Designation: D 418 – 93

Standard Test Methods for Testing Pile Yarn Floor Covering Construction[1]

This standard is issued under the fixed designation D 418; 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.

ε[1] NOTE—This standard was corrected editorially in June 1993. The 1992 edition was incorrect. The current test methods contained in the document will eventually be balloted as individual standards.

1. Scope

1.1 These test methods cover the construction testing of machine-made woven, knitted, and tufted pile yarn floor covering both before and after an adhesive back coating, which bonds the pile yarn to the backing fabric, has been applied.

1.2 This standard includes the following test methods:

	Section
Component Masses[2] per Unit Area	8
Number of Binding Sites per Unit Length or Width of Floor Covering	16
Number of Binding Sites per Unit Length or Width of Pile Floor Covering	21
Pile Thickness—Level Pile	10
Pile Thickness—Multilevel Pile	11
Pile Yarn Length per Unit Length of Floor Covering	14
Pile Yarn Length per Unit Length of Floor Covering	20
Pile Yarn Mass per Unit Area	9
Total Mass per Unit Area	7
Tuft and Yarn Length of Uncoated Floor Covering	18
Tuft Length	12
Tuft Length	19
Tuft Length for Level Loop Pile Floor Covering	15
Tuft Height	13

1.2.1 Specimen preparation procedures common to Sections 7-11 are presented in Annex A1, Preparing Specimens of Measured Area. Annex A2 and Annex A3 give examples of typical calculations for Sections 9-11.

1.3 The values stated in inch-pound units are to be regarded as the standard for all measurements except mass. The SI (metric) values for all measurements except mass are provided for information purposes only.

1.4 *This standard may involve the use of hazardous materials, operations and equipment. It is the responsibility of the user of this standard to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 123 Terminology Relating to Textiles[3]

D 861 Practice for Use of the Tex System to Designate Linear Density of Fibers, Yarn Intermediates, and Yarns[3]

D 1193 Specification for Reagent Water[4]

D 1909 Table of Commercial Moisture Regains for Textile Fibers[3]

E 122 Recommended Practice for Choice of Sample Size to Estimate the Average Quality of a Lot or Process[5]

E 380 Standard for Metric Practice[6]

3. Terminology

3.1 *Definitions:*

3.1.1 *back coating*, *n—in textiles*, an adhesive-type substance applied to the back of a fabric for such purposes as locking pile yarn tufts into a carpet backing, bonding a secondary backing to a primary backing, or increasing fabric body or stiffness.

3.1.2 *backing*, *n—for pile yarn floor covering*, all materials in a pile yarn floor covering other than pile yarn.

3.1.3 *backing fabric*, *n—in textiles*, (*1*) a fabric into which a pile yarn is inserted, or (*2*) a reinforcing layer adhered to the reverse side of a fabric.

3.1.3.1 *Discussion*—In woven and knitted pile yarn floor coverings the backing fabric is created at the same time the pile yarn is bound to the backing fabric but in tufted pile yarn floor coverings the backing fabric is made prior to the operation in which the pile yarn is fastened to the backing fabric.

3.1.4 *backing, primary*, *n—for tufted pile yarn floor covering*, the fabric through which the pile yarn is carried by needles to form tufts: the backing fabric.

3.1.5 *backing, secondary*, *n—for pile yarn floor covering*, a material adhered to the backing fabric side of a pile yarn floor covering.

[1] These methods are under the jurisdiction of ASTM Committee D-13 on Textiles and are the direct responsibility of Subcommittee D13.21 on Pile Floor Coverings.

Current edition approved May 12, 1993. Published August 1993. Originally published as D 418 – 82. Last previous edition D 418 – 92.

[2] The technically correct term "mass" is used throughout this standard in place of "weight," the term in common usage. The buoyancy effect of the displaced air is considered negligible for the test methods in this standard, so that apparent mass and mass are the same within the limits of precision and accuracy achieved (see section 3.4.1of E 380E 380).

[3] *Annual Book of ASTM Standards*, Vol 07.01.

[4] *Annual Book of ASTM Standards*, Vol 11.01.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

[6] Excerpts appear in *Annual Book of ASTM Standards*, Vol 07.01.

