Designation: D6859 – 11

Standard Test Method for Pile Thickness of Finished Level Pile Yarn Floor Coverings[1]

This standard is issued under the fixed designation D6859; 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 test method covers the determination of pile thickness of finished level pile yarn floor covering using a thickness measuring instrument having a stationary surface (platen), a circular pressure foot under specified force, and capable of being moved vertically above the platen.

1.2 This test method is applicable only to finished level loop, cutpile and cut & loop constructions with tuft heights less than 0.25 in. (6 mm).

NOTE 1—Determination of pile thickness of finished level pile yarn floor coverings was previously contained within Test Methods D418. For user convenience, Subcommittee D13.21 subdivided Test Methods D418 into separate standards of which this test method is one.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

D418 Test Method for Testing Pile Yarn Floor Covering Construction (Withdrawn 1998)[3]

D1776 Practice for Conditioning and Testing Textiles

D5684 Terminology Relating to Pile Floor Coverings

D5823 Test Method for Tuft Height of Pile Floor Coverings

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

3. Terminology

3.1 For definitions of terms relating to Pile Floor Coverings, D13.21, refer to Terminology D5684. See also Annex A1.

3.1.1 The following terms are relevant to this standard: carpet, finished, finished pile yarn floor covering, floor covering, pile, pile thickness, pile yarn floor covering, pitch. primary backing, shorn pile, stubble, stubble height, textile floor covering, tufted fabric.

3.2 For all other terminology related to textiles, refer to Terminology D123.

4. Summary of Test Method

4.1 The total thickness of an unsheared strip specimen is measured as the distance between two parallel plates exerting a specified pressure on the test specimen. The pile yarn of the strip specimen is sheared down to a stubble. The backing thickness of the sheared strip specimen is measured as the distance between two parallel plates exerting a different specified pressure on the sheared strip specimen. The difference between the two measurements is the pile thickness.

5. Significance and Use

5.1 The determination of pile thickness of level pile yarn floor covering is useful in quality and cost control during the manufacture of pile yarn floor covering. The appearance and performance may be affected by changes in pile thickness of pile yarn floor coverings. This test method is considered satisfactory for acceptance testing of commercial shipments because current estimates of between laboratory precision are acceptable, and this test method is commonly used in the trade for acceptance testing.

5.2 If there are differences of practical significance between reported test results for two laboratories (or more), comparative tests should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, use the samples for such comparative tests that are as homogenous as possible, drawn from the same lot of material as the samples that resulted in disparate results during initial testing and randomly assigned in equal numbers to each laboratory. The test results from the laboratories involved should be compared using a statistical test for unpaired data, a probability level chosen prior to the testing series. If a bias is found either its cause must be found and

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.21 on Pile Floor Coverings.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

corrected, or future test results for that material must be adjusted in consideration of the known bias.

6. Sampling Units and Test Specimens

6.1 *Sampling Units:*

6.1.1 *Coated Floor Covering*—The basic sampling unit of coated floor covering is a shipping roll. The number of shipping rolls obtained from each production roll ranges from one to over ten.

6.2 *Lot Sample*—Take a lot sample as directed in Practice E122 when statistical knowledge of the product variability and test method precision is available, and a decision has been made on the maximum deviation that can be tolerated between the estimate to be made from the sample and the result that would be obtained by measuring every sampling unit of the lot. Otherwise the number of sampling units in a lot sample and the use of the test results obtained from the individual test samples shall be in accordance with the manufacturer's quality control program or with the specification agreed upon between the purchaser and supplier.

6.3 *Laboratory Sampling Unit*—A laboratory sampling unit shall consist of a full width section of floor covering cut from one end of each roll in the lot sample and shall be at least 4 in. (100 mm) longer than the specimens required for the tests being conducted. Do not cut a laboratory sampling unit of coated floor covering from a seam end of a production roll.

6.4 *Test Specimens:*

6.4.1 A test specimen is a designated area cut from a laboratory sampling unit. For laboratory sampling units 120 in. (3000 mm) wide or wider, three test specimens are required for a test method, one at each edge no nearer to the edge than 5 % of the total floor covering width and one in the middle portion of laboratory sampling unit. For laboratory sampling units at least 60 in. (1500 mm) wide but less than 120 in. (3000 mm), take two test specimens, one at each edge no nearer to the edge than 5 % of the total floor covering width. For laboratory sampling units less than 60 in. (1500 mm) wide, take one test specimen from the middle.

