Designation: D2235 – 04 (Reapproved 2016)

Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings[1]

This standard is issued under the fixed designation D2235; 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.

1. Scope

1.1 This specification covers solvent cement for joining acrylonitrile-butadiene styrene (ABS) plastic pipe and fittings for pressure and nonpressure systems.

1.2 Recommendation for using solvent cement for joining acrylonitrile-butadiene-styrene (ABS) plastic pipe and fittings is given in Appendix X1. Satisfactory joining of pipe and fittings cannot be made in the presence of water, as water destroys the bonding ability of solvent cement; therefore, all materials must be dry for satisfactory joining.

1.3 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.

1.4 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.

1.5 The following safety hazards caveat pertains only to the test methods portion, Section 7, 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]

D329 Specification for Acetone
D618 Practice for Conditioning Plastics for Testing
D740 Specification for Methyl Ethyl Ketone
D883 Terminology Relating to Plastics
D1084 Test Methods for Viscosity of Adhesives
D1527 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80 (Withdrawn 2013)[3]
D2282 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (Withdrawn 2006)[3]
D2465 Specification for Threaded Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80 (Withdrawn 1985)[3]
D2468 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40 (Withdrawn 2003)[3]
D2469 Specification for Socket-Type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80 (Withdrawn 1985)[3]
D2661 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
D2680 Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
D2750 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastics Utilities Conduit and Fittings (Withdrawn 1997)[3]
D2751 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings (Withdrawn 2014)[3]
D1600 Terminology for Abbreviated Terms Relating to Plastics
D3965 Classification System and Basis for Specifications for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings
F402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
F409 Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
F412 Terminology Relating to Plastic Piping Systems
F493 Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

[1] This specification 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.

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

F628 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core

2.2 *Federal Standard:*
Fed. Std. 123 Marking for Shipment (Civil Agencies)[4]

2.3 *Military Standard:*
MIL STD-129 Marking for Shipment and Storage[4]

2.4 *National Sanitation Foundation Standards:*
Standard No. 14 Plastic Piping Components and Related Materials[5]
Standard No. 61 for Drinking Water Systems Components—Health Effects[5]

3. Terminology

3.1 Definitions are in accordance with Terminologies D883 and F412. Abbreviations are in accordance with Terminology D1600 unless otherwise indicated. The abbreviation for Acrylonitrile-Butadiene-Styrene plastic is ABS.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *solvent cement*—adhesive made by dissolving a plastic resin or compound in a suitable solvent or mixture of solvents. The solvent cement dissolves the surfaces of the pipe and fittings to form a bond between the mating surfaces provided the proper cement is used for the particular materials and proper techniques are followed.

4. Classification

4.1 Solvent Cement shall be acrylonitrile-butadiene-styrene plastic resin dissolved in either of the following solvents:

(1) methyl ethyl ketone,

(2) a blend of methyl ethyl ketone and acetone, with acetone constituting no more than 25 % of the solvent blend by weight.

NOTE 1—It is recommended that solvent cements made to this specification *not* be orange since that color is recommended for use with CPVC solvent cement under Specification F493.

5. Materials

5.1 *Material Specification*—Virgin ABS material shall conform to the requirements prescribed in Specification D3965 with a minimum cell classification of 1-1-2-2-2 or equivalent to the cell classification for the material being joined.

5.2 *Acrylonitrile-Butadiene-Styrene (ABS) Plastic*—Plastic containing polymers in which the minimum butadiene content is 6 %, the minimum acrylonitrile content is 15 %, the minimum styrene or substituted styrene content, or both, is 15 %, and the maximum content of all other monomers is not more than 5 %.

5.3 *Rework Material*—Only clean regrind material conforming to the requirements of this specification may be used.

5.4 *Methyl Ethyl-Ketone*— Commercial or industrial grade of MEK shall be used which complies with Specification D740.

5.5 *Acetone*—Commercial or industrial grade of acetone shall be used which complies with Specification D329.

6. Requirements

6.1 *Resin Content*—The ABS resin content shall be 15 % minimum when tested in accordance with 7.3.

6.2 *Dissolution*—The cement shall be capable of dissolving 10 % by weight of the plastic compound used in the pipe or fitting, and still be free flowing and not contain lumps or undissolved resin particles.

6.3 The cement shall be free flowing and shall not contain lumps, undissolved particles, or foreign matter. It shall show no gelation or separation that cannot be removed by stirring.

