



# Standard Specification for Extruded Rods and Bars Made From Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC)<sup>1</sup>

This standard is issued under the fixed designation D 6263; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

This specification is intended to be a means of calling out mechanical grade plastic product used in the fabrication of end items or parts.

### 1. Scope

1.1 This specification covers requirements and test methods for the material, dimensions, and workmanship, and the properties of extruded shapes of rods and bars made from poly(vinyl chloride) (PVC), and chlorinated poly(vinyl chloride) (CPVC).

1.2 The properties included in this specification are those required for the compositions covered. Requirements necessary to identify particular characteristics important to specialized applications may be described by using the classification system given in Section 4.

1.3 This specification allows for the use of regrind and recycled plastics as defined in Guide D 5033 providing: products produced from regrind or recycled PVC material can be shown to meet the requirements of this standard with regard to material classification, physical performance, dimensions and workmanship; and the regrind or recycled plastics used have not been subjected to severe environments in post consumer applications (such as chemical service) which could adversely affect the end products performance when subjected to machining or critical applications or both.

1.4 The values are stated in inch-pound units and are regarded as the standard in all property and dimensional tables. For reference purposes, SI units are also included in Table 1 only.

1.5 The following safety hazards caveat pertains only to the test method portions section 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 is no similar or equivalent ISO standard.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics<sup>2</sup>

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials<sup>2</sup>

D 638 Test Method for Tensile Properties of Plastics<sup>2</sup>

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Materials<sup>2</sup>

D 883 Terminology Relating to Plastics<sup>2</sup>

D 1784 Specification for Rigid Poly(Vinyl Chloride) (PVC), and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds<sup>3</sup>

D 3892 Practice for Packaging/Packing of Plastics<sup>3</sup>

D 4000 Classification System for Specifying Plastics Materials<sup>3</sup>

D 5033 Guide for the Development of Standards Relating to the Proper Use of Recycled Plastics

#### 2.2 ANSI Standard:

Z1.4-1993 Sampling Procedures and Tables for Inspection by Attributes<sup>4</sup>

#### 2.3 NSF Standard:

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.20 on Plastic Products (Section D20.20.02).

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<sup>2</sup> Annual Book of ASTM Standards, Vol 08.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 08.02.

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

NSF Standard 61<sup>5</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 For definitions of other technical terms pertaining to plastics used in this specification, see Terminology D 883 or Guide D 5033.

3.1.2 *regrind plastic, n*—a product or scrap such as sprues and runners and edge trim that have been reclaimed by shredding and granulating for use in-house.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *rod, n*—an extruded solid cylindrical shape with a minimum diameter of 1/8 in. [3.2 mm].

3.2.2 *tubular bar, n*—an extruded annular shape with minimum inside diameter of 3/8 in. [9.5 mm] and minimum wall thickness of 1/16 in. [1.6 mm].

### 4. Classification and Material

4.1 Product shape and size as defined in the applicable purchase order.

4.2 This specification covers extruded product as listed in Tables S-PVC-I and S-PVC-II. Products included in the designations reference Specification D 1784 callouts where applicable.

4.2.1 The type of poly(vinyl chloride), and chlorinated poly(vinyl chloride) shape product may be categorized by type, grade, and class depending on resin composition as defined in Table S-PVC-II.

4.3 The type, class and grade is further differentiated based on dimensional stability (elevated temperature excursion test). See Table S-PVC-II and dimensional requirements, Table A.

#### 4.4 Property Tables:

4.4.1 Tables S-PVC-I and S-PVC-II may be used to describe extruded products.

4.4.2 Table 1 may also be used to describe extruded products not included in Table S-PVC-I or S-PVC-II via a cell callout that includes the applicable material type and specific properties (Designations 1 through 7).

4.4.3 To facilitate the incorporation of future or special materials not covered by Tables S-PVC-I and S-PVC-II, the “as specified” category (00) for type, class and grade is shown in the applicable table with the basic properties to be obtained from Table 1 as they apply.