6.4.2 Where it is known that systematic variations in a floor covering characteristic may occur in bands 18 in. (460 mm) or more in width, as with a modular pattern device having separate controls or adjustments for each module, take test specimens from the middle of each band.

6.4.3 When a full-width laboratory sampling unit is not available, take test specimens as directed in 6.4, and state in the report the width available and the number of test specimens taken.

7. Apparatus

7.1 *Shear or Clipper,* capable of shearing close enough to the backing to leave a stubble of no more than 0.05 in. (1.3 mm).

7.2 *Thickness Measuring Instrument:*

7.2.1 Having a stationary surface (plate) on which to place the specimen, and a presser foot capable of being moved vertically above the plate, at least 1 in. (25 mm) from the plate.

7.2.2 Having two interchangeable presser feet; one 1.000 ± 0.001 in. (25.40 ± 0.03 mm) diameter, the other 2.250 ± 0.001 in. (57.15 ± 0.003 mm) in diameter.

7.2.3 Having means for indicating the vertical distance between the presser foot and the plate to the nearest 0.001 in. (0.03 mm) and capable of developing and indicating a force up to 0.6 lbf (2.77 n) between the presser foot and the plate.

8. Conditioning

8.1 Condition the test sample or test specimens in the standard atmosphere for testing textiles, that is 70 ± 2°F (21 ± 1°C) at 65 ± 2 % relative humidity, 12 h or until the mass changes no more than 0.1 % in 2 h as directed in Practice D1776.

9. Procedure

9.1 *Total Thickness:*

9.1.1 Select the number and location of the test specimens as directed in Section 6. Prepare the test specimens according to the procedures listed in Section 8. The test specimens shall be 10.0 ± 0.1 in. (250 ± 3 mm) in the lengthwise direction and 12.5 ± 0.1 in. (320 ± 3 mm) in the widthwise direction. The test specimens may be prepared according to the examples in Appendix X1.

9.1.2 Select a strip specimen from each of the test specimens. The strip specimens shall be 10.0 ± 0.1 in. (250 ± 3 mm) in the lengthwise direction and 2.5 ± 0.1 in. (64 ± 3 mm) in the widthwise direction and shall be conditioned as directed in Section 8.

9.1.3 Attach the 2.250 in. (57.15 mm) diameter presser foot loosely to the moveable stem or head of the instrument and bring the diameter presser foot into firm contact with the plate. Tighten the presser foot on the stem.

9.1.4 Check the instrument zero by lowering the presser foot into contact with the plate until the indicated pressure increases to the pressure to be used in measuring the indicated distance between the foot and the plate, which must read 0 ± 0.001 in. (± 0.03 mm). If the reading is not within this range, make an adjustment appropriate to the type of instrument being used. Verify the instrument with calibrated thickness blocks.

9.1.5 For each strip specimen, raise the presser foot and center the specimen, pile face up, on the plate under the foot. Lower the presser foot slowly (take about 5 s to apply full load) onto the pile surface until a pressure of 0.100 ± 0.003 psi (689 ± 21 Pa) is exerted on the specimen. Read the distance between the presser foot and the plate to the nearest 0.001 in. (0.03 mm), determine the total thickness in three different areas for each strip specimen and record the average as the total thickness, *T*.

9.1.6 Shear the pile on the strip specimen down to a stubble measuring approximately 0.05 in. (1.3 mm).

NOTE 2—Both adhesive projections and a fiber layer needle punched to the surface of the backing can interfere with shearing the pile down to a stubble of 0.05 in. (1.3 mm). Therefore, a seven and one half fold increase in pressure in measuring the thickness of the stubble specimen is used to level out minor variations in stubble height.

9.2 *Backing Thickness:*

9.2.1 Attach the 1.000 in. (25.40 mm) diameter presser foot loosely to the stem and bring the presser foot into firm contact

with the plate. Tighten the presser foot on the stem. Check the instrument zero as directed in 9.1.4.

9.2.2 For each stubble specimen, raise the presser foot and center the specimen, stubble side up, on the plate. Lower the presser foot onto the stubble surface until a pressure of 0.75 ± 0.01 psi (5170 ± 69 Pa) is exerted on the stubble specimen. Read the distance between the presser foot and the plate to the nearest 0.01 in. (0.03 mm), determine the backing thickness in three different areas for of each strip specimen and record the average as the backing thickness, *B*.

