Designation: D ~~4216 – 00ε1~~ 4216 – 03

Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly(Vinyl Chloride) (CPVC) Building Products Compounds[1]

This standard is issued under the fixed designation D 4216; 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.

~~ε[1] NOTE—Editorially corrected 11.6 in April 2002.~~

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 compounding ingredients may 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. Physical properties may be determined 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. See Specifications D 3679, D 4477, D 4726, and F 964 for requirements for finished products.

1.4 It may 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 D 635, 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 the 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 are no ISO standards covering the primary subject matter of this specification.

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 Rigid PVC recycle plastic meeting the requirements of this specification may 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:*

[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 March 10, 200~~0~~3. Published ~~June 2000.~~ April 2003. Originally ~~published as D 4216 – 83.~~ approved in 1983. Last previous edition approved in 1996 as D 4216 – ~~98~~00.

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

D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics[2]
D 618 Practice for Conditioning Plastics ~~and Electrical Insulating Materials~~ for Testing[2]
D 635 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position[2]
D 638M Test Method for Tensile Properties of Plastics [Metric][2]
D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load[2]
D 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics[2]
D 883 Terminology Relating to Plastics[2]
D 1435 Practice for Outdoor Weathering of Plastics[2]
D 1600 Terminology for Abbreviated Terms Relating to Plastics[2]
D 1898 Practice for Sampling of Plastics[2]
D 3010 Practice for Preparing Compression-Molded Test Sample Plaques of Rigid Poly(Vinyl Chloride) Compounds[3]
D 3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding[4]
D 4226 Test Methods for Impact Resistance of Rigid Poly(Vinyl Chloride) (PVC) Building Products[4]
D 4477 Specification for Rigid (Unplasticized) Poly(Vinyl Chloride) (PVC) Soffit[4]
D 4726 Specification for White Rigid Poly(Vinyl Chloride) (PVC) Exterior Profile Extrusions Used for Assembled Windows and Doors[4]
D 5260 Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds[5]
F 964 Specification for Rigid Poly(Vinyl Chloride) (PVC) Exterior Profiles Used for Fencing[6]

3. Terminology

3.1 *Definitions:*

[2] *Annual Book of ASTM Standards,* Vol 08.01.
[3] *Discontinued 1992; Replaced by D 4703.*
[4] *Annual Book of ASTM Standards,* Vol 08.04.
[5] *Annual Book of ASTM Standards,* Vol 08.03.
[6] *Annual Book of ASTM Standards,* Vol 01.06.

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

NOTE—The minimum property value will determine the cell number, although 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)~~ (ft · lbf/in. of notch)	Unspecified	>34.7 ~~(>0.65)~~ [>0.65]	>53.4 ~~(>1.0)~~ [>1.0]	>107 ~~(>2.0)~~ [>2.0]	>267 ~~(>5.0)~~ [>5.0]			
3	Impact resistance, drop dart, ~~Procedure A, Test Method~~ Procedure A, Test Method D 4226, J/m (in.-lb/mil)	Unspecified	>4450 ~~(>1.0)~~ [>1.0]	>6675 ~~(>1.5)~~ [>1.5]	>8900 ~~(>2.0)~~ [>2.0]	>13 350 ~~(>3.0)~~ [>3.0]			
4	Impact resistance, drop dart, ~~Procedure B, Test Method~~ Procedure B, Test Method D 4226, J/m (in.-lb/mil)	Unspecified	>4450 ~~(>1.0)~~ [>1.0]	>6675 ~~(>1.5)~~ [>1.5]	>8900 ~~(>2.0)~~ [>2.0]	>13 350 ~~(>3.0)~~ [>3.0]			
~~5~~	~~Tensile strength, MPa (psi)~~	~~Unspecified~~	~~>34~~	~~>37.7~~	~~>41.4~~	~~>44.9~~	~~>48.3~~		
5	Tensile strength, MPa [psi]	Unspecified	>34 ~~(>5000)~~ [>5000]	>37.7 ~~(>5500)~~ [>5500]	>41.4 ~~(>6000)~~ [>6000]	>44.9 ~~(>6500)~~ [>6500]	>48.3 ~~(>7000)~~ [>7000]		
~~6~~	~~Modulus of elasticity in tension, MPa (psi)~~	~~Unspecified~~	~~>2000~~	~~>2400~~	~~>2800~~	~~>3200~~			
6	Modulus of elasticity in tension, MPa [psi]	Unspecified	>2000 ~~(>290 000)~~ [>290 000]	>2400 ~~(>348 000)~~ [>348 000]	>2800 ~~(>377 000)~~ [>377 000]	>3200 ~~(>406 000)~~ [>406 000]			
7	Deflection temperature under ~~load, 1.82 MPa (264 psi) °C (°F)~~ load, 1.82 MPa (264 psi) °C [°F]	Unspecified	>60 ~~(>140)~~ [>140]	>65 ~~(>149)~~ [>149]	>70 ~~(>158)~~ [>158]	>75 ~~(>167)~~ [>167]	>80 ~~(>176)~~ [>176]	>85 ~~(>185)~~ [>185]	
~~8~~	~~Coefficient of linear expansion,~~	~~Unspecified~~	~~$<4 \times 10^{-5}$~~	~~$<6 \times 10^{-5}$~~	~~$<8 \times 10^{-5}$~~	~~$<10 \times 10^{-5}$~~			
8	Coefficient of linear expansion, ~~cm/cm/°C (in/in/°F)~~ cm/cm/°C (in/in/°F)	Unspecified	$<4 \times 10^{-5}$ ~~($<2.2 \times 10^{-5}$)~~ [$<2.2 \times 10^{-5}$]	$<6 \times 10^{-5}$ ~~($<3.3 \times 10^{-5}$)~~ [$<3.3 \times 10^{-5}$]	$<8 \times 10^{-5}$ ~~($<4.4 \times 10^{-5}$)~~ [$<4.4 \times 10^{-5}$]	$<10 \times 10^{-5}$ ~~($<5.5 \times 10^{-5}$)~~ [$<5.5 \times 10^{-5}$]			

