Designation: ~~D1784 – 11~~ D1784 – 20

Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds[1]

This standard is issued under the fixed designation D1784; 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 covers rigid PVC and CPVC compounds intended for general purpose use in extruded or molded form—including pressure piping applications and nonpressure piping applications—composed of poly(vinyl chloride), chlorinated poly(vinyl chloride), or vinyl chloride copolymers containing at least 80 % vinyl chloride, and the necessary compounding ingredients. The compounding ingredients shall be permitted to consist of lubricants, stabilizers, non-poly(vinyl chloride) resin modifiers, pigments, and inorganic fillers.~~

~~NOTE 1—Selection of specific compounds for particular end uses or applications requires consideration of other characteristics such as thermal properties, optical properties, weather resistance, etc. Specific requirements and test methods for these properties should be by mutual agreement between the purchaser and the seller.~~

~~NOTE 2—Selection of compounds for pressure piping applications requires consideration of material stress ratings that are required for determining pressure ratings, but are not addressed in this specification. Requirements for long-term material stress ratings in accordance with recognized stress rating standards, such as HDB in accordance with Test Method D2837 for pressure piping, should be included in specifications for pressure piping products or systems.~~

~~NOTE 3—The list of compounding ingredients in 1.1 is not meant to be an exhaustive list of allowable compound ingredients. In addition to the compounding ingredients listed, others may also be used. The list of compounding ingredients in 1.1 does not imply that every ingredient listed is a required ingredient. Some compounds may not contain all the ingredients listed in 1.1.~~

~~1.2 For applications involving special chemical resistance see Classification D5260.~~

~~1.3 The requirements in this specification are intended for the quality control of compounds used to manufacture finished products. These properties are based on data obtained using standard test specimens tested under specified conditions. They are not directly applicable to finished products. See the applicable ASTM standards for requirements for finished products.~~

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

~~1.5 Rigid PVC recycle plastics meeting the requirements of this specification may be used in some applications. Refer to the specific requirements in the materials and manufacture section of the applicable product standard.~~

~~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 4—This specification is similar in content (but not technically equivalent) to ISO 1163-1:1985 and ISO 1163-2:1980.~~

~~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~~

[1] This ~~specification~~ classification system standard is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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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.

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

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
D883 Terminology Relating to Plastics
D1600 Terminology for Abbreviated Terms Relating to Plastics
D3892 Practice for Packaging/Packing of Plastics
D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
D4703 Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets
D5260 Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

2.2 *ISO Standards:*[3]
ISO 1163-1:1985
ISO 1163-2:1980

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology D883 and abbreviations with Terminology D1600 unless otherwise indicated.

4. Classification

4.1 Means for selecting and identifying rigid PVC and CPVC compounds are provided in Table 1. The properties enumerated in Table 1 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 5—The manner in which selected materials are identified by this classification system is illustrated by a Class 12454 rigid PVC compound having the following requirements (see Table 1). The two-digit cell limits 10 and 11 are rarely used, only for special high-temperature grades of CPVC compound:

Class	1	2	4	5	4
Identification:					
Poly(vinyl chloride) homopolymer					
Property and Minimum Value:					
Izod					
(34.7 J/m (0.65 ft·lbf/in.)) under notch					
Tensile strength					
(48.3 MPa (7000 psi))					
Modulus of elasticity in tension					
(2758 MPa (400 000 psi))					
Deflection temperature under load					
(70°C (158°F))					

NOTE 6—The cell-type format provides the means for identification 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 in accordance with the classification section of Classification D5260.

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, D1784, Class 12454.

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 6.1),
5.2.2 Contamination level (see 6.2),
5.2.3 Color (see 6.3),
5.2.4 Other supplementary definition if necessary, and
5.2.5 Inspection (see 12.1).

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

6. Materials and Manufacture

6.1 Materials supplied under this specification shall be PVC and CPVC compounds in the form of cubes, granules, free-flowing powder blends, or compacted powder blends.

6.2 Materials shall be of uniform composition and size and shall be free of foreign matter to such level of contamination as may be agreed upon between the purchaser and the seller.

6.3 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. Physical Requirements

7.1 Test values for specimens of the material prepared as specified in Section 9 and tested in accordance with Section 10 shall conform to the requirements given in Table 1 for the class selected.

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 Sample using a statistically acceptable procedure.

