5°F (82 ± 2°C) for 48 ± 2 hr.

6.4.6 Attach suitable end closures and fill the test assembly with water, purging all air, and condition at the test temperature for 30 ± 5 min if using a water bath or 120 ± 5 min if using an air bath, then test immediately.

6.4.7 Attach to pressure source and place on test at 180°F (82°C) and the proper hydrostatic pressure ±10 psi (±70 kPa) as specified in Table 2. Increase the internal pressure at a constant rate to reach the test pressure in 15 to 20 s.

6.4.8 Leakage or separation at any of the joints tested at less than the test duration time specified in Table 2 for both test conditions A and B shall constitute failure in this test.

7. Retest and Rejection

7.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) shall be conducted again only by agreement between the purchaser and the seller. Under such agreement, minimum requirements shall not be lowered, nor tests omitted, substituted, changed, or modified, nor shall specification limits be changed. If upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this specification.

8. Report

8.1 Report the following information:

8.1.1 Name of cement manufacturer,

8.1.2 Lot number or sample identification,

8.1.3 Resin content, %,

8.1.4 Dissolution, pass or fail,

8.1.5 Viscosity,

8.1.6 Shelf stability, pass or fail,

8.1.7 Hydrostatic burst strength, and

8.1.8 Hydrostatic sustained pressure strength, test duration time.

9. Certification

9.1 When specified in the purchase order, the manufacturer shall certify to the purchaser or to his nominee that the products in the specified lots meet all the requirements of this specification and when requested shall include a copy of the manufacturer's routine quality control tests to document that the specification requirements have been met. Each certification so furnished shall be signed by an authorized agent of the manufacturer.

10. Container Labeling and Marking

10.1 Container labeling of CPVC solvent cement shall include the following:

10.1.1 Manufacturer's or seller's name and address and tradename or trademark, or both.

10.1.2 This designation: "ASTM F493."

10.1.3 Function of material (Cement for CPVC Pipe).

10.1.4 Cement type according to viscosity as shown in detail requirement of 5.3.

10.1.5 Pipe sizes, SDR's, and schedules for which the cement is recommended.

10.1.6 Procedure or instructions for application and use.

10.1.7 Lot number of batch on container.

10.1.8 Solvent cement intended for use on potable water systems should be evaluated and certified as safe for this purpose by a testing agency acceptable to the local health authority.

NOTE 7— The evaluation should be in accordance with requirements for chemical extraction, taste, and odor, that are no less restrictive than those included in NSF Standard No. 14. The seal or mark of the laboratory making the evaluation should be included on the container.

10.1.9 End use application (Example: potable water).

10.1.10 All warnings and cautions necessitated by:

10.1.10.1 Ingredients,

10.1.10.2 Handling and distribution of the product,

10.1.10.3 Intended use, and

10.1.10.4 Requirements of Law (such as the Federal Hazardous Substance Act).

These are intended to warn those who handle or use the product against potential hazards, such as flammability, toxicity, etc.

NOTE 8—It is recommended that the color of the cement also be indicated on the label.

11. Safe Handling of Solvent Cement

11.1 Solvent cements for plastic pipe are made from flammable liquids. Keep them away from all sources of ignition. Maintain ventilation to reduce fire hazard and to minimize breathing of solvent vapors. Avoid contact of cement with skin and eyes.

11.2 Refer to Practice F402 for information on safe handling of solvent cements.

12. Quality Assurance

12.1 When the product is marked with this designation, F493, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

13. Keywords

13.1 cement; CPVC; solvent cement

SUPPLEMENTARY REQUIREMENTS

This requirement applies whenever a regulatory authority or user calls for the product to be used to convey or to be in contact with potable water.

S1. *Potable Water Requirement*—Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard No. 61 or the the health effects portion of NSF Standard No. 14 by an acceptable certifying organization when required by the regulatory authority having jurisdiction.

APPENDIXES

(Nonmandatory Information)

X1. RECOMMENDED PROCEDURE FOR MAKING SOLVENT-CEMENTED JOINTS WITH CHLORINATED POLY(VINYL CHLORIDE) (CPVC) PIPE AND FITTINGS

X1.1 *Cutting*—Cut the pipe square, using a tubing cutter or a fine-toothed hand saw and mitre box. Tubing cutters with thin cutting wheels designed specially for plastic are recommended.

X1.2 *Burrs*—Remove all ridges caused by tube cutter and burrs with sandpaper or knife.

