



Designation: D 4225 – 9703

Standard Specification for Styrene-Butadiene Sheeting¹

This standard is issued under the fixed designation D 4225; 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 styrene-butadiene sheeting in thicknesses of 0.25 mm–([0.01 in.]) and greater. Sheeting conforming to this specification is intended for use in instrument housings and applications requiring resistance to impact. Methods of fabrication may require that the sheet be drawn or bent.

1.2 This specification covers natural and colored sheeting.

1.3 This specification covers quality requirements that include degree of orientation, amount of warpage or twist, dimensions, tolerances, and workmanship.

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

1.5 This specification allows for the use of recycled plastics as defined in Guide D 5033.

1.6 The following precautionary statement pertains to the test method portion only, Section 12, of this specification: *This standard does not purport to address 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~~ known ISO equivalent to this standard.

2. Referenced Documents

2.1 *ASTM Standards:*

¹ This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.19 on Film and Sheeting. Current edition approved July 10, ~~1997~~; 2003. Published ~~April 1998~~; September 2003. Originally ~~published as D 4225—83~~; approved in 1983. Last previous edition approved in 1997 as D 54225 – 907.

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

- D 256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics and Electrical Insulating Materials²
- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²
- D 638 Test Method for Tensile Properties of Plastics²
- D 883 Terminology Relating to Plastics²
- D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer²
- D 1525 Test Method for Vicat Softening Temperature of Plastics²
- D 1898 Practice for Sampling of Plastics³
- D 2732 Test Method for Unrestrained Linear Thermal Shrinkage of Plastic Film and Sheet⁴
- D 3892 Practice for Packaging/Packing of Plastics⁴
- D 4549 Specification for Polystyrene and Rubber-Modified Polystyrene Molding and Extrusion Materials (PS)⁵
- D 5033 Guide for the Development of ASTM Standards Relating to the Proper Recycling and Use of Recycled Plastics⁵

2.2 *Federal Standard:*⁶

Fed. Std. No. 406, Plastics: Methods of Testing (Method 6051, Warpage)

2.3 *Military Standard:*⁷

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

3. Terminology

3.1 *Definitions:* Unless otherwise indicated, the terminology used in this specification is in accordance with definitions given in Terminology D 883.

4. Classification

4.1 The styrene-butadiene sheeting in accordance with this specification is classified by Type (see Table 1) as follows:

- 4.1.1 *Type I*—Low shrinkage.
- 4.1.2 *Type II*—Intermediate shrinkage.
- 4.1.3 *Type III*—High shrinkage.

4.2 The styrene-butadiene sheeting is further divided into classes as follows:

- 4.2.1 Class 1 - Natural
- 4.2.2 Class 2 - As specified by user

4.3 Sizes

- 4.3.1 Size A: ~~0.5~~ 0.5 by 1 m.
- 4.3.2 Size B: as specified by user.

4.4 The sheeting covered by this specification shall be identified by a document-based part numbering system as follows:

² Annual Book of ASTM Standards, Vol 08.01.

³ Discontinued; see 1997 Annual Book of ASTM Standards, Vol 08.021.

⁴ Annual Book of ASTM Standards, Vol 08.032.

⁵ Available from Superintendent

⁵ Annual Book of Documents, U.S. Government Printing Office, North Capital and H Sts., NW, Washington, DC 20401: ASTM Standards, Vol 08.03.

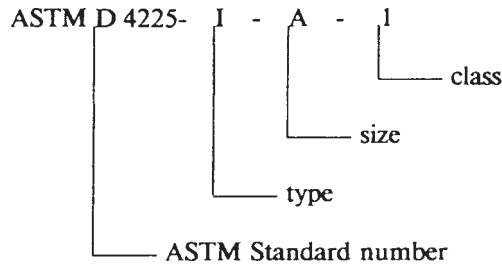
⁶ Available from Standardization Superintendent of Documents, Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS: U.S. Government Printing Office, North Capital and H Sts., NW, Washington, DC 20401.