4.5 *Callout Designation*—A one-line system shall be used to specify poly(vinyl chloride), or chlorinated poly(vinyl chloride) materials covered by this specification. The system uses pre-defined cells to refer to specific aspects of this specification as illustrated below:

#### 4.5.1 Examples:

4.5.1.1 *Example 1*—Product made from general purpose poly(vinyl chloride):

CELL CALLOUT:	S-PVC0111
S-PVC01	= Product made from PVC in accordance with Table S-PVC-I and Table S-PVC-II
1	= Unfilled class
1	= General purpose grade product

4.5.1.2 *Example 2*—Product made from general purpose chlorinated poly(vinyl chloride):

CELL CALLOUT:	S-CPVC0211
S-PVC02	= Product made from CPVC in accordance with Tables S-PVC-I and S-PVC-II
1	= Unfilled class
1	= General purpose grade product

4.5.2 These two examples illustrate how a one-line, alphanumeric sequence can identify the product composition, commercial parameters and physical characteristics of extruded product. A space must be used as a separator between the specification number and the type designation. No separators are needed between type, class, and grade. When special notes are to be included, such information should be preceded by a comma. Special tolerances must be noted at time of order and are inserted after the grade in parenthesis and preceded by a comma.

NOTE 2—The material used in the manufacture of PVC and CPVC shapes intended for contact with or the transport of potable water, or both, must be evaluated and certified as safe for this purpose by a testing agency acceptable to the local health authority. The evaluation shall be in accordance with the requirements for chemical extraction, taste, and odor, that are no less restrictive than those included in the National Sanitation Foundation (NSF) Standard 61.

### 5. Ordering Information

5.1 All shapes covered by this specification shall be ordered using the proper callout designation (see 4.5).

### 6. Physical Property Requirements

6.1 The physical property values listed within this specification’s tables are to be considered minimum specification values. Any requirement for specific test data for a given production lot shall be specified at the time of order. Physical properties for products not yet included in Table S-PVC-I or S-PVC-II may be specified by using Table 1 for extruded products.

### 7. Dimensional Requirements

7.1 The type, class, and grade is differentiated based on dimensional stability (elevated temperature excursion test) as indicated in Table S-PVC-II.

7.2 Products shall be produced within the commercial tolerances and with the lowest stress levels for machined parts as delineated in Table A.

7.3 Tubular bar dimensions shall be supplied in the unfinished condition, unless otherwise specified at time of order, sufficient to finish to the nominal dimensions ordered.

7.4 The maximum allowable camber at final inspection at the factory shall be within the limits referenced in Table A.

### 8. Workmanship, Finish and Appearance

8.1 *Appearance*—The resin material color for poly(vinyl chloride) shall be dark gray. The resin material color for chlorinated poly(vinyl chloride) shall be light gray. All shapes shall be uniform in color throughout the thickness. Specific colors and color matching only as agreed to by order.

8.1.1 Physical properties may be affected by other colors. Regardless of color, minimum properties of 4.4 must be met.

<sup>5</sup> Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140.

8.2 *Finish*—All products shall be free of blisters, wrinkles, cracks, gouges and defects that restrict commercial use of the product. Special surface finish shall be supplied only when specified in the purchase order or contract.

8.3 *Defects*—All products shall be free of visual voids, dirt, foreign material and embedded particles exceeding 0.040 in. [1 mm] maximum diameter as defined in 8.3.1

8.3.1 The criteria for determining the cleanliness shall be external visual inspection. A maximum number of two defects per one foot length of rod and tubular bar are allowed. Clusters of defects less than 0.040 in. [1 mm] diameter are to be counted as a single defect.

8.4 *Extrusion Quality*—Products shall not flake or disintegrate when tested in accordance with the test method for degree of fusion as defined in 12.6.

## 9. Sampling

9.1 Sampling shall be statistically adequate to satisfy the requirements of this specification as applicable (see ANSI Z1.4-1993).