X1.3 *Pipe Fit*—Check dry fit of pipe in the fitting to ensure that there is an interference fit. The dry pipe or tubing should enter the fitting socket from one third to two thirds of the full socket depth when assembled by hand.

X1.4 *Cleaning*—Clean the pipe end and fitting socket. Wipe away dust, moisture, and foreign materials with a clean dry cloth or use a cleaner, or primer, or sand with fine abrasive paper. Cleaner or primer should be that recommended by the cement manufacturer for use with CPVC plastic pipe. Apply the cleaner or primer with an applicator or wear gloves impervious to the solvents, to prevent skin contact.

X1.5 *Cement Application*—Apply a heavy thick coat of CPVC cement to the pipe end and a light thin coat to the inside of the fitting socket. If cement dries on either surface before joining, apply another coat.

X1.6 *Joining*—Immediately insert the pipe into the fitting with a slight twisting motion until it bottoms in the socket. Quickly align fitting direction. Hold the joint together momentarily until cement has set. Remove excess cement from the joint.

X1.7 *Handling*—The joint may be handled immediately with care. Avoid rough handling for 1 h. The joint normally may be pressure tested after 16 h.

NOTE X1.1—Additional information concerning CPVC piping systems and installation practices may be found in Specification D2846/D2846M.

X2. GUIDE FOR CPVC SOLVENT CEMENT SELECTION

X2.1 It is recommended that only regular-bodied cements be used to join CPVC tubing sizes of Specification D2846/D2846M, since medium-bodied and heavy-bodied cements are generally formulated for larger pipe sizes and have longer open or drying times than regular-bodied cements.

X2.2 The successful joining of CPVC pipe and fittings, larger than 2 in. (63mm), and noninterference-type joints requires the use of solvent cements that have higher-gap filling properties than the minimum-viscosity 90 cP (90 MPa·s) cements permitted in this specification. 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 (Note X2.1). A guide to the proper selection of a solvent cement for the various pipe sizes is given in Table X2.1 and Table X2.2, where cements are classified into three types (for purposes of identification) as regular-bodied, medium-bodied, or heavy-bodied, based on minimum viscosity and minimum wet-film thickness. Solvent cement manufacturer's recommendations should be followed. The guidelines shown in Table X2.1 and Table X2.2 are general ones, and solvent cement properties may vary considerably among manufacturers.

NOTE X2.1—The wet-film thickness of a solvent cement can be measured by using a Nordson Wet Film Thickness Gage or equivalent, available from Nordson Corp., Amherst, OH 44001, as Nordson No. 79-0015. To use this gage, dip a short length of 1-in. pipe vertically into the cement at a temperature of approximately 23°C (73°F) to a depth of 1.5 to 2 in. (40 to 50 mm) for a period of 15 s. Remove the pipe from the cement and hold the pipe horizontally for 45 s. Measure the wet-film thickness on the top surfaces of the pipe with the end of the gage about ¼ in. (10 mm) from the end of the pipe. With a little care and experience, the wet cement layer can be readily measured to ±0.002 in. (±0.05 mm).

NOTE X2.2—The cement manufacturer's recommendations should be followed in selecting the proper cement for joining Schedule 80 pipe sizes above 6 in.

TABLE X2.1 CPVC Cements for Tubing and Schedule 40 Interference Fit

Pipe Size Range, in.	Cement Type	Tubing				Schedule 40 Interference Fit			
		Minimum Viscosity		Minimum Wet Film		Minimum Viscosity		Minimum Wet Film	
		cP	(MPa·s)	in.	(mm)	cP	(MPa·s)	in.	(mm)
⅜ to 2	regular-bodied	90	(90)	0.006	(0.15)				
⅛ to 2	regular-bodied					90	(90)	0.006	(0.15)
2½ to 6	medium-bodied					500	(500)	0.012	(0.30)
6 to 12	heavy-bodied					1600	(1600)	0.024	(0.60)

TABLE X2.2 CPVC Cements for Schedule 80 and Noninterference Fits (Note X2.2)

Pipe Size Range, in.	Cement Type	Minimum Viscosity		Minimum Wet Film Thickness	
		cP	(MPa·s)	in.	(mm)
⅛ to 1¼	medium-bodied	500	(500)	0.012	(0.30)
1½ to 6	heavy-bodied	1600	(1600)	0.024	(0.60)

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F493–10) that may impact the use of this standard.

(1) Table 1 was revised.