6.4 *Viscosity*—The minimum viscosity shall be 100 cP (100 mPa·s) when tested in accordance with 7.2.2.

6.5 *Lap Shear Strength*—The minimum average lap shear strength shall be 800 psi (5.5 MPa) when tested in accordance with 7.4.

NOTE 2—The specified shear strength value is used to evaluate the cement and should not be used for designing pipe joints.

7. Test Methods

7.1 The properties enumerated in this specification shall be determined in accordance with the following methods:

7.1.1 *Conditioning*—Condition the test specimens at 73.4 ± 3.6°F (23 ± 2°C) for not less than 40 h prior to test in accordance with Procedure A of Practice D618, for those tests where conditioning is required.

7.1.2 *Test Conditions*—Conduct tests at 73.4 ± 3.6°F (23 ± 2°C), unless otherwise specified in the test methods or in this specification.

7.2 *Viscosity:*

7.2.1 The samples for test shall be representative of the material under consideration. One sample for every batch shall be tested in accordance with 7.2.2.

7.2.2 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 are used for qualification purposes.

7.3 *Total Solids:*

7.3.1 *Apparatus:*

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

7.3.1.2 *Vacuum Oven.* [6]

7.3.1.3 *Desiccator*

7.3.1.4 *Analytical Balance.*

[4] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

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

[6] Labline Duo-Vac vacuum oven, or equivalent, has been found satisfactory for this purpose.

7.3.2 *Procedure*—Stir the sample thoroughly with a spatula before weighing. Weigh 3.0 ± 0.5 g of the sample into a tared ointment tin. Place tin into the vacuum oven and heat at 248°F (120°C) for 45 min. Vacuum must be continually in operation to draw off flammable solvents and should be maintained at 0.6 in. Hg (15 mm Hg) minimum. 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 0.015 grains (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 volatization.

7.3.3 The use of a vacuum oven is mandatory for drying the specimen because it has no exposed heating surface nor an open flame, thus avoiding the danger of flashing. The oven also provides an open vacuum to exhaust solvent fumes.

7.3.4 The specimen shall be left in the oven for 45 min and no longer. Specimens left in for 1 h or more show a definite increase in weight.

7.3.5 *Calculation*—Calculate the percentage total solids, TS, as follows:

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

where:

A = weight of ointment tin,
B = weight of tin and specimen after drying, and
C = weight of tin and specimen before drying.

7.3.6 *Precision*—Duplicate samples shall be tested for best results. Duplicate results obtained by the same analyst, on the same material, on the same day, in the same laboratory are suspect if they differ by more than 0.52 % absolute. This procedure has a standard deviation of 0.13.

7.4 Lap Shear Strength (Qualification Tests):

7.4.1 *Number of Specimens*—A minimum of seven specimens shall be tested for the requirement specified in 6.5.

7.4.2 Cut sections 1 by 1 in. (25 by 25 mm) and 1 by 2 in. (25 by 50 mm) from 0.25-in. (6-mm) thick ABS sheets. One section of each size is required for each specimen (Fig. 1).

7.4.3 Clean the surfaces to be adhered with a cloth dampened with methyl ethyl ketone (MEK).

NOTE 4—The cleaning of the surface with an abusive amount of MEK may affect the performance of the test. Tests should be conducted to determine if this is significant.

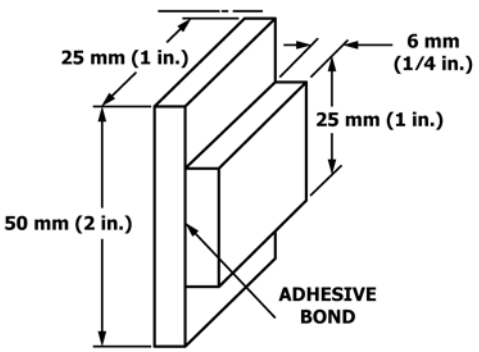

FIG. 1 Compression Shear Specimen

7.4.4 Using a 1-in. (25-mm) natural bristle brush, apply two layers of cement in immediate succession to the complete surface of a 1 by 1-in. (25 by 25-mm) sheet section and to the center of a 1 by 2-in. (25 by 50-mm) sheet section.

7.4.5 Assemble these sections immediately and rotate the 1 by 1-in. (25 by 25-mm) section 180° on the 1 by 2-in. (25 by 50-mm) section within 5 s using light hand pressure (approximately ½ lbf (2 N)).