⁷ Available from Standardization Documents, Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

TABLE 1 Orientation (Percent Shrinkage)^A

Sheet Thickness mm-{ [in.]}	Type I %	Type II %	Type III %
0.25 to 0.50 0.25 to 0.50 (0.01 to 0.019)	less than 30 < 30	30 to 60 30 to 60	greater than 60 > 60
0.50 to 1.0 >0.50 to 1.00 (0.020 to 0.039)	less than 20 < 20	20 to 50 20 to 50	greater than 50 > 50
1.0 to 1.50 1.0 to 1.50 (0.040 to 0.059)	less than 20 < 20	20 to 40 20 to 40	greater than 40 > 40
1.50 to 2.00 >1.50 to 2.00 (0.060 to 0.079)	less than 10 < 10	10 to 30 10 to 30	greater than 30 > 30
2.00 to 2.54 >2.00 to 2.54 (0.080 to 0.10)	less than 5 < 5	5 to 20 5 to 20	greater than 20 > 20

^A Shrinkage in the sheets is an indication of orientation. The higher the shrinkage, the higher the orientation.



IA1

where:

- D 4225 = ASTM standard designation number.
- I = Type I (low shrinkage),
- A = Size (0.5 by 1 m), and
- 1 = Class (natural color), and
- ~~D 4225~~ = ~~ASTM standard designation number.~~ color.

5. Ordering Information

- 5.1 Purchasers ~~should~~ shall select the preferred options permitted herein and include the following information in the purchase contract.
 - 5.1.1 Title, number, and date of this specification.
 - 5.1.2 Classification ~~according to~~ in accordance with Specification D 4549 of the material to be used to manufacture the sheet (see 6.1).
 - 5.1.3 Length and width of sheets (see ~~section~~ 7.5).
 - 5.1.4 Thickness of sheets (see ~~section~~ 7.5).
 - 5.1.5 Color (see 7.4).
 - 5.1.6 Requirements for packaging, packing, and marking (see 15.1).

6. Materials and Manufacture

- 6.1 *Materials*—The sheeting shall be manufactured from styrene-butadiene thermoplastic material of the classification specified in 5.1.2. The supplier shall furnish, for the material used, data for the four classification properties as follows:
 - 6.1.1 *Impact Strength*, Method A (~~Azod~~) of Test Methods D 256.
 - 6.1.2 *Vicat Softening Temperature*, Test Method D 1525, Loading 1, Rate B.
 - 6.1.3 *Flow Rate*, Test Method D 1238, Condition ~~G-200/5.0~~.
 - 6.1.4 *Tensile-Yield Stress at Yield*, Test Method D 638, Speed-B, of testing, 5.0 mm [0.20 in.] per minute.
- 6.2 *Manufacture*—Sheeting shall be formed by extrusion molding and press polished. Sheeting shall be annealed if necessary to assure compliance with the orientation requirement of 7.2.

7. Specific Requirements

- 7.1 *Form*—The material shall be furnished in the form of flat rectangular sheeting of the dimensions specified.
- 7.2 *Orientation*—The sheeting, when tested as specified in 12.2, shall conform to the requirements of Table 1.
- 7.3 *Warpage or Twist*—Applicable only to sheets having diagonals of 1 m (~~36 in.~~) [39.4 in.] or more in length. Warpage or twist shall not exceed the values shown in Table 2, when measured in accordance with 12.3.
- 7.4 *Color*—The color shall be as specified by the user.
- 7.5 *Dimensions and Tolerances*—Unless otherwise specified, the standard size of sheets shall be 0.5 by 1 m (~~20 [19.7 by 40 in.], 39.4 in.~~), and the tolerances on the width, length and thickness shall be as shown in Table 3.
- 7.6 *Workmanship*:
 - 7.6.1 *Uniformity*—All sheets in the lot shall, when subjected to visual examination, satisfy the color and surface finish requirements of this specification.