9.2 For purposes of sampling, an inspection lot for examination and tests shall consist of all material of the same type, class, grade and nominal size submitted for inspection at one time.

## 10. Number of Tests

10.1 Routine lot inspection shall consist of all the criteria specified in the applicable product tables.

10.2 The criteria listed in these product tables and definitions are sufficient to establish conformity of the shape to this specification. When the number of test specimens is not stated in the test method, a single determination may be made. If more than single determinations and separate portions of the same sample are made, the results shall be averaged. The final result shall conform to the requirements prescribed in this specification.

## 11. Test Conditions

11.1 *Conditions of Specimens*—The specification values and dimensions are based on conditioning techniques outlined in Procedure A of Practice D 618

11.2 *Standard Temperature*—The tests shall be conducted at the standard laboratory temperature of  $73.4 \pm 3.6^\circ\text{F}$  [ $23 \pm 2^\circ\text{C}$ ] and  $50 \pm 5\%$  relative humidity.

## 12. Test Methods

12.1 Tensile stress at break, elongation at break, and tensile modulus (tangent) are in accordance with Test Method D 638, at the rate of 0.2 in. [5 mm]/min. Values obtained shall meet the requirements called out in Table S-PVC-I.

12.1.1 All rod specimens are in accordance with Test Method D 638.

12.2 *Dimensional Stability:*

12.2.1 *Specimen Preparation (a Minimum of Three Test Samples Required):*

12.2.1.1 *Rods*—Prepare each specimen by cutting a 1.5 in. [35 mm] long slice from the shape to be tested. Machine the slice using a coolant and good machining practices to a length

of  $1.000 \pm 0.005$  in. [ $25 \pm 0.13$  mm]. Each end of the specimen shall have a machined surface.

12.2.2 *Testing Procedure*—Measure the outside diameter and thickness or length of the specimen as applicable at  $73.4 \pm 1.8^\circ\text{F}$  [ $23 \pm 1^\circ\text{C}$ ] to the nearest 0.0001 in. [0.025 mm]. All measurements shall be done on the centerline. Also take measurements for thickness halfway to center and for diameter at mid-point.

12.2.2.1 Place the specimen in a bath consisting of polyalkylene glycol or an air circulating oven heated to  $250 \pm 5^\circ\text{F}$  [ $121 \pm 3^\circ\text{C}$ ]. After 6 h allow the specimen to slowly cool to room temperature at a rate not to exceed  $40^\circ\text{F}$  [ $22^\circ\text{C}$ ]/h. Measure the specimen at  $73.4 \pm 3.6^\circ\text{F}$  [ $23 \pm 2^\circ\text{C}$ ] and calculate the percent change in each dimension.

12.2.3 *Reproducibility*—Interlaboratory reproducibility is being determined and will be added within one year. A precision statement will be finalized and included within two years.

12.3 *Lengthwise Camber:*

12.3.1 Make all measurements for camber using the maximum distance rod deviates from the straight line extended from edge to edge when measured in accordance with 12.3.2. The shape shall be oriented such that the weight of the product doesn't influence the results.

12.3.2 *Rod:*

12.3.2.1 *Rod*—Lay each rod on its side and measure it with concave side facing a straight edge. Measure camber from the straight edge to the maximum concave point on the rod. Camber may not exceed the values of Table A.

12.3.3 *Reproducibility*—Interlaboratory reproducibility is being determined and will be added within one year. A precision statement will be finalized and included within two years.

12.4 Flexural modulus is in accordance with Test Method D 790, specimen  $\frac{1}{4}$  in. [1.4 mm] thick maximum, testing speed 0.11 in. [2.9 mm]/min. Values obtained shall meet the requirements called out in Table S-PVC-I.

12.5 Izod impact, in accordance with Test Method D 256, Method A, Fig. 4, notched  $\frac{1}{4}$  in. [1.4 mm] thick maximum specimen. Values obtained shall meet the requirements called out in Table S-PVC-I.