7.4.6 Place the assembled test specimen on a clean, level surface, by using the 1 by 2-in. (25 by 50-mm) section as a base. After 30 s, place a 4.4-lb (2-kg) weight on the test specimen for a period of 3 min, then remove.

7.4.7 Store the assembled test specimens at 73.4 ± 3.6°F (23 ± 2°C) for 48 to 50 h and test them in a holding fixture similar to that shown in Fig. 2.

7.4.8 Place the specimen in the holding fixture and adjust the screws to bring the sample to a vertical position with the face of the 2-in. (50-mm) specimen in contact with the test jig as shown in Fig. 2 (Note 5). Back off the screw in contact with the 2-in. specimen slightly, and insert a 0.001-in. (0.02-mm) shim between the screw plate and the specimen. Then bring the bearing plate of the test machine into contact with the top of the 2-in. specimen, using care to ensure that the plate is on a horizontal plane.

7.4.9 Apply the compressive shear at a speed of 0.05 in. (1.25 mm)/min. Express the results in megapascals (or pounds-force per square inch).

NOTE 5—Alternative jigs may be used if they can be shown to be equivalent.

7.4.10 Disregard the lowest and highest value for the calculation of the average lap shear strength.

8. Retest and Rejection

8.1 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.

9. Report

9.1 A report of the test results shall include the following:
9.1.1 Name of cement manufacturer,
9.1.2 Lot number, if given,
9.1.3 Total solids, in percent,
9.1.4 Dissolution, pass or fail,
9.1.5 Viscosity, and

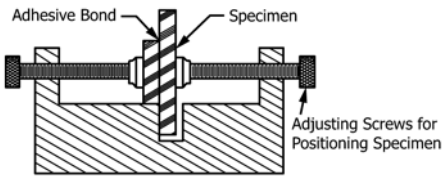

FIG. 2 Typical Specimen-Holding Device

9.1.6 Average lap shear strength and complete identification of ABS sheet stock used for test.

10. Container Labeling and Marking

10.1 Cement shall be packaged in 1-qt containers or smaller unless agreed upon by the supplier and the purchaser to use a larger size.

10.2 Container labeling of cement shall include the following:

10.2.1 *Federal Hazardous Substance Act*—Governing safe handling, shipping, storage, and disposal of hazardous materials.

10.2.2 *OSHA Hazard Communication Standard, Labels, and Other Forms of Warning*—Requiring the generic nomenclature of ingredients to be indicated on the container label.

NOTE 6—Solvent cement intended for use in the joining of potable water piping should be evaluated and certified as safe for this purpose by a testing agency acceptable to the local health authority. 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.

10.2.3 This designation: ASTM D2235.

10.2.4 Function of material (example) cement for ABS pipe for pressure rated, non-pressure rated, and potable water.

10.2.5 Procedure or instructions for application and use.

11. Safe Handling of Solvent Cement

11.1 See Appendix X1.

12. Quality Assurance

12.1 When the product is marked with this designation, D2235, 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.

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 health effects portion of NSF Standard No. 14 by an acceptable certifying organization when required by the regulatory authority having jurisdiction.

S2. *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless the purchaser disapproves. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE S2.1—In U.S. federal contracts, the contractor is responsible for inspection.

S3. *Packaging and Product Marking for U.S. Government Procurement:*

S3.1 *Packaging*—Unless otherwise specified in the contract, the materials shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules or National Motor Freight Classification rules.

S3.2 *Product Marking*—Product marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

NOTE S3.1—The inclusion of the U.S. Government procurement requirements shall not be construed as an indication that the U.S. Government uses or endorses the products described in this specification.

APPENDIX

(Nonmandatory Information)

X1. RECOMMENDED PROCEDURE FOR JOINING ABS PIPE AND FITTINGS WITH ABS SOLVENT CEMENT

X1.1 *Field Inspection*—Prior to use, all pipe should be carefully inspected for cuts, gouges, deep scratches, damaged ends, and other imperfections. Defective pipe should be rejected or damaged sections should be cut out.

X1.2 *Safety Requirements for Solvent Cement and Primers*—Prior to the use of solvent cement for joining plastic pipe, the safety requirement for primers, Practice F402, should be read and followed.