TABLE 2 Warpage or Twist

Thickness of Sheet, mm-([in.])	Warpage or Twist, %, max
0.25 to 3 (0.010 to 0.125)	1.0
0.25 to 3 [0.010 to 0.118]	1.0
>3 to 6 (>0.125 to 0.250)	0.7
>6 to 19 (>0.25 to 0.75)	0.5
>19 (>0.75)	0.3

TABLE 3 Examination of Sheets for Defects in Dimensions

Examine	Defects
Width	Varies by more than ± 3 mm (± 0.125 in.) from width specified.
Width	Varies by more than ± 3 mm [± 0.118 in.] from width specified.
Length	Varies by more than $+ 6$ mm ($+ 0.25$ in.), $- 0$ mm ($- 0$ in.).
Length	Varies by more than $+ 6$ mm [$+ 0.236$ in.], $- 0$ mm [$- 0$ in.].
Thickness	Varies by more than $+ 10$ % or $- 5$ % from the specified thickness.

7.6.2 *Surface Finish*—The surface shall be free from defects as described in Table 4.

7.6.3 *Internal Defects*—The edges and cut sections shall show none of the defects as described in Table 4.

8. Sampling

8.1 Unless otherwise agreed upon between the user and the supplier, the materials shall be sampled in accordance with the sampling procedure prescribed in Practice D 1898 - 68 (Reapproved 1989). Adequate statistical sampling shall be considered an acceptable alternative. A lot ~~should~~ shall consist of all items of one type, size, and class offered for delivery at one time on one contract or order.

9. Testing

9.1 The sheet shall be tested for the applicable characteristics listed in Table 1 and Table 2 in accordance with the test methods specified herein, for each lot submitted for inspection.

10. Specimen Preparation

10.1 Test specimens shall be molded as specified in the test methods of the *ASTM Book of Standards* or as specified by the sheet supplier.

11. Conditioning

11.1 Condition the test specimen at $23 \pm 2^\circ\text{C}$ ($[73.4 \pm 3.6^\circ\text{F}]$) and 50 ± 5 % relative humidity for not less than 40 h prior to testing in accordance with Procedure A of Practice D 618.

12. Test Methods

12.1 Testing shall be conducted at $23 \pm 2^\circ\text{C}$ ($[73.4 \pm 3.6^\circ\text{F}]$) and 50 ± 5 % relative humidity, after conditioning in accordance with Procedure A of Practice D 618.

12.2 Orientation shall be determined as percent shrinkage using Test Method D 2732 at a temperature of $151.6 \pm 2.8^\circ\text{C}$ ($[305 \pm 5^\circ\text{F}]$). The immersion time for specimens 25.4 mm (± 1 in.) [1 in.] and under in thickness shall be 10 to 10.5 min. Specimens over 25.4 mm (± 1 in.) [1 in.] thickness shall be immersed for 16 to 16.5 min.

12.3 Warp or twist shall be determined using two sheets tested in accordance with Method 6051 of Fed. Std. No. 406 except for the following: a straight edge 1 -m (± 36 in.) [39.4 -in.] long shall be used. The straight edge shall be moved over the sheet and rotated along the sheet length about an axis perpendicular to the plane of the sheet without permitting an end of the straight edge to extend beyond the edge of the sheet. The maximum distance from the sheet to the straight edge shall be measured and reported. The measurement shall be made with the sheet lying with its surface of maximum convexity in contact with a horizontal flat surface. The straight edge shall be light in weight and no pressure shall be exerted on it that might tend to reduce the warp or twist during the measurement.

12.3.1 *Calculations*—The warp or twist shall be calculated as follows:

$$W = \frac{D \times 100}{L} \quad (1)$$

where:

W = warp or twist, %,

D = maximum deviation, mm (\pm in.), [\pm in.], and

L = length of the sheet in millimetres (\pm inches) along the straight edge.

