



Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds¹

This standard is issued under the fixed designation D 2287; 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 nonrigid vinyl chloride polymer and copolymer classes in which the resin portion of the composition contains at least 90 % vinyl chloride. The remaining 10 % may include one or more monomers copolymerized with vinyl chloride or consist of other resins mechanically blended with polyvinyl chloride or copolymers thereof.

1.2 These nonrigid vinyl compounds are defined by a hardness range and include the necessary stabilizers, plasticizers, fillers, dyes, and pigments to meet the designated requirements.

1.3 This specification includes nonrigid vinyl chloride compounds recommended for compression molding, injection molding, and extrusion, but it must be recognized that particular compounds may not be suitable for all these means of fabrication.

NOTE 1—This standard is similar in content, but not technically equivalent to ISO 2898-1:1986 and ISO 2898-2:1989.

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

1.5 *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.*

1.6 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.

1.7 Recycle PVC 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.

2. Referenced Documents

2.1 ASTM Standards:

- D 257 Test Methods for DC Resistance or Conductance of Insulating Materials²
- D 412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension³
- D 618 Practice for Conditioning Plastics for Testing⁴
- D 635 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position⁴
- D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact⁴
- D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement⁴
- D 883 Terminology Relating to Plastics⁴
- D 1203 Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods⁴
- D 1600 Terminology for Abbreviated Terms Relating to Plastics⁴
- D 1898 Practice for Sampling of Plastics⁵
- D 2240 Test Method for Rubber Property Durometer Hardness³
- D 3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets³
- D 3892 Practice for Packaging/Packing of Plastics⁶

2.2 ISO Standards:⁷

- ISO 2898-1:1986 Plastics—Plasticide Compounds of Homopolymers and Copolymers of Vinyl Chloride (PVC-P)
- ISO 2898-2:1989 Plastics—Plasticide Compounds of Homopolymers and Copolymers of Vinyl Chloride (PVC-P)—Part 2 Preparation of Test Specimens and Determination of Properties

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This edition contains changes in 1.6 to accommodate BOCA requirements and to 1.7 and 14.1 to reference recycle plastics.

² *Annual Book of ASTM Standards*, Vol 10.01.

³ *Annual Book of ASTM Standards*, Vol 09.01.

⁴ *Annual Book of ASTM Standards*, Vol 08.01.

⁵ Discontinued; see 1997 *Annual Book of ASTM Standards*, Vol 08.01.

⁶ *Annual Book of ASTM Standards*, Vol 08.02.

⁷ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

3. Terminology

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

4. Classification

4.1 Provision is made in this specification for the identification of vinyl chloride polymers and copolymers by use of Terminology D 1600. Additionally, there is provision for distinguishing electrical grades and burning rate by suffix. The system of classification provided in Table 1 permits characterization and identification of all compounds having properties within the ranges of the combinations that may be selected from the table. Following type identification in accordance with Terminology D 1600, grades are designated by the cell number for each property in the order in which they are listed in Table 1, including the suffixes identifying electrical grades and flammability when required. When a property is not specified, a “0” is entered as the cell number unless identification is terminated prior to that point.

NOTE 2—The manner in which selected materials are identified is illustrated by the examples given below:

General-Purpose, Electrical Requirements Excluded:

Type PVC-3	5	5	0	7	X
Durometer hardness, A scale (55 to 64)					
Specific gravity, 23/23°C (1.35 to 1.39)					
Tensile strength, min (13.8 MPa)					
Volatile loss at 105°C (unspecified)					
Brittleness temperature, max (–40°C)					
Burning rate					

Type PVCAC-4	4	4	0	6
Durometer hardness, A scale (65 to 74)				
Specific gravity, 23/23°C (1.30 to 1.34)				
Tensile strength, min (10.8 MPa)				
Volatile loss at 105°C (unspecified)				
Brittleness temperature, max (–30°C)				

Electrical Grades, E Requirement Included:

Type PVC-5	4	6	1	5	E	2	X
Durometer hardness, A scale (75 to 84)							
Specific gravity, 23/23°C (1.30 to 1.34)							
Tensile strength, min (17.2 MPa)							
Volatile loss at 105°C, max (1.0 %)							
Brittleness temperature, max (–20°C)							
Volume resistivity at 50°C, min (10 ¹² Ω·cm)							
Burning rate							

Type PVCAC-5	5	5	3	4	E	2	X
Durometer hardness, A scale (75 to 84)							
Specific gravity, 23/23°C (1.35 to 1.39)							
Tensile strength, min (13.8 MPa)							
Volatile loss at 105°C, max (3.0 %)							
Brittleness temperature, max (–15°C)							
Volume resistivity at 50°C, min (10 ¹² Ω·cm)							
Burning rate							

NOTE 3—The cell-type format provides means for close characteriza-

tion and specification of material properties, alone or in combination, for a broad range of materials. This 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.

5. General Requirements

5.1 Material shall be of uniform composition and be so compounded as to meet the requirements designated for it.

5.2 The designated material shall contain the ingredients necessary to permit satisfactory processing with appropriate equipment under recommended or commercially acceptable conditions. There shall be no separation of components under conditions of application normal for these compounds.

6. Significance and Use

6.1 Means for selecting and identifying nonrigid vinyl chloride 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. Only when specimens are molded in accordance with 11.1.1 can comparative data be expected. The tests selected may be employed for inspection or quality control provided that they are performed strictly in accordance with the instructions given herein and in the designated methods so that extraneous variables are minimized and results are reproduced within the limits of variability of the material being examined and of the tests used for its examination.

