



Designation: D 3915 – 99a^{ε1}

Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used in Pressure Applications¹

This standard is issued under the fixed designation D 3915; 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.

^{ε1} NOTE—Editorially corrected 11.4 in April 2002.

1. Scope

1.1 This specification covers plastic compounds composed of poly(vinyl chloride), chlorinated poly(vinyl chloride), or vinyl chloride copolymers, and the necessary compounding ingredients intended for use in making pipe, fittings, and other piping appurtenances. The compounding ingredients may consist of lubricants, stabilizers, non-poly(vinyl chloride) resin modifiers, pigments, and inorganic fillers.

1.2 This specification is designed to cover compounds for pressure piping applications. Refer to Specification D 4396 for compounds designed for non-pressure applications.

1.3 Rigid PVC-type compounds for building applications other than piping are covered in Specification D 4216.

1.4 Rigid PVC-type compounds for general purpose extrusion and molding use are covered in Specification D 1784. Specification D 1784 is applicable to piping applications involving special chemical and acid resistance.

1.5 The requirements in this specification are intended for the quality control of compounds used to manufacture pipe and fittings. They are not applicable to finished pipe and fittings. See the applicable ASTM standards for requirements for finished products.

1.6 It may be necessary in special cases to select specific compounds for unusual piping applications that require consideration of other properties not covered in this specification, such as service temperature, sag resistance, chemical resistance, weather resistance, bending forces, etc.

1.7 The following safety hazards caveat pertains only to the test methods section, Section 11, 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.*

NOTE 1—There are no ISO standards covering the primary subject matter of this specification.

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

1.9 Recycled plastics shall not be used in pipe and fittings for pressure applications.

2. Referenced Documents

2.1 ASTM Standards:

D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics²

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

D 638 Test Method for Tensile Properties of Plastics²

D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load²

D 883 Terminology Relating to Plastics²

D 1243 Test Method for Dilute Solution Viscosity of Vinyl Chloride Polymers²

D 1600 Terminology for Abbreviated Terms Relating to Plastics²

D 1784 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds²

D 1898 Practice for Sampling of Plastics³

D 2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials⁴

D 3010 Practice for Preparing Compression-Molded Test Sample Plaques of Rigid Poly(Vinyl Chloride) Compounds⁵

D 4216 Specification for Rigid Poly(Vinyl Chloride) (PVC) and Related Plastic Building Products Compounds⁶

¹ This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

Current edition approved Nov. 10, 1999. Published February 2000. Originally published as D 3915 – 80. Last previous edition D 3915 – 99.

² Annual Book of ASTM Standards, Vol 08.01.

³ Discontinued. See 1998 Annual Book of ASTM Standards, Vol 08.01.

⁴ Annual Book of ASTM Standards, Vol 08.04.

⁵ Discontinued. See 1992 Annual Book of ASTM Standards, Vol 08.02.

⁶ Annual Book of ASTM Standards, Vol 08.02.

D 4396 Specification for Rigid Poly(Vinyl Chloride) (PVC) and Related Plastic Compounds for Nonpressure Piping Products⁷

D 5260 Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds⁷

F 412 Terminology Relating to Plastic Piping Systems⁴

3. Terminology

3.1 Definitions:

3.1.1 *General*—Definitions used in this specification shall be in accordance with Terminologies D 883, D 1600, and F 412, unless otherwise noted.

4. Classification

4.1 Means for classifying and identifying PVC and CPVC pipe and fittings compounds are provided in Table 1. The properties enumerated in this table and the tests defined are expected to provide identification of the compounds selected. They are not necessarily suitable for direct application in

design because of differences in shape of part, size, loading, environmental conditions, etc.

4.2 Classes are designated by the cell number for each property in the order in which they are listed in Table 1.

NOTE 2—The manner in which selected materials are identified by this classification system is illustrated by a Class 134544 PVC pipe compound having the following requirements (see Table 1):

Class	1	3	4	5	4	4
<i>Identification:</i>						
Poly(vinyl chloride)						
<i>Property and Minimum Value:</i>						
Impact strength (1.50 to 5.00 ft·lbf/in.)						
Tensile strength (7000 to 8000 psi)						
Modulus of elasticity in tension (400 000 to 480 000 psi)						
Deflection temperature under load (100 to 110°C)						
Hydrostatic design basis (4000 psi)						

NOTE 3—The cell-type format provides the means for classification and close characterization and specification of material properties, alone or in combination, for a broad range of materials. This type format, however, is

⁷ Annual Book of ASTM Standards, Vol 08.03.

