



Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly(Vinyl Chloride) (CPVC) Building Products Compounds¹

This standard is issued under the fixed designation D4216; 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 Department of Defense.

1. Scope*

1.1 This specification covers rigid plastic PVC and CPVC Exterior compounds composed of poly(vinyl chloride), chlorinated poly(vinyl chloride), vinyl chloride copolymers or vinyl chloride blends, and the necessary compound ingredients intended for use in making building products. The compound-ing ingredients are permitted to consist of lubricants, stabilizers, nonpoly(vinyl chloride) resin modifiers, colorants or pigments, or both, and inorganic fillers.

1.2 This specification is intended to provide classification of base compounds used to manufacture PVC and CPVC exterior building products. It is acceptable to determine physical properties by evaluating compounds of any color.

NOTE 1—Two year weathering studies, without specific requirements for color change and physical property change, are recommended for all colors of new compounds and compounds for new applications to provide the basis for agreement between producer and buyer on the suitability of the compound for the intended application.

1.3 The requirements in this specification are intended for qualification, as well as for quality control of compounds used to manufacture building products. They are not applicable to finished building products.

1.4 It will be necessary, in special cases, to select specific compounds for unusual applications that require consideration of other properties not covered in this specification.

1.5 The rate of burning test, Test Method D635, is used in this specification only as a screening test for identification of certain properties of the PVC compound; there is no flammability test or flammability requirement for the compound.

1.6 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.7 The following safety hazards caveat pertains only to the test methods portion, 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 2—There is no known ISO equivalent to this standard.

1.8 The text of this standard 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 standard.

1.9 It is possible that rigid PVC recycle plastic meeting the requirements of this specification will be usable in some applications. Refer to the specific requirements in the Materials and Manufacture Section of the applicable product standard.

2. Referenced Documents

2.1 ASTM Standards:²

- D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
- D618 Practice for Conditioning Plastics for Testing
- D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
- D638 Test Method for Tensile Properties of Plastics
- D648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
- D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between –30°C and 30°C with a Vitreous Silica Dilatometer
- D883 Terminology Relating to Plastics
- D1435 Practice for Outdoor Weathering of Plastics
- D1600 Terminology for Abbreviated Terms Relating to Plastics

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 (Section D20.15.08).

Current edition approved Nov. 1, 2013. Published November 2013. Originally approved in 1983. Last previous edition approved in 2006 as D4216 – 06. DOI: 10.1520/D4216-13.

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

TABLE 1 Class Requirements for Rigid Poly(Vinyl Chloride) and Related PVC and CPVC Compounds for Building Products

NOTE 1—The minimum property value will determine the cell number, although it is possible that the maximum expected values may fall within the next higher cell.

Designation Order No.	Property and Unit	Cell Limits							
		0	1	2	3	4	5	6	7
1	Kind of resin in compound	Unspecified	poly(vinyl chloride) (PVC)	chlorinated poly(vinyl chloride) (CPVC)	vinyl chloride copolymer	vinyl chloride blend			
2	Impact resistance, J/m of notch (ft · lbf/in. of notch)	Unspecified	>34.7 (>0.65)	>53.4 (>1.0)	>107 (>2.0)	>267 (>5.0)			
3	Impact resistance, drop dart, Procedure A, Test Method D4226, J/m (in.-lb/mil)	Unspecified	>4450 (>1.0)	>6675 (>1.5)	>8900 (>2.0)	>13 350 (>3.0)			
4	Impact resistance, drop dart, Procedure B, Test Method D4226, J/m (in.-lb/mil)	Unspecified	>4450 (>1.0)	>6675 (>1.5)	>8900 (>2.0)	>13 350 (>3.0)			
5	Tensile strength, MPa (psi)	Unspecified	>34 (>5000)	>37.7 (>5500)	>41.4 (>6000)	>44.9 (>6500)	>48.3 (>7000)		
6	Modulus of elasticity in tension, MPa (psi)	Unspecified	>2000 (>290 000)	>2400 (>348 000)	>2600 (>377 000)	>2800 (>406 000)			
7	Deflection temperature under load, 1.82 MPa (264 psi) °C (°F)	Unspecified	>60 (>140)	>65 (>149)	>70 (>158)	>75 (>167)	>80 (>176)	>85 (>185)	
8	Coefficient of linear expansion, cm/cm/°C (in/in/°F)	Unspecified	<4 × 10 ⁻⁵ (<2.2 × 10 ⁻⁵)	<6 × 10 ⁻⁵ (<3.3 × 10 ⁻⁵)	<8 × 10 ⁻⁵ (<4.4 × 10 ⁻⁵)	<10 × 10 ⁻⁵ (<5.5 × 10 ⁻⁵)			

D4226 Test Methods for Impact Resistance of Rigid Poly-(Vinyl Chloride) (PVC) Building Products

D5260 Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

3. Terminology

3.1 Definitions:

3.1.1 *General*—Definitions are in accordance with Terminology **D883** and Terminology **D1600**, unless otherwise indicated.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73° to 100°W longitude and 37° to 45°N latitude.