12.6 *Degree of Fusion of Extruded PVC and CPVC by Solvent Immersion*—Make a determination of the degree of fusion for extruded PVC as indicated by reaction to immersion in anhydrous acetone (American Chemical Society reagent grade having a maximum density of 0.7857 g/mL at  $25^\circ\text{C}$ ). A determination of the degree of fusion shall be made for extruded CPVC as indicated by reaction to immersion in methyl isobutyl ketone (MIBK).

12.6.1 *Specimen Preparation*—Specimen shall be a size that is convenient to immerse in the test container, but not less than 2 in. [5 cm] immersion height (depth). For small diameter rod (sizes 6 in. [15 cm] or less), the sample shall cut in half lengthwise and both halves immersed to provide a complete circumferential section. For large diameter rod the specimen can be cut into smaller pieces to facilitate testing, provided that the height of the sections meet the 2 in. [5 cm] immersion height requirements, and provide a full circumferential section.

12.6.2 *Conditioning*—Unless otherwise specified, condition the specimens in air for a minimum of 1 h at 73.4 ± 3.6°F [23 ± 2°C] prior to testing. The specimens shall not be conditioned in water because of the effect water has on the solvents.

12.6.3 *Procedure*—Place sufficient solvent in the container to ensure proper immersion (2 in. [5 cm] depth) of the test specimen. Place the test specimen in the solvent, seal the container, and do not agitate. Allow specimen to stand immersed for 30 min. After 30 min remove the specimen from the container and inspect for signs of attack. Attack is described as a lifting, raising, or removing of any material from the surfaces immersed. Swelling or softening of the test specimen shall not be considered attack.

12.6.4 *Failure Criteria*—50 % attack on any one surface immersed, or 10 % attack on more than one surface shall be considered a failure.

12.6.5 *Reproducibility*—Interlaboratory reproducibility is being determined and will be added within one year. A precision statement will be finalized and included within two years.

### 13. Certification

13.1 When requested at the time of order, the purchaser shall be furnished a certification that the lot is made from the required poly(vinyl chloride) or chlorinated poly(vinyl chloride) plastic and percent recycle if applicable) meets the requirements of this specification.

### 14. Packing, Packaging, and Marking

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

### 15. Keywords

15.1 chlorinated poly(vinyl chloride), recycled plastics; chlorinated poly(vinyl chloride), rod; chlorinated poly(vinyl chloride), shapes; poly(vinyl chloride); poly(vinyl chloride), rod; poly(vinyl chloride), shapes; poly(vinyl chloride), tubular bar

**TABLE S-PVC-I Material Requirements for Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Shapes**

Material	Cell Classification (Specification D 1784)	Minimum Compound Property Requirements (Specification D 1784)				Flexural Modulus, psi [MPa], min, @ 73°F (Test Method D 790)
		Izod Impact Strength, ft-lb in. of notch [J/m of notch]	Tensile Strength, psi [MPa], min	Tensile Modulus, psi [MPa]	Deflection Temp- erature Under Load, min 264 psi, °F [°C]	
PVC	12454	0.65 [35]	7000 [48]	400 000 [2760]	158 [70]	375 000 [2590]
Other PVC	As Specified	...	...	...	...	...
CPVC	23437	1.5 [80]	7000 [48]	320 000 [2200]	212 [100]	315 000 [2170]
Other CPVC	As Specified	...	...	...	...	...

**TABLE S-PVC-II Requirements for Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Rod**

Type	Description	Class	Description	Grade	Resin/Compound Type (Cell Classification Specification D 1784)	Description	Dimensional Stability, max, %
01	PVC	1	Unfilled	1	12454	General Purpose	1.5 %
		0	As Specified	0	As Specified	As Specified	...
02	CPVC	1	Unfilled	1	23437	General Purpose	1.5 %
		0	As Specified	0	As Specified	As Specified	...