TABLE 1 Class Requirements for Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

NOTE 1—The minimum property value will determine the cell number although the maximum expected value may fall within the next higher cell.

Designation Order No.	Property and Unit	Cell Limits								
		0	1	2	3	4	5	6	7	8
1	Kind of resin in compound	unspecified	poly(vinyl chloride) (PVC)	chlorinated poly(vinyl chloride) (CPVC)	vinyl chloride copolymer (CVC)					
2	Impact resistance, min: J/m of notch (ft·lbf/in. of notch)	unspecified	< 40.0 (<0.65)	40.0 (0.65)	80.1 (1.50)	266.9 (5.00)				
3	Tensile strength, min: MPa (psi)	unspecified	<34.0 (<5000)	34.0 (5000)	41.0 (6000)	48.0 (7000)	55.0 (8000)			
4	Modulus of elasticity in tension, min: MPa (psi)	unspecified	<1930 (<280 000)	1930 (280 000)	2210 (320 000)	2480 (360 000)	2760 (400 000)	3310 (480 000)	3860 (560 000)	
5	Deflection temperature under load, 1.82 MPa (264 psi), min: °C (°F)	unspecified	60 (140)	70 (158)	80 (176)	100 (212)	110 (230)	120 (248)	130 (266)	140 (284)
6	Hydrostatic design basis: MPa (psi)	unspecified	13.80 (13.25 to 16.50) (2000) (1920 to 2390)	17.25 (16.55 to 20.75) (2500) (2400 to 3010)	21.70 (20.80 to 26.35) (3150) (3020 to 3820)	27.60 (20.40 to 33.05) (4000) (3830 to 4790)	34.50 (33.10 to 41.60) (5000) (4800 to 6030)			

subject to possible misapplication since unobtainable property combinations can be selected if the user is not familiar with commercially available materials. The manufacturer should be consulted.

4.3 Product application chemical resistance when specified shall be classified in accordance with the Classification Section of Classification D 5260.

5. Ordering Information

5.1 The purchase order, or inquiry for these materials, shall state the specification number and identify the class selected, for example D 3915, Class 134544.

5.2 Further definition, as may be required for the following, shall be on the basis of agreement between the purchaser and the seller:

- 5.2.1 Physical form and particle size (see 6.2 and 6.3),
- 5.2.2 Contamination level (see 6.5),
- 5.2.3 Color (see 6.4),
- 5.2.4 Other supplementary definition, if necessary, and
- 5.2.5 Inspection (see 12.1).

6. Materials and Manufacture

6.1 Resin (Polymer) Requirements:

6.1.1 Poly(vinyl chloride)(PVC) resin (polymer) meeting Cell 1 in Designation Order 1 shall have a vinyl chloride monomer content not less than 99.0 %.

6.1.2 Chlorinated poly(vinyl chloride)(CPVC) resin (polymer) meeting Cell 2 in Designation Order 1 shall have a chlorine content not less than 63 %.

6.1.3 Vinyl chloride copolymer resin (polymer) meeting Cell 3 in Designation Order 1 shall contain not less than 80 % vinyl chloride content.

6.1.4 Poly(vinyl chloride)(PVC) resin (polymer) used in pipe compounds meeting Cell 1 in Designation Order 1 shall have an inherent viscosity not less than 0.88 when measured in accordance with Test Method D 1243.

6.1.5 Poly(vinyl chloride)(PVC) resin (polymer) used in fittings compounds meeting Cell 1 in Designation Order 1 shall have an inherent viscosity not less than 0.65 when measured in accordance with Test Method D 1243.

6.2 Materials supplied under this specification shall be PVC compound in the form of cubes, granules, free-flowing powder blends, or compacted powder blends.

6.3 Materials shall be of uniform composition and size as agreed upon between the purchaser and the seller.

6.4 Color and transparency or opacity of molded or extruded articles formed under the conditions recommended by the seller shall be comparable within commercial match tolerances to the color and transparency or opacity of standard molded or extruded samples of the same thickness supplied in advance by the seller of the material.

6.5 Materials shall be free of foreign matter to a level that is not expected to affect serviceability adversely.

7. Physical Requirements

7.1 Test values for specimens of the material prepared as specified in Section 10 and tested in accordance with Section 11 shall conform to the requirements given in Table 1 for the class selected.

7.2 The compound shall be adequately stabilized.

NOTE 4—The type and amount of stabilizer may vary with the compound formulation, the equipment on which the compound is processed, the temperatures during processing steps, and the amount of regrind (reworked) material employed. No test procedure has been found to date that is suitable for use in specifications of this type. Research methods that vary among laboratories and that have not been amenable to standardization are used.