4. Classification

4.1 The means for classifying and identifying rigid PVC building products 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 3—Because of the large number of property requirements, the properties of classes are divided into groups for easy identification of the selected materials. The groups are the following: kind of resin in compound, strength properties, and dimensional stability. The class numbers are grouped as shown by the following example:

Kind of resin in compound _____ 1
Strength properties _____ 3 2 0 2 1
Dimensional properties _____ 2 2

NOTE 4—The manner in which selected materials are identified by this classification system is illustrated by a Class 1-32021-22 PVC building products compound having the following requirements (see **Table 1**):

Class 1 3 2 0 2 1 2 2

Poly(vinyl chloride) _____
Impact-Izod, >107 J/m notch (>2 ft-lbf/in notch) _____
Impact-drop dart, Procedure A of D4226, >6675 J/m (>1.5 in-lb/mil) _____
Impact-drop dart, Procedure B of D4226, unspecified _____
Tensile Strength, >37.7 Mpa (>5500 psi) _____
Tensile Modulus of Elasticity, >2000 Mpa, (>290000 psi) _____
Deflection Temperature under load at 1.82 MPa (264 psi), >65°C (>149°F) _____
Coefficient of linear expansion, <6x10⁻⁵ cm/cm/°C (<3.3x10⁻⁵ in/in/°F) _____

NOTE 5—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 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 according to the Classification Section of **D5260**.

5. Ordering Information

5.1 The purchase order, or inquiry, for these materials shall state this specification number and identify the class selected; for example, D4216, Class 1-32021-22.

5.2 Further definition, as potentially 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 6.4).
- 5.2.3 Other supplementary definition, if necessary.
- 5.2.4 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 polymerized vinyl chloride content not less than 99.0 %.

6.1.2 Unless otherwise stated, vinyl chloride copolymer resin (polymer) meeting Cell 3 in Designation Order 1 shall contain not less than polymerized 80 % vinyl chloride content.

6.1.3 Vinyl chloride resin (polymer) blends with non-PVC polymers meeting Cell 4 of Designation Order 1 shall have not less than 50 % PVC content.

6.2 Materials supplied under this specification shall be PVC compound in the form of cubes, pellets, 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 Materials shall be free of foreign matter to a level that is not expected to affect processability, serviceability, or finished product appearance adversely.

6.5 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.

7. Sampling

7.1 A batch or lot shall be considered as a unit of manufacture and is permitted to consist of a blend of two or more production runs of material.

7.2 Unless otherwise agreed between the seller and purchaser, samples shall be taken from either a product or process in statistical control.

8. Physical Requirements

8.1 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.

8.2 The compound, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 100 mm (4 in.) with an average time of burn not to exceed 10 s. A sample thickness of 1 mm (0.040 in.) $\pm$ 10 % is recommended.

8.3 *Stability*—The compound shall be adequately stabilized against thermal degradation without sacrificing weathering performance.

NOTE 6—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 or rigid PVC recycled plastic employed. To date, no test procedure has been found 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.

8.4 *Weatherability*—The compound shall be stabilized adequately against changes in color, physical properties, and appearance due to weathering.

8.4.1 New compounds and compounds for new applications shall demonstrate minimal color, physical property, and appearance change when tested in accordance with 11.8.

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 for each batch or lot. 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 for a lot 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 chosen from Table 1 shall be determined with compression-molded, extruded or injection-molded test specimens for Izod impact resistance, tensile strength, tensile modulus of elasticity, deflection temperature under load, and coefficient of linear expansion. Specimens cut from laminates of compression-molded sections shall not be used unless it is shown by test that complete fusion is obtained. Specimens cut from flat extruded profile samples shall be used for dropped dart impact and weatherability tests. It is understood that a material shall not be tested without also specifying the method of specimen preparation. When comparative tests of materials are desired, the greatest care shall be taken to ensure that all specimens are prepared in exactly the same way used to certify the cell class of the compound. Procedures used in preparing the test specimens shall be as recommended by the supplier for each specific compound.