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 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 flammability. Specimens cut from laminates of compression-molded or extruded sections (see Practice D4703) shall not be used unless it can be shown by test that complete fusion is obtained. 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*—The test specimen for deflection temperature (Test Method D648) shall be conditioned in accordance with Procedure B of Practice D618, except that the minimum conditioning time in the circulating air oven shall be 24 h. All other molded test specimens shall be conditioned 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 test methods or in this specification, tests shall be conducted 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 *Tensile Strength and Modulus of Elasticity*—Test Method D638, using Type I specimens of 3.2 ± 0.4 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.

11.4 *Impact Resistance (Izod)*—Method A of Test Method D256, 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 or extruded 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.

11.5 *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

TABLE 1 Class Requirements for Rigid 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 a higher cell.

Designation Order No.	Property and Unit	Cell Limits											
		0	1	2	3	4	5	6	7	8	9	10	11
~~1~~	~~Base resin~~	~~unspecified~~	~~poly(vinyl chloride) homopolymer~~	~~chlorinated poly (vinyl chloride)~~	~~vinyl copolymer~~								
2	Impact resistance (Izod), min:												
	~~J/m of notch under notch~~ ~~ft·lb/in. of notch under notch~~	~~unspecified~~	~~<34.7~~ ~~<0.65~~	~~34.7~~ ~~0.65~~	~~80.1~~ ~~1.5~~	~~266.9~~ ~~5.0~~	~~533.8~~ ~~10.0~~	~~800.7~~ ~~15.0~~					
3	Tensile strength, min:												
	~~MPa~~ ~~psi~~	~~unspecified~~	~~<34.5~~ ~~<5 000~~	~~34.5~~ ~~5 000~~	~~41.4~~ ~~6 000~~	~~48.3~~ ~~7 000~~	~~55.2~~ ~~8 000~~						
4	Modulus of elasticity in tension, min:												
	~~MPa~~ ~~psi~~	~~unspecified~~	~~<1930~~ ~~<280 000~~	~~1930~~ ~~280 000~~	~~2206~~ ~~320 000~~	~~2482~~ ~~360 000~~	~~2758~~ ~~400 000~~	~~3034~~ ~~440 000~~					
5	Deflection temperature under load, min, 1.82 MPa (264 psi):												
	~~°C~~ ~~°F~~	~~unspecified~~	~~<55~~ ~~<131~~	~~55~~ ~~131~~	~~60~~ ~~140~~	~~70~~ ~~158~~	~~80~~ ~~176~~	~~90~~ ~~194~~	~~100~~ ~~212~~	~~110~~ ~~230~~	~~120~~ ~~251~~	~~130~~ ~~266~~	~~140~~ ~~284~~
	~~Flammability~~	~~A~~	~~A~~	~~A~~	~~A~~	~~A~~	~~A~~	~~A~~	~~A~~	~~A~~	~~A~~	~~A~~	~~A~~

TABLE 1 Class Requirements for Rigid 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 a higher cell.

Designation Order No.	Property and Unit	Cell Limits											
		0	1	2	3	4	5	6	7	8	9	10	11
1	Base resin	A	poly(vinyl chloride) homopolymer	chlorinated poly (vinyl chloride)	vinyl copolymer								
2	Impact resistance (Izod), min:												
	J/m of notch under notch (ft·lb/in.)	A	<34.7 (<0.65)	34.7 (0.65)	80.1 (1.5)	266.9 (5.0)	533.8 (10.0)	800.7 (15.0)					
3	Tensile strength, min:												
	MPa (psi)	A	<34.5 (<5000)	34.5 (5000)	41.4 (6000)	48.3 (7000)	55.2 (8000)						
4	Modulus of elasticity in tension, min:												
	MPa (psi)	A	<1930 (<280 000)	1930 (280 000)	2206 (320 000)	2482 (360 000)	2758 (400 000)	3034 (440 000)					
5	Deflection temperature under load, min, 1.82 MPa (264 psi):												
	°C (°F)	A	<55 (<131)	55 (131)	60 (140)	70 (158)	80 (176)	90 (194)	100 (212)	110 (230)	120 (251)	130 (266)	140 (284)
	Flammability	B	B	B	B	B	B	B	B	B	B	B	B

A The value for this property is unspecified.

B All compounds covered by this specification, when tested in accordance with Test Method D635, shall yield the following results: average extent of burning of <25 mm; average time of burning of <10 s.

~~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.~~