3.1.1 *General*—Definitions are in accordance with Terminology D 883 and Terminology D 1600, unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard:*

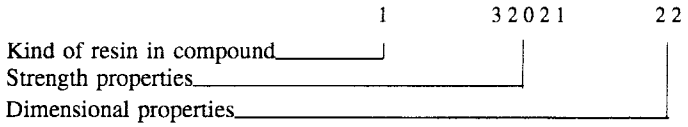
3.2.1 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73° to 100°W longitude and 37° to 45°N latitude.

4. Classification

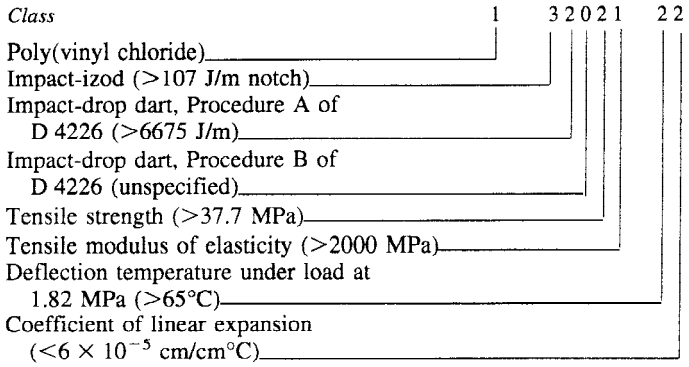
4.1 The means for classifying and identifying rigid PVC building products compounds are provided in Table 1. The properties enumerated in this table and the tests defined are expected to provide identification of the compounds selected. They are not necessarily suitable for direct application in design 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:



NOTE 4—The manner in which selected materials are identified by this classification system is illustrated by a Class 1-32021-22-2020 PVC building products compound having the following requirements (see Table 1):



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 Classification D 5260.

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, D 4216, Class 1-32021-22.

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 6.4).

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 may consist of a blend of two or more production runs of material.

7.2 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.

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 D 635, shall not exceed an average extent of burn of 100 mm ~~(4 in.)~~ [4 in.] with an average time of burn not to exceed 10 s. A sample thickness of 1 mm ~~([0.040 in.)~~] ± 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 Specific weathering requirements are covered within product Specifications D 3679, D 4477, D 4726, and F 964 for the applications related to these standards.

8.4.2 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 (see Practice D 3010) 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. Procedures used in preparing the test specimens shall be as recommended by the seller.

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 in the oven 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 23 ± 2°C~~ ([73.4 ± 3.6°F)~~] and 50 ± 5 % relative humidity. In cases of disagreement, the tolerances shall be ±1°C~~ ([±1.8°F)~~] and ±2 % relative humidity.

11.3 *Impact Resistance (Izod)*—Method A of Test Methods D 256, using 3.2-mm~~ ([0.125-in.)~~] thick specimens. The specimens may 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 D 4226. 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 7—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 D 638, 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 %.

11.6 *Deflection Temperature*—Test Method D 648– Method A– using 127 mm~~ (5 in.)~~ [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)~~ [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.

11.7 *Coefficient of Linear Expansion* —Test Method D 696.

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 D 1435.

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 8—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 D 4216 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

This section identifies the location of selected changes to this specification. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this specification. This section may also include descriptions of the changes or reasons for the changes, or both.

D 4216 – 03:

(*1*) Revised Table 1, cells 3 and 4–Modulus of elasticity in tension, MPa.

D 4216 – 00:

(*1*) Deleted polymer definitions specific to this standard from Section 3.

(*2*) Added resin requirements to Section 6.

D 4216 – 98:

(*1*) Changed title to accommodate CPVC.

(*2*) Deleted specific weathering requirements in 1.2, 4.2, 5.1, 11.8, and Table 1.

(*3*) Added footnote and reference note statement (1.8).

(*4*) Added recycle use statement (1.9).

(*5*) Deleted incorrect white PVC profile description of term.

(*6*) Referenced product standards, which contain specific weathering requirements.

(*7*) Added weathering test requirements for new compounds and compounds for new applications (8.4 and 11.8).

(*8*) Added conformance testing requirements (Section 9).

(*9*) Added deflection test detail requirements (11.6).

(*10*) Deleted quality assurance requirements (Section ~~14).~~

~~*D 4216 – 00:*~~

~~(*1*) Deleted polymer definitions specific to this standard from Section 3.~~

~~(*2*) Added resin requirements to Section 6.~~ 14).