NOTE 7—It is possible that a specimen taken from a finished product will not produce the same results as a specimen prepared by the method used for purposes of cell class testing and certification.

11. Test Methods

11.1 *Conditioning*—Condition the test specimen for deflection temperature (Test Method D648) in accordance with Procedure B of Practice D618, except that the minimum conditioning time in the oven shall be 24 h. Condition all other test specimens in accordance with Procedure A of Practice D618. 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 23 $\pm$ 2°C (73 $\pm$ 4°F) and

50 ± 10 % relative humidity. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±5 % relative humidity.

11.3 *Impact Resistance (Izod)*—Method A of Test Methods **D256**, using 3.2-mm (0.125-in.) thick specimens. It is acceptable for the specimens to be compression molded, injection molded, or extruded, with the provision that compression-molded specimens buildup 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.

11.4 *Impact Resistance (Drop Dart)*—Procedures A and B)—Use dart C.125 with Procedure A and Procedure B of Test Method **D4226**. The specimen shall be extruded at the melt temperature recommended by the manufacturer of the compound and shall be between 0.51 to 2.29 mm (0.020 to 0.090 in.) in thickness.

NOTE 8—Specimen thickness shall be within the normal range of thickness associated with the building product in which the compound will be used.

11.5 *Tensile Strength and Modulus of Elasticity*—Test Method **D638**, using Type I specimens of 3.2 ± 0.44 mm (0.13 ± 0.02 in.) thickness and testing speed of 5.1 mm (0.20 in.)/min ± 25 %. Report tensile strength at the yield point if the material yields, otherwise at break.

11.6 *Deflection Temperature*—Test Method **D648**—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 50°C (122°F) for 24 h or at the manufacturer's recommendation. Specimens shall be cooled in accordance with Procedure B of Practice **D618**. The test report for annealed specimens shall include the time and temperature of annealing used. The test report for all high temperature annealed specimens shall include the time and temperature of annealing used.

11.7 *Coefficient of Linear Expansion*—Test Method **D696**.

11.8 *Weathering*—The producers or users, or both, of new compounds for exterior building applications shall conduct weathering studies on all colors of each compound produced for at least two years in at least three widely different climatic areas. A dry, hot climate, such as Phoenix, AZ; a hot, humid climate, such as Miami, FL; and a temperate northern climate,

such as Northern Ohio, Kentucky, or New Jersey are suggested sites. Records of color change, physical appearance, and property change shall be maintained for reference by purchaser.

11.8.1 Expose samples in accordance with Practice **D1435**.

11.8.2 Samples shall face south at a 45° angle of elevation for exposure periods of 6 months, 1 year, and 2 years at each exposure site selected.

11.8.3 Samples shall be extruded between 0.51 and 2.29 mm (0.020 to 0.090 in.) in thickness and as large as possible to facilitate both impact and optical appearance evaluation.

11.8.4 Impact testing and optical tests shall be selected by the producer to reflect requirements for a specific application.

NOTE 9—The lengthy outdoor weatherability testing shall be performed concurrently with market development of new applications and sales of compound to existing markets. Completion of weatherability testing prior to marketing of the compound is not required. The compound producer shall immediately respond in terms of compound change to unsatisfactory weatherability behavior of the compound under test in any climatic test site at any stage of the weatherability testing.

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*—Shipping containers shall be marked with:

13.2.1 Manufacturer's name, trade mark or trade name.

13.2.2 ASTM Designation D4216 and cell classification to which the compound complies.

13.2.3 The date, and any other relevant information, such as factory, machine, production shift, etc., either directly, or all, or part coded.

14. Keywords

14.1 building products; chlorinated poly(vinyl chloride) (CPVC); poly(vinyl chloride) (PVC); recycled plastic; rigid PVC; vinyl chloride blends

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D4216 - 06) that may impact the use of this standard. (November 1, 2013)

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| (1) Reworded 1.3 and 7.2 . | (6) Removed 8.4.1. |
| (2) Reworded ISO statement in Note 2 in accordance with Guide D4968. | (7) Updated 11.2 in accordance with Practice D618. |
| (3) Updated Note 4 . | (8) Updated 11.5 and 11.6 in accordance with Specification D1784. |
| (4) Removed references to Practices D1898 and D3010 since these standards have been withdrawn. | (9) Updated Summary of Changes. |
| (5) Removed references to Specifications D3679, D4477, D4726, and F964. | |

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