



Designation: D1593 – 22

# Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting<sup>1</sup>

This standard is issued under the fixed designation D1593; 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.

## 1. Scope\*

1.1 This specification covers nonrigid, unsupported vinyl chloride plastic film and sheeting in which the resin portion of the composition contains at least 90 % vinyl chloride. The remaining 10 % can include one or more monomers copolymerized with vinyl chloride, or consist of other resins mechanically blended together with poly(vinyl chloride) or copolymers thereof.

1.2 The vinyl chloride plastic film and sheeting covered herein shall be 0.075 to 0.25 mm (3 to 10 mils) in thickness for film and greater than 0.25 mm in thickness for sheeting. The film and sheeting shall include the stabilizers and plasticizers necessary to meet the requirements of this specification. This specification covers transparent, translucent, or opaque film and sheeting that is plain, printed, embossed, or otherwise surface treated.

1.3 The values stated in SI units are to be regarded as the standard.

1.4 The following safety hazards caveat pertains only to the test methods portion, Section 10, 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—There is no known ISO equivalent to this standard.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recom-*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.19 on Film, Sheeting, and Molded Products.

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*mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- 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
- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D882 Test Method for Tensile Properties of Thin Plastic Sheeting
- D883 Terminology Relating to Plastics
- D1004 Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
- D1203 Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods
- D1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
- D1239 Test Method for Resistance of Plastic Films to Extraction by Chemicals
- D1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D1790 Test Method for Brittleness Temperature of Plastic Sheeting by Impact
- D1922 Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method
- D3892 Practice for Packaging/Packing of Plastics
- D4804 Test Method for Determining the Flammability Characteristics of Nonrigid Solid Plastics
- D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

**D6988 Guide for Determination of Thickness of Plastic Film Test Specimens**
**3. Terminology**

3.1 *Definitions*—For definitions of terms in this test method relating to plastics, refer to Terminology **D883**. For abbreviations used in this test method, refer to Terminology **D1600**, unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *vinyl chloride plastics*—plastics based on polymers of vinyl chloride or copolymers of vinyl chloride with other monomers, the vinyl chloride being in greatest amount by mass.

**4. Significance and Use**

4.1 This specification designates three general-purpose types of vinyl chloride plastic film and sheeting. The tests involved are expected to provide information to identify the type of material and to ensure a minimum of good workmanship and quality. The test data are not necessarily suitable for direct application in design because of differences encountered in the shape of the part, loading, size, environmental conditions, and so forth. The test results can be used for inspection and quality control tests, provided similar test equipment and proper methods are used.

4.2 Films and sheetings are available, compounded differently, where special properties are required. Special types of film and sheeting will be added to the specification as their inclusion becomes generally desirable and the necessary data and methods become available.

**5. Classification**

5.1 This specification covers three types of nonrigid vinyl chloride plastic film and sheeting, designated in accordance with the method of manufacture as follows:

- 5.1.1 *Type I*—Calendered film and sheeting,
- 5.1.2 *Type II*—Extruded film and sheeting, and
- 5.1.3 *Type III*—Cast film and sheeting.

**6. General Requirements**

6.1 The material shall be of uniform composition and so compounded as to conform to the requirements of this specification.

6.2 The color, transparency or opacity, and surface finish shall be as specified by the purchaser.

6.3 The material shall be free from pinholes, particles of foreign matter, undispersed raw materials, and visual defects. Edges are to be smooth and free from cuts.

**7. Dimensional Tolerances**

7.1 *Thickness*—The average thickness of the film and sheeting shall be determined in accordance with **10.1.4** and shall be within the following limits:

- 7.1.1 *Type I*— $\pm 10\%$  of the specified thickness.
- 7.1.2 *Type II*— $\pm 15\%$  of the specified thickness.
- 7.1.3 *Type III*— $\pm 10\%$  of the specified thickness.