TABLE 4 Examination of Sheets for Defects in Appearance and Workmanship

Examine	Defect
Appearance	Not uniform texture, finish, or color. Any pits, blisters, cracks, dents, waviness, heat marks, or scratches.
Workmanship	Surface not press polished and straight; edges not smooth and straight. Any delaminations or porosity on edges.

13. Certification and Inspection

- 13.1 Certification and lot acceptance of the material ~~may~~ shall be made as agreed upon by the user and supplier, or as a part of the purchase contract.
- 13.2 Periodic check inspection shall consist of the tests agreed to by the supplier and user.
- 13.3 A report of the test results shall be furnished at a frequency agreed to by the supplier and user when specified in a purchase order or contract.

14. Rejection and ~~Rehearing~~ Retesting

14.1 Material that fails to conform to the requirements as agreed upon by the user and supplier ~~may~~ shall be rejected. ~~If any failure occurs, the materials may be retested to establish conformity in accordance with agreement between user and supplier. Rejection should~~ shall be reported to the supplier promptly and in writing. ~~In case Retesting of dissatisfaction with the results of material to determine conformity is permissible if agreed upon by the test, the supplier may make claim for a rehearing.~~ user and supplier.

15. Packaging, Packing, and Marking

15.1 Provisions of Practice D 3892 apply for packaging, packing, and marking of plastic materials.

16. Keywords

16.1 sheeting; styrene-butadiene

SUPPLEMENTARY REQUIREMENTS

QUALITY ASSURANCE PROVISIONS FOR GOVERNMENT/MILITARY PROCUREMENT

These requirements apply *only* to Federal/Military procurement, not domestic sales or transfers.

- S1. Sampling for inspection and testing shall be carried out in accordance with the recommendations of Practice D 1898 - 68 (Reapproved 1989).
- S2. Selection of Acceptable Quality Level (AQL) and of Inspection Level (IL) shall be made, with consideration of the specific use requirements. This is discussed in Sections 7 and 8 of the above document, with reference to MIL-STD-105.
- S3. In the absence of contrary requirements, the following values shall apply:

	IL	AQL
Defects in material and workmanship	II	2.5
Defects of preparation for delivery	S-2	2.5
Testing (products)	S-1	1.5
Testing (polymer, unfabricated)	S-1 ^A	...

^A Samples shall be drawn from the required number of units, and pooled for preparation of molded samples for mechanical properties evaluation.

PACKAGING PROVISIONS FOR GOVERNMENT/MILITARY PROCUREMENT

S1. All packing, packaging, and marking provisions of

Practice D 3892 shall apply to this specification.

SUMMARY OF CHANGES

This section identifies the location of selected changes to this specification. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this specification. This section may also include descriptions of the changes or reasons for the changes, or both.

D 4225 - 03:

- (1) Five year review conducted (December 2002).
- (2) Reworded Note 1.
- (3) Updated Referenced Documents section.
- (4) In 4.3.1, relocated decimal to correct standard sheet size.
- (5) Updated designation for test conditions in 6.1.1, 6.1.2, 6.1.3, and 6.1.4.
- (6) In 7.3, 7.5, and 12.3, changed dimensions in parentheses to more accurately reflect SI equivalency.
- (7) Changed “should” to “shall” in 5.1 and last sentence in 8.1.
- (8) Changed “may” to “shall” in 13.1, and 13.3.
- (9) Revised title of Section 14 and revised 14.1 to remove permissive language.
- (10) In Table 1, corrected sheet thickness conversions in parentheses and added “>” symbol to eliminate thickness overlap. Also, substituted “<” and “>” symbols for “less than” and “greater than” in Type I and Type III columns.
- (11) Corrected conversion errors in dimensions in parentheses in Tables 2 and 3.
- (12) Added Summary of Changes section.

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