10. Calculation

10.1 A test result is the average of the measurements made on a set of test specimens described in 6.4. In this method, directions are given only for obtaining a test result from one test specimen. The value representative of the lot being sampled will be the average of the test results from each laboratory sampling unit.

10.2 For each strip specimen calculate the pile thickness using Eq 1.

$$P = T - B \quad (1)$$

where:

P = pile thickness, in. (mm),
T = average total thickness, in. (mm), and
B = average backing thickness, in. (mm).

10.2.1 Calculate the average values of pile thickness and total thickness from average values obtained on individual strip specimens to the nearest 0.01 in. (0.03 mm) for each laboratory sampling unit.

10.3 Calculate the average values of pile thickness and total thickness for the lot from average values obtained from all laboratory sampling units in the lot to the nearest 0.01 in. (0.3 mm).

11. Report

11.1 State the test sample was tested as directed in Test Method D6859 for determining the pile thickness of level pile yarn floor covering. Describe the material or product sampled and the method of sampling used.

11.2 Report the average pile thickness and when required, total thickness, for each laboratory sampling unit and for the lot.

TABLE 1 Components of Variance Expressed as Standard Deviations[A]

Variance Component	Single Material Comparisons for Loop Pile Carpet	Single Material Comparisons for Cut Pile Carpet
Within Laboratory	0.002	0.005
Between Laboratory	0.011	0.006

[A] The square roots of the components of variance are being reported to express the variability in the appropriate units of measure rather than as the squares of those units of measure.

12. Precision and Bias

12.1 *Summary*—In comparing two averages, the differences should not exceed the single-operator precision values shown in Tables 1 and 2 for the respective number of tests in 95 out of 100 cases when all the observations are taken by the same well-trained operator using the same piece of equipment and specimens randomly drawn from the sample of material. Larger differences are likely to occur under all other circumstances.

12.2 *Interlaboratory Test Data*—An interlaboratory test was run in 2000 in which randomly drawn samples of four materials were tested in each of five laboratories. One operator in each laboratory each tested two specimens of each material using Test Method D6859. One of the two specimens was tested on one day and one specimen was tested on a second day. Analysis of the data was conducted using standard statistical practice. The components of variance for Pile Thickness expressed as standard deviations were calculated to the values listed in Table 1. The material; types were:

Material A: 1/10 Gauge Level Loop
Material B: 1/10 Gauge Level Loop
Material C: 1/10 Gauge Cut Pile
Material D: 1/10 Gauge Cut Pile Graphics

12.3 *Precision*—For the components of variance reported in Table 1, two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals the critical difference listed in Tables 2 and 3. There were sufficient differences related to the material type and structure to warrant listing the components of variance and the critical differences separately.

NOTE 3—The tabulated values of the critical differences should be considered to be a general statement, particularly with respect to between-laboratory precision. Before a meaningful statement can be made about two specific laboratories, the amount of statistical bias, if any, between them must be established, with each comparison being based on recent data obtained on specimens taken from a lot of material to the type being evaluated so as to be as nearly homogeneous as possible and then randomly assigned in equal numbers to each of the laboratories.

12.4 *Bias*—The value of pile thickness can only be defined in terms of a test method. Within this limitation, Test Method D6859 has no known bias.

13. Keywords

13.1 carpet; pile height; pile thickness; pile yarn floor covering; tuft height

TABLE 2 Critical Differences for Two Averages for the Conditions Noted, 95 % Probability Level, Pile Thickness in Inches for Loop Pile Carpet

Number of Determinations	Single Material Comparisons	
	Within Laboratory Precision	Between Laboratory Precision
1	0.0056	0.0299
2	0.0040	0.0296
3	0.0033	0.0295
5	0.0025	0.0294

TABLE 3 Critical Differences for Two Averages for the Conditions Noted 95 % Probability Level, Pile Thickness in Inches for Cut Pile Carpet

Number of Determinations	Single Material Comparisons	
	Within Laboratory Precision CD	Between Laboratory Precision CD
1	0.0131	0.0208
2	0.0093	0.0186
3	0.0076	0.0177
5	0.0059	0.0172

ANNEX

(Mandatory Information)

A1. CLARIFICATION OF PILE HEIGHT, PILE THICKNESS, AND TUFT HEIGHT

A1.1 Introduction

A1.1.1 Confusion sometimes arises in specifying and testing pile yarn floor coverings due to the similarity of the terminology describing these distinctly different methods of measuring the height of the pile in relation to the backing. Each method has a specific purpose and yields different data. They cannot be compared or interchanged. Problems occur when specifications are written using pile height and the testing laboratory reports pile thickness or tuft height, which may be appropriate for the particular product. Measuring pile thickness or tuft height of a typical loop pile carpet by either procedure will yield a difference in the range of 30 to 40 % from the pile height measurement.