7.1.4 Average gauge for embossed film and sheeting shall be determined in accordance with **10.1.4.2**.

7.2 *Average Thickness Based on Yield per Roll*—The average thickness based on yield shall be determined in accordance with **10.1.4** and shall be within the following limits:

- 7.2.1 *Type I*— $\pm 5\%$  of the specified thickness.
- 7.2.2 *Type II*— $\pm 10\%$  of the specified thickness.
- 7.2.3 *Type III*— $\pm 5\%$  of the specified thickness.

7.3 *Width*—The film and sheeting shall be held to a tolerance of  $\pm 12$  or  $-0$  mm ( $+\frac{1}{2}$  or  $-0$  in.) for Types I and II, and  $+19$  or  $-0$  mm ( $+\frac{3}{4}$  or  $-0$  in.) for Type III, of the width specified by the purchaser. This tolerance shall apply when the material is in roll form on the core.

7.4 *Length*—The length of material for Types I and II, excluding that which has been subjected to embossing, printing, and so forth, shall be continuous in any one roll. Four heat-sealed splices shall be allowed for Type III sheeting. The total length in a roll shall be as specified by the purchaser.

**8. Requirements**

8.1 Test specimens shall conform to the requirements prescribed in **Table 1**.

**9. Sampling**

9.1 A sample shall be selected at random from each lot of material sufficient to determine the conformance of the material to this specification. Individual visual inspection of selected film or sheeting samples is permissible.

**TABLE 1 Detail Requirements for Nonrigid Vinyl Chloride Plastic Film and Sheet**

Property	Requirement		
	Type I	Type II	Type III
Tensile strength, min, MPa (psi):	14.5 (2100)	17.2 (2500)	17.9 (2600)
Elongation at rupture, min, %	150	125	150
Tear resistance, min, N/mm (lbf/in.)	35 (200)	not applicable	not applicable
Volatile loss, max, %	see Fig. 1		
Water extraction, max, %	1	1	1
Low-temperature impact, max:			
°C	-18 to -20	-18 to -20	-10 to -12
°F	(0 to 4)	(0 to 4)	(14 to 10)
Burning rate, max, mm/s (in./s)	30.5 (1.2)	not applicable	not applicable
Shrinkage at elevated temperature, max, %	7	8	5

10. Test Methods

10.1 Determine the properties enumerated in this specification in accordance with the following methods:

10.1.1 *Conditioning*—Condition the test specimens as  $23 \pm 2^\circ\text{C}$  ( $73.4 \pm 3.6^\circ\text{F}$ ) and  $50 \pm 10\%$  relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D618, for those tests where conditioning is required. In cases of disagreement, the tolerances shall be  $1^\circ\text{C}$  ( $\pm 1.8^\circ\text{F}$ ) and  $\pm 2\%$  relative humidity.

NOTE 2—Tolerances are the maximum allowable operation fluctuations for the specified temperature and relative humidity set points. Tolerances do not imply that these parameters can be set any higher or lower than specified.

10.1.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of  $23 \pm 2^\circ\text{C}$  ( $73.4 \pm 3.6^\circ\text{F}$ ) and  $50 \pm 10\%$  relative humidity, unless otherwise specified in the test methods or in this specification. In cases of disagreements, the tolerances shall be  $\pm 1^\circ\text{C}$  ( $\pm 1.8^\circ\text{F}$ ) and  $\pm 5\%$  relative humidity.

10.1.3 *Specific Gravity*—Determine specific gravity in accordance with Method A or Method B of Test Method D792, or Test Method D1505

10.1.4 *Thickness*:

10.1.4.1 *Non-Embossed Film or Sheeting*—For routine testing, standard dead weight methods may be used. Measure thickness by D5947 or D6988, as appropriate.

10.1.4.2 *Embossed Film or Sheeting*—This method for thickness is to be used as a referee method and must be used for embossed film and sheeting

(1) *Apparatus*—The apparatus shall consist of the following:

- (a) *Analytical Balance*, equipped with pan straddle or other stationary support, sensitive to 0.005 g,
- (b) *Class S Weights*,
- (c) *Beaker*, 250-mL,
- (d) *Fine Thread or Wire*, nonabsorbent,
- (e) *Thermometer*, 0 to  $100^\circ\text{C}$ , graduated in  $1^\circ\text{C}$  divisions,
- (f) *Die or Template*, for cutting test specimens, 10 by 10 cm, with dimensional tolerance of  $\pm 0.01$  cm/side, and
- (g) *Sharp Knife or Razor*.