X1.3 *Pipe Fit*—Pipe is manufactured to close tolerances to ensure satisfactory "interference'' fit between the pipe and the fittings socket during assembly. Use only combinations of pipe and fittings that give interference fits. Pipe that is a loose fit in the socket may not properly bond. The allowable tolerance assures a forced fit and when solvent cement is applied, the pipe and fitting will readily mate, thus assuring proper adhesion. The pipe should enter the dry fitting socket to between one half and two thirds of the fitting socket depth.

X1.4 *Cutting*—Pipe can be easily cut with an ordinary hacksaw or carpenter's saw. Fine-tooth blades with little or no set should be used for best results. The pipe should be cut square and all burrs removed with a sharp knife, a fine-tooth file, or other suitable tool such as a chamfering tool or reamer. A miter box is recommended to ensure square cut ends. Standard steel pipe or tubing cutters are not recommended for cutting ABS pipe since they may cause excessive heat and pressure, which can result in cracked or irregular pipe ends. There are special plastic pipe cutters available with extra wide rollers and thin cutting wheels which have been especially designed for cutting plastic pipe, and their use is recommended.

X1.5 *Cleaning*—A clean dry cloth should be used to clean the pipe or follow the manufacturer's recommendation after all burrs have been removed and prior to applying the solvent cement. The pipe must be free of all materials which would interfere with the bonding.

X1.6 *Solvent Cement*—Use only solvent cement designed for ABS. A solvent cement meeting the requirements of D2235, when used in accordance with the manufacturer's recommendations, should provide satisfactory results. Should problems be encountered with the use of solvent cement, contact the solvent cement manufacturer for directions. Failure to use the designated solvent cement for ABS may result in joints which will not bond properly.

X1.6.1 *Application of Cement*—Using the applicator supplied with the can of solvent cement, or a brush with a width of about one half the pipe diameter for pipe sizes above 2 in., apply a moderate even coating of cement in the fitting socket to cover only the surfaces to be joined. Heavy or excessive application of solvent cement may become an obstruction in the pipe and prevent satisfactory joining. Quickly apply a heavy coat of solvent cement to the outside of the pipe. Make sure that the coated distance on the pipe is equal to the depth of the fitting socket.

X1.7 *Assembly*—Make the joint as quickly as possible after application of the solvent cement and before the solvent cement dries. Should the solvent cement dry partially before the joint is made up, reapply solvent cement before assembling. Insert the pipe into the fitting socket, making sure that the pipe is inserted to the full depth of the fitting socket. Hold joint together firmly for about 30 s for diameters up to 6 in. and 60 s for diameters above 6 in. to avoid push out. Remove excessive solvent cement from the exterior of the joint with a clean, dry cloth. At no time should pipe or fittings be assembled that are wet or damp. Pipe and fittings must be dry before assembly to obtain good joints.

X1.8 *Set Time*—Do not attempt to disturb the pipe and fittings joint until after the solvent cement has set or damage to the joint and loss of fit may result. Reasonable handling of assembly is permissible within two minutes after joining. Allow 15 min for the joint to develop good handling strength and the joint will withstand the stresses of normal installation. A badly misaligned installation will cause excessive stresses in the joint, pipe, and fittings and should be avoided. The recommendation of the solvent cement manufacturer must be followed for best results. Should problems be encountered in obtaining good joints, contact the solvent cement manufacturer for directions.

X1.9 *Cure Time*—Joint strength development is very rapid during periods of high-ambient temperatures, lowrelative humidity, and using interference-type fittings. Joint strength development is not as rapid during periods of lowambient temperatures, high-relative humidity and using loose fits. The recommendations of the solvent cement manufacturer, therefore, should be followed for best results prior to leak testing.

X1.10 Keep the solvent cement container closed between operations. Failure to follow this recommendation allows the solvent cement to absorb moisture and lose solvent vapor resulting in solvent cement which will not bond properly.

X1.11 Solvent cementing of ABS pipe and fittings, utilizing ABS cement, is not recommended if a pressure line is designed to operate at temperatures exceeding 140°F (60°C).

X1.12 The following specifications cover products that may be joined using solvent cement meeting this specification:

D1527 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80

D2282 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)

D2465 Threaded Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80

D2468 Acrylonitrile-Butadiene Styrene (ABS) Plastic Pipe Fittings, Schedule 40

D2469 Socket-Type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80

D2661 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Drain, Waste, and Vent Pipe and Fittings

D2680 Acrylonitrile-Butadiene-Styrene (ABS) Composite Sewer Piping

D2750 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Utilities Conduit and Fittings

D2751 Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings

F409 Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings

F628 Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core