



Designation: **D1593—09 D1593 – 13**

Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting¹

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 (ϵ) 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 % ~~may 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 ~~sheet, sheeting.~~ The film and sheeting shall include the stabilizers and plasticizers necessary to meet the requirements of this specification. ~~The material may be~~ This specification covers transparent, translucent, or ~~opaque, and may be 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 and health practices and determine the applicability of regulatory limitations prior to use.*

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

2. Referenced Documents

2.1 *ASTM Standards:*²

[D618 Practice for Conditioning Plastics for Testing](#)

~~[D689 Test Method for Internal Tearing Resistance of Paper \(Withdrawn 2009\)](#)~~³

[D792 Test Methods for Density and Specific Gravity \(Relative Density\) of Plastics by Displacement](#)

[D882 Test Method for Tensile Properties of Thin Plastic Sheeting](#)

[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](#)

~~[D1433 for Method of Rate of Burning and/or Extent and Time of Burning of Flexible Thin Plastic Sheeting Supported on a 45-Deg Incline \(Withdrawn 1986\)](#)~~³

[D1505 Test Method for Density of Plastics by the Density-Gradient Technique](#)

~~[D1898](#)~~[D1790 Practice for Sampling of Plastics Test Method for Brittleness Temperature of Plastic Sheeting by Impact \(Withdrawn 1998\)](#)

[D1922 Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method](#)

[D3801 Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position](#)

[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](#)

[D6988 Guide for Determination of Thickness of Plastic Film Test Specimens](#)

¹ 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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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

2.2 *Military Standard:*

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes³

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *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 sheets ~~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 in the contract or order.

6.3 The material shall be reasonably free from pinholes, particles of foreign matter, undispersed raw materials, and visual defects. Edges ~~should~~ are to be smooth and free from cuts. The extent of the above defects permissible shall be as agreed upon between the purchaser and the seller.

7. Dimensional Tolerances

7.1 ~~Thickness~~—The average thickness of the film and sheeting ~~determined from five uniformly spaced~~ shall be determined in accordance with 10.1.4 readings taken across the width of the sheet 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 ~~10.1.3~~ 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 ± 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 on the contract or order. 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 in the contract or order.

8. Requirements

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

³ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://www.dodssp.daps.mil>.

TABLE 1 Detail Requirements for Nonrigid Vinyl Chloride Plastic Film and Sheeting

Property	Requirement		
	Type I	Type II	Type III
Tensile strength, ^A min, MPa (psi):			
Tensile strength, min, MPa (psi):			
— D882, Method A	15.9 (2300)	20.7 (3000)	20.0 (2900)
— D882, Method B	14.5 (2100)	17.2 (2500)	17.9 (2600)
— D882	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
Internal tear resistance, min:			
— Over 0.076 mm (0.003 in.) thick, g/μm (g/mil)	2.36 (60)	3.94 (100) for all thicknesses	5.91 (150) for all thicknesses
— 0.076 (0.003 in.) or less, g/sheet	180		
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 -2	0 to -2	+14 to +12
°F	0 to -4	0 to -4	+14 to +12
Burning rate, max, mm/s (in./s)	30.5 (1.2)	not applicable	not applicable
Crecking	no crecking	no crecking	no crecking
Shrinkage at elevated temperature, max, %	7	8	5

^AIf the sheeting meets the requirement by either method, it shall be considered as passed.

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. ~~In addition, selected samples of the individual visual inspection of selected film or sheeting may be subjected to individual visual inspection; samples is permissible.~~

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 $50 \pm 5\%$ to 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°C ($\pm 1.8^\circ\text{F}$) and $\pm 2\%$ relative humidity.

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 $50 \pm 5\%$ to 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 $\pm 2\%$ to $\pm 5\%$ 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*—*Thickness*: This method for thickness is to be used as a referee method and must be used for embossed sheeting. For routine testing, standard dead weight methods may be used.

10.1.4.1 *Apparatus*—*Non-Embossed Film or Sheeting*—The apparatus shall consist of the following: For routine testing, standard dead weight methods may be used. Measure thickness by **D5947** or **D6988**, as appropriate.

(1) *Analytical Balance*, equipped with pan straddle or other stationary support, sensitive to 0.005 g;

(2) *Class S Weights*;

(3) *Beaker*, 250-mL;

(4) *Fine Thread or Wire*, nonabsorbent;

(5) *Thermometer*, 0 to 100°C , graduated in 1°C divisions;

(6) *Die or Template*, for cutting test specimens, 10 by 10 cm, with dimensional tolerance of ± 0.01 cm/side, and

(7) *Sharp Knife or Razor*.

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

10.1.4.2 *Procedure*—*Embossed Film or Sheeting*—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. This method for thickness is to be used as a referee method. Determine the specific gravity of each specimen in accordance with Method A of Test Methods referee method **D792**, or Test Method **D1505**, and record as must be used. Use of a wetting agent is recommended 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°C , graduated in 1°C divisions.