7. Detail Requirements

7.1 Compliance with the designated requirements shall be determined with test specimens prepared of sheets molded in accordance with 11.1.1 of this specification.

7.2 Test values for specimens so prepared shall comply with the designated requirements as given in Table 1.

7.3 Subject to agreement between the purchaser and the seller, tests may be made on specimens prepared of finished molded articles. Results of such tests may not agree with the values given in Table 1. Therefore, in reports of such tests, methods, and conditions of preparation, dimensions, and all other pertinent information shall be included.

8. Contractual Requirements

8.1 Nonrigid vinyl chloride plastics ordinarily are supplied in either diced or granulated form. Particle size shall be as agreed between the purchaser and the seller. Other forms sometimes are available and may be obtained by arrangement with the seller.

8.2 Color and transparency or opacity of the materials, when molded under the conditions recommended by the seller, shall be comparable within commercial tolerances with a standard specimen of the same thickness furnished in advance by the seller.

9. Number of Tests

9.1 One set of test specimens as needed to verify the requirements selected in Table 1 and as prescribed in Section 11 shall be considered sufficient for testing the material.

TABLE 1 Detail Grade Requirements

Designation Order No.	Property and Unit	Cell Limits									
		0	1	2	3	4	5	6	7	8	9
1	Durometer hardness, A scale	unspecified	<45	45 to 54	55 to 64	65 to 74	75 to 84	85 to 94	94	...	...
2	Specific gravity (nominal), 23/23°C	unspecified	<1.20	1.20 to 1.24	1.25 to 1.29	1.30 to 1.34	1.35 to 1.39	1.40 to 1.44	1.45 to 1.49	1.50 to 1.59	>1.59
3	Tensile strength, min:										
	MPa		<6.9	6.9	8.8	10.8	13.8	17.2	20.7	24.1	>24.1
	psi		<1000	1000	1285	1575	2000	2500	3000	3500	>3500
4	Volatile loss at 105°C, max, %	unspecified	1.0	2.0	3.0	4.0	5.0	6.0	7.0	>7.0	
5	Brittleness temperature, max, °C	unspecified	0	-5	-10	-15	-20	-30	-40	-50	-60
E	Volume resistivity at 50°C, min, Ω-cm	unspecified	10 ¹¹	10 ¹²	10 ¹³	...	...	...	...	...	...
X	Burning rate	unspecified	... ^A	...	...	...	...	...	...	...	...

^A When tested in accordance with Test Method D 635, the compounds of this cell unit designation shall yield the following results: average extent of burning of <25 mm; average time of burning of <10 s.

10. Sampling

10.1 Material shall be sampled in accordance with Practice D 1898. Adequate statistical sampling before packaging is an acceptable alternative. A batch or lot of material shall be considered as a unit of manufacture prepared for shipment and may consist of a blend of two or more production runs of material.

10.2 Material shall be free of foreign matter to such a level of contamination as may be agreed between the purchaser and the seller.

11. Test Methods

11.1 The properties enumerated herein shall be determined in accordance with the following methods:

11.1.1 *Test Specimens*—Unless otherwise specified, test specimens shall be prepared of sheets 1.9 ± 0.2 mm (0.075 \pm 0.010 in.) thick molded by compression as described in Practice D 3182. The conditions of molding shall be either as recommended by the seller or in keeping with accepted commercial practice for the material being used. Specimens shall be of the shape and dimensions specified in the individual test methods.

11.1.2 *Conditioning*—Test specimens of nonrigid vinyl chloride plastics shall be conditioned in accordance with Procedure A of Practice D 618.

11.1.3 *Test Conditions*—Tests shall be conducted in the Standard Laboratory Atmosphere of $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and $50 \pm 5\%$ relative humidity unless otherwise specified herein or in the individual test methods.

11.1.4 *Durometer Hardness*—Test Method D 2240 using a 15-s interval as described in 10.2 of that method.

11.1.5 *Specific Gravity*—Method A of Test Methods D 792. The use of alternative methods of equal accuracy is permitted except for referee tests.

11.1.6 *Tensile Strength*—Test Methods D 412 using specimens prepared with Die C.

11.1.7 *Volatile Loss*—Test Methods D 1203 using Method A except that the test temperature shall be 105°C.

11.1.8 *Brittleness Temperature*—Procedure A of Test Method D 746.

11.1.9 *Volume Resistivity*—Test Methods D 257. Test specimens may be of any uniform thickness between 0.5 mm (0.020 in.) and 2.2 mm (0.085 in.), test temperature shall be $50 \pm 1.0^\circ\text{C}$, and electrodes may be either mercury, conductive paints, or sprayed or evaporated metal as described in the section on Electrode Systems of Test Methods D 257 and mounted as shown in the figures illustrating a flat specimen for measuring volume and surface resistances or conductances and mercury electrodes for flat, solid specimens in that method. Applied voltage within the range 100 to 500 V is recommended.

11.1.10 *Burning Rate*—Test Method D 635.

12. Retest and Rejection

12.1 If any failure occurs, the materials may be retested to establish conformity in accordance with agreement between the purchaser and the seller.

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*—Unless otherwise agreed between the seller and the purchaser, shipping containers shall be marked with the name of the material, the batch or lot number, and the 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.

13.3 All packing, packaging, and marking provisions of Practice D 3892 shall apply to this specification.

14. Keywords

14.1 compounds; poly(vinyl chloride); recycle plastics; vinyl chloride copolymers

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