(2) *Test Specimens*—Test five 10 by 10-cm specimens taken uniformly across the width of the sheet.

(3) *Procedure*—By means of the die or template and the sharp knife or razor, cut five specimens from the sample of material. Weigh each specimen to the nearest 0.5 mg on the analytical balance. Record the weight as *W*. Determine the specific gravity of each specimen in accordance with Method A of Test Methods D792, or Test Method D1505, and record as *D*. Use of a wetting agent is recommended.

(4) *Calculation*—Calculate the average thickness of each test specimen, using the following formula, and average the five values:

$$T = 394W / 100D = 3.94W/D \quad (1)$$

where:

- T* = average thickness of test specimen, mils,
- W* = weight of test specimen, g,
- D* = density of test specimen,  $\text{g}/\text{cm}^3$ ,

394 = conversion factor, cm to mils, and  
100 = area of specimen,  $\text{cm}^2$ .

10.1.5 *Average Thickness Based on Yield per Roll*—Calculate the average thickness based on yield per roll as follows:

$$\text{average thickness, mils} = \frac{768.9 \times \text{net weight (lb)}}{\text{specific gravity} \times \text{length (yd)} \times \text{width (in.)}} \quad (2)$$

10.1.6 *Tensile Strength and Elongation at Rupture*—Test Method D882 shall be used. Test specimens shall be 25.4 mm (1 in.) wide. The test method used shall be stated in the report.

10.1.7 *Tear Resistance*—Test Method D1004 or D1922 shall be applied.

10.1.7.1 The test method performed must be agreed upon between the purchaser and the seller of the product(s) since the two test methods are not equivalent

10.1.8 *Volatile Loss*—Measure volatile loss by Procedure A of Test Methods D1203. (See also Fig. 1 of this specification.)

10.1.9 *Water Extraction*—Test Method D1239, except that the specimens shall be preconditioned for 3 h at  $50 \pm 3^\circ\text{C}$  ( $122 \pm 5^\circ\text{F}$ ), removed from the oven, placed in the desiccator, and allowed to cool to room temperature before weighing. Also, the immersion test shall be made for 24 h at  $50 \pm 3^\circ\text{C}$  ( $122 \pm 5^\circ\text{F}$ ) in distilled water only.

10.1.10 *Low-Temperature Impact*—Determine the low-temperature impact in accordance with the procedure described in D1790.

10.1.11 *Burning Rate*—Test Method D635.

10.1.11.1 Due to specimen thinness and nonrigidity, distortion or shrinkage can occur when testing per this test method.

10.1.11.2 Use Test Method D4804 if distortion or shrinkage occurs.

10.1.12 *Shrinkage at Elevated Temperatures*—Test Method D1204, using a temperature of  $100^\circ\text{C}$  for 30 min.

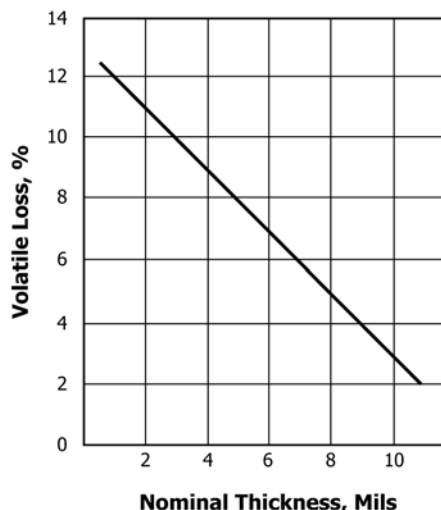


FIG. 1 Maximum Percentage of Volatile Loss versus Thickness (All Types)