A1.2 Pile Height

A1.2.1 Pile height is typically used generically by the layman and by manufacturing personnel in setting machinery.

A1.2.2 Pile height is measured by inserting a small graduated ruler into the pile down to the backing and reading the overall height of the pile. This procedure is subject to significant variability between technicians and is therefore used only for rough field work and in machinery settings during the manufacturing process and shall not be used for acceptance testing.

A1.3 Pile Thickness

A1.3.1 Pile thickness is a technical term used to describe the measurement of thickness of pile yarn which can be sheared from the backing of a carpet.

A1.3.2 Pile thickness is the preferred procedure for precision measurement of level pile carpets, whether loop, cut and loop or cut pile carpets with a tuft height of less than 0.25 in. (6 mm). Although it is more complex, it is very repeatable between different technicians and laboratories. It involves the use of a thickness measuring instrument which measures thickness of materials between a platen and a circular foot of specified area under a specified force. In measuring carpet with this device, the total thickness of pile and backing is measured, the pile sheared away, and the backing only measured. Pile thickness is the difference between the two values. The procedure is complicated by remaining stubble which cannot be sheared.

A1.4 Tuft Height

A1.4.1 Tuft height, as described in this test method, is a laboratory procedure typically used for cut pile constructions, which is very repeatable. Ten tufts are severed from the backing with a cutting device, placed into a V-shaped groove in a specimen holder, covered with a clear plate, and measured with a precision scale.

A1.4.2 Tuft height is not applicable to cut pile constructions with tuft heights less than 0.25 in. (6 mm) due to the problems associated with mounting a tuft of this length in the grooved specimen holder. For this construction, pile thickness shall be performed. Refer to Test Method D5823.

APPENDIX

(Nonmandatory Information)

X1. PREPARING SPECIMENS OF MEASURED AREA

X1.1 Three procedures for obtaining specimens of measured area may be used. The following procedures are distinguished by the apparatus employed. The choice of procedure depends primarily on the cost of preparing specimens.

X1.2 *Procedure No. 1:*

X1.2.1 *Scale or Tape,* metal, graduated in 0.01 in. (2 mm), and at least 10 % longer than the test specimen dimensions.

X1.2.2 *Pen,* felt tip.

X1.2.3 *Straight Edge,* steel, 0.06 to 0.08 in. (1.5 to 2.0 mm) thick, at least 10 % longer than the test specimen dimensions, and having a row of pins projecting approximately 0.15 in. (3.8 mm) from one face at intervals of approximately 2.0 in. (50 mm) along its centerline.

X1.2.4 *Razor Knife,* having a blade about 0.02 in. (0.5 mm) thick.

X1.2.5 *Scissors,* sharp.

X1.3 *Test Specimen Cutting:*

X1.3.1 Place the test sample pile down on a flat surface, measure and mark the boundaries of the test specimens on the back using the scale, straight edge, and pen.

X1.3.2 Cut just through the backing with the razor knife guided by the straight edge, following the ink markings. Hold the plane of the razor knife perpendicular to the back of the test sample. Separate each test specimen from the test sample using scissors to cut away loops connected to the remainder of the test sample.

X1.4 *Procedure No 2:*

X1.4.1 *Apparatus:*

X1.4.1.1 *Template,* steel, 0.06 to 0.08 in. (1.5 to 2.0 mm) thick, having dimensions 0.02 in. (0.5 mm) less than the test specimen dimensions specified in the test method, and having a pin projecting approximately 0.15 in. (3.8 mm) from one face in each corner 0.25 in. (6 mm) in from the sides of the corner. Two such templates are illustrated in Figs. X1.1 and X1.2.

X1.4.1.2 *Razor Knife,* having a blade about 0.02 in. (0.5 mm) thick.

X1.4.1.3 *Scissors,* sharp.

X1.4.2 *Test Specimen Cutting:*

X1.4.2.1 Place the conditioned sample face down on a flat surface. Place the template on the back of the test sample.