**TABLE A Dimensional Requirements for PVC and CPVC Rod**

Size, in. <sup>A</sup>	Outside Diameter <sup>A</sup>	Diameter Tolerance <sup>A</sup>	Camber, in. <sup>A</sup>
¼	0.250	+0.016/–0	N/A
⅜	0.375	+0.020/–0	N/A
½	0.500	+0.020/–0	1½ in./10 ft
⅝	0.625	+0.028/–0	1½ in./10 ft
¾	0.750	+0.028/–0	1½ in./10 ft
⅞	0.875	+0.028/–0	1½ in./10 ft
1	1.000	+0.030/–0	1½ in./10 ft
1⅛	1.125	+0.035/–0	1¼ in./10 ft
1¼	1.250	+0.035/–0	1¼ in./10 ft
1⅜	1.375	+0.040/–0	1¼ in./10 ft
1½	1.500	+0.040/–0	1¼ in./10 ft
1⅝	1.625	+0.045/–0	1¼ in./10 ft
1¾	1.750	+0.050/–0	1 in./10 ft
1⅞	1.875	+0.055/–0	1 in./10 ft
2	2.000	+0.060/–0	1 in./10 ft
2⅛	2.125	+0.060/–0	½ in./5 ft
2¼	2.250	+0.068/–0	½ in./5 ft
2⅜	2.375	+0.071/–0	½ in./5 ft
2½	2.500	+0.075/–0	½ in./5 ft
2¾	2.750	+0.080/–0	½ in./5 ft
3	3.000	+0.090/–0	¼ in./5 ft
3½	3.500	+0.105/–0	¼ in./5 ft
4	4.000	+0.120/–0	¼ in./5 ft
4½	4.500	+0.135/–0	¼ in./5 ft
5	5.000	+0.150/–0	¼ in./5 ft
5½	5.500	+0.165/–0	¼ in./5 ft
6	6.000	+0.180/–0	¼ in./5 ft
7	7.000	+0.210/–0	⅛ in./5 ft
8	8.000	+0.240/–0	⅛ in./5 ft
9	9.000	+0.270/–0	⅛ in./5 ft
10	10.000	+0.300/–0	⅛ in./5 ft
11	11.000	+0.330/–0	⅛ in./5 ft
12	12.000	+0.360/–0	⅛ in./5 ft

<sup>A</sup>To convert inches to millimetres multiply by 25.40.


**TABLE 1 Additional Detail Requirements for Extruded Poly(Vinyl Chloride) and Chlorinated(Poly Vinyl Chloride) Shapes**

Note 1—The applicable shape type (Tables S-PVC-I or S-PVC-II) must precede this table designation.

Designation Order Number	Property	0	1	2	3	4	5	6	7	8	9
1	Tensile Strength, Test Method D 638, psi [MPa], min	Unspecified	6000 [41]	3000 [55]	10 000 [69]	12 000 [83]	14 000 [97]	16 000 [110]	20 000 (138)	25 000 [172]	Specify Value
2	Elongation at Break, Test Method D 638, min, %	Unspecified	1	3	5	10	20	50	100	200	Specify Value
3	Tensile Modulus, Test Method D 638, psi [MPa], min	Unspecified	100 000 [690]	200 000 [1379]	300 000 [2073]	400 000 [2760]	500 000 [3448]	600 000 [4137]	800 000 [5516]	1 000 000 [6895]	Specify Value
4	Dimensional Stability per 12.2, max, %	Unspecified	0.1	0.2	0.3	0.4	0.6	0.8	1.0	1.5	Specify Value
5	Flexural Modulus, Test Method D 790, psi [MPa], min	Unspecified	250 000 [1649]	350 000 [2400]	450 000 [3100]	550 000 [3792]	650 000 [4482]	750 000 [5171]	1 000 000 [6895]	1 500 000	Specify Value
6	Izod Impact, Test Method D 256, ft-lb in. of notch [J/m of notch], min	Unspecified	0.5 [27]	0.75 [40]	1.0 [53]	2.5 [133]	5.0 [266]	10.0 [533]	15.0 [800]	18.0 [960]	Specify Value
7	To be determined	Unspecified	...	...	...	...	...	...	...	...	Specify Value

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