8. Sampling

8.1 A batch or lot shall be considered as a unit of manufacture and may consist of a blend of two or more production runs of material.

8.2 Unless otherwise agreed upon between the seller and the purchaser, the material shall be sampled in accordance with the procedure described in the General and Specific Sampling Procedures, as applicable, of Practice D 1898. Adequate statistical sampling prior to packaging shall be considered an acceptable alternative.

9. Conformance Testing

9.1 The minimum properties identified by the class designations in Table 1 specified in the purchase order (see 5.1) shall be verified by the tests described in Section 11.

9.2 Conformance with this specification shall be determined with one set of test results. If there are multiple test results, the average value for all test samples shall be used to determine conformance.

9.3 If the average test value produces values below the minimum property values of the Class designation in Table 1, the material does not conform to this specification.

10. Specimen Preparation

10.1 Compliance with the designated requirements shown in Table 1 shall be determined with the compression-molded, extruded, or injection-molded specimens for Izod impact resistance, tensile strength, tensile modulus of elasticity, and deflection temperature under load. Specimens cut from extruded pipe samples shall be used for hydrostatic design basis tests. Specimens cut from laminates of compression-molded or extruded sections (see Practice D 3010) shall not be used unless it can be shown by test that complete fusion is obtained. Procedures used in preparing the test specimens shall be as recommended by the seller for each specific compound.

11. Test Methods

11.1 *Conditioning*—Condition the test specimen for deflection temperature (Test Method D 648) in accordance with Procedure B of Practice D 618, except that the minimum conditioning time shall be 24 h. Condition all other test specimens in accordance with Procedure A of Practice D 618. The minimum conditioning time shall be 24 h.

11.2 *Test Conditions*—Unless otherwise specified in the testing methods or in this specification, conduct tests in the standard laboratory atmosphere of $73.4 \pm 3.6^{\circ}\text{F}$ ($23 \pm 2^{\circ}\text{C}$) and 50 ± 5 % relative humidity. In cases of disagreement, the tolerances shall be $\pm 1.8^{\circ}\text{F}$ ($\pm 1^{\circ}\text{C}$) and ± 2 % relative humidity.

11.3 *Tensile Strength and Modulus of Elasticity*—Test Method D 638, using Type I specimens.

NOTE 5—Current industrial practice uses a specimen thickness of 0.13 ± 0.02 in. (3.2 ± 4 mm) and a speed of testing of 0.20 in. (5 mm)/min ± 25 %.

11.4 *Deflection Temperature*—Test Method D 648—Method A- using 127-mm (5-in.) long, 12.5-mm (0.5-in.) wide, and 3.2-mm (0.125-in.) thick specimens under 1.82-MPa (264-psi) fiber stress. Materials that require high-temperature annealing prior to testing shall be annealed at 90°C (194°F) unless a higher annealing temperature is required. The test report for all high-temperature annealed specimens shall include the time and temperature of annealing used.

11.5 *Hydrostatic Design Basis*—Test Method D 2837.

11.6 *Impact Resistance (Izod)*—Test Method A of Test Methods D 256, using 3.2-mm (0.125-in.) thick specimens. The specimens may be compression-molded, extruded, or injection-molded with the provision that compression-molded specimens built-up as laminates in which complete fusion is obtained shall be acceptable. Complete fusion means there shall be no evidence of fraying or delamination at the break.

12. Inspection

12.1 Inspection of the material shall be made as agreed upon between the purchaser and the seller as part of the purchase contract.

13. Packaging and Package Marking

13.1 *Packaging*—The material shall be packaged in standard commercial containers, so constructed as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the point of delivery, unless otherwise specified in the contract or order.

13.2 *Package Marking*—If agreed upon between the purchaser and the seller, shipping containers shall be marked with the name of the materials, the name of the manufacturer, class, batch or lot number, quantity contained therein as defined by the contract or order under which shipment is made, the name of the seller, and the number of the contract or order.

14. Keywords

14.1 chlorinated poly(vinyl chloride) (CPVC); poly(vinyl chloride) (PVC); pressure piping; rigid PVC

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this edition of this specification since the last issue that may impact the use of this specification:

D 3915 – 97:

- (1) Corrected keywords section.
- (2) Revised Section 9.
- (3) Table 1—Property ranges changed to minimums.

D 3915 – 99:

- (1) In 11.6, impact resistance (Izod) test specimen thickness

was changed to 3.2 mm (0.125 in.).

D 3915 – 99a:

- (1) Polymer definitions specific to this standard deleted from Section 3.
- (2) Resin requirements added to Section 6.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).