X1.4.2.2 Cut just through the backing with the razor knife guided by the edge of the template. Hold the plane of the razor knife perpendicular to the back of the test sample. Separate the test specimen from the test specimen using scissors to cut away loops connected to the remainder of the sample.

X1.4.3 *Procedure No. 3:*

X1.4.3.1 *Apparatus:*

X1.4.3.1.1 *Clicking Dye,* steel, having dimensions specified in test method.

X1.4.3.1.2 *Die Clicking Machine,* with cutting block.

X1.4.3.2 *Calibration of Clicking Die*—After each sharpening, die cut a piece of cardboard and measure the dimensions of the specimen. The area computed from these dimensions should be within 1 % of the area specified in the test method.

X1.4.4 *Test Specimen Cutting:*

X1.4.4.1 Place the sample pile side up on the cutting block of the clicking machine. Brush pile surface by hand toward the middle of the area to be included in the specimen.

X1.4.4.2 Place the die on the face of the test sample with the longer sides parallel to the lengthwise direction of the floor covering, unless otherwise specified in the test method.

X1.4.4.3 Activate the clicking machine, remove the test sample remnant from around the die. Remove the specimen from the die and discard any loose fiber.

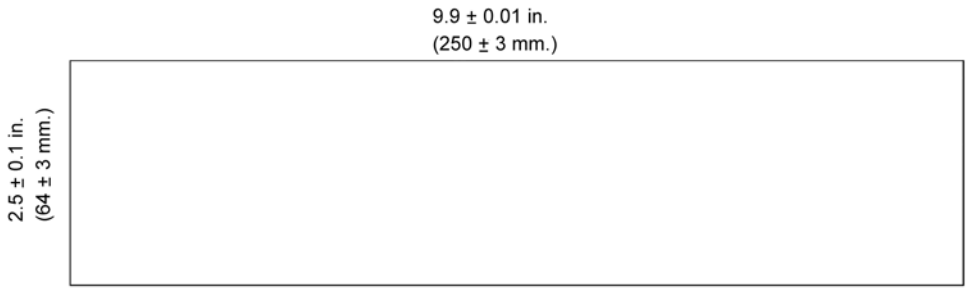

FIG. X1.1 Template for 2.5 by 10 in. (64 by 250 mm) Specimen

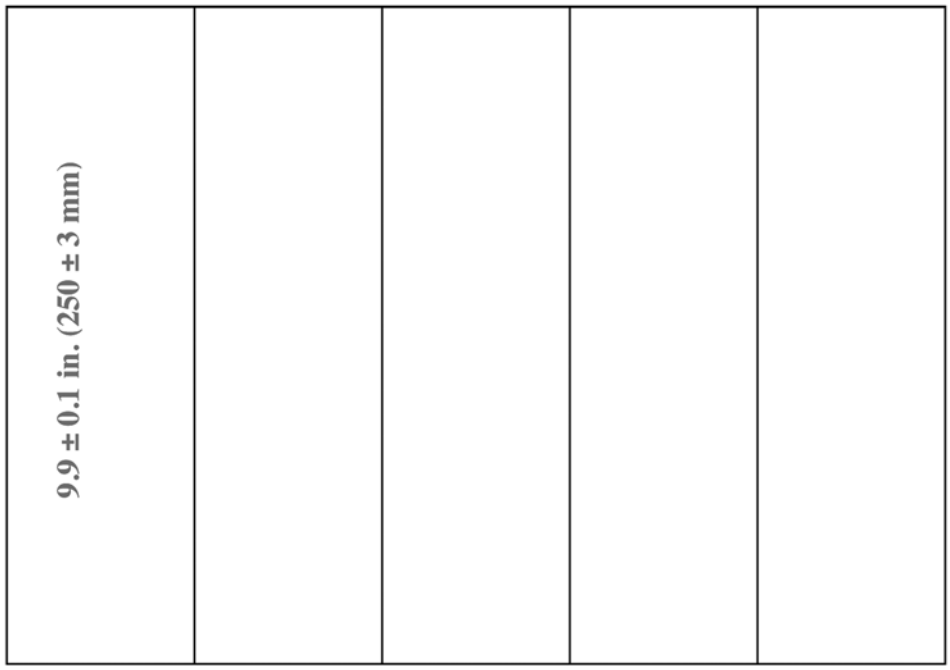

FIG. X1.2 Template for 12.5 by 10.0 in. (250 by 320 mm) Specimen