3.1.5.1 *Discussion*—The secondary backing may be a textile layer, a solid plastic layer, a rubber sponge, or an elastomeric foam.

3.1.6 *binding site, n.—for pile yarn floor covering*, a place at which the pile yarn is, or can be, bound to the backing fabric. See Fig. 1.

3.1.6.1 *Discussion*—In any machine-made pile yarn floor covering the binding sites occur in an orderly and repetitive array at uniform intervals in both the lengthwise and widthwise directions of the floor covering. The nature of the binding site differs among woven, knitted, and tufted floor coverings. For example, the binding site of a woven floor covering consists of one or more filling shots under which the face yarn passes, while the binding site of a tufted floor covering consists of the section of backing fabric between two adjacent needle holes in the lengthwise direction.

3.1.6.2 The number of pile yarn strands that can be fastened at one binding site can vary from none to several, according to design.

3.1.7 *carpet*, *n*—all textile floor coverings not designated as rugs.

3.1.8 *components*, *n—for pile yarn floor covering*, the individual yarn or fabric elements into which a pile yarn floor covering can be dissected.

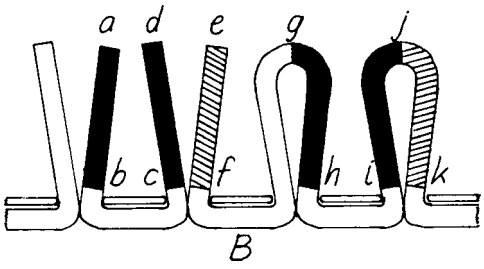
3.1.8.1 *Discussion*—The major components of uncoated pile yarn floor covering are the pile yarn and the backing fabric. For woven and knitted floor covering, the backing fabric may be further dissected into component yarns.

3.1.9 *dents per unit width*, *n—for woven pile yarn floor covering*, the number of binding sites per unit width; dents being the reed spaces through which the warp yarns pass in the loom or the metal strips in the reed which form these spaces.

3.1.10 *direction, lengthwise*, *n—in textiles*, the direction in a machine-made fabric parallel to the direction of movement the fabric followed in the manufacturing machine. (*Syn. machine direction and wrapwise*.)

3.1.11 *direction, widthwise*, *n—in textiles*, the direction in a machine-made fabric perpendicular to the direction of movement the fabric followed in the manufacturing machine. (*Syn. cross machine direction, weftwise, and fillingwise*.)

3.1.12 *floor covering, n.*—an essentially planar material, having a relatively small thickness in comparison to its length or width, which is laid on a floor to enhance the beauty, comfort, and utility of the floor.



ad = cutpile tuft element
gj = loop pile tuft element
ab, cd, ef, gh, ij, jk = tuft legs
cd, ef = cut pike tuft leg pair
ij, jk = loop pile tuft leg pair, a loop
B = one binding site

FIG. 1 Cross Section of Tufted Pile Yarn Floor Covering

3.1.12.1 *Discussion*—It is customary to distinguish between hard or resilient floor coverings and soft or textile floor coverings. Textile floor coverings are further subdivided into pile floor coverings and nonpile floor coverings such as braided rugs or flat, nonwoven barb needlepunched felt. There are two types of pile floor coverings: pile yarn and pile fiber. Typical examples of pile fiber floor coverings are flocked floor covering and fork needlepunched nonwoven floor covering.

3.1.12.2 Textile floor coverings are also classified as *carpets* or *rugs*.

3.1.13 *floor covering, pile yarn, n.*—a textile product in which yarn or yarn segments are attached intermittently to a backing fabric so as to project above the backing fabric to form a pile; the yarn entering the backing fabric substantially perpendicular to the plane of the backing fabric.

3.1.13.1 Pile yarn floor covering is distinguished from flannel, fork needlepunched, and flocked products in that the latter have a nap or pile formed of individual fibers rather than of yarn.

3.1.13.2 Pile yarn upholstery fabrics are sometimes distinguishable from pile yarn floor covering only in that they having backings that are not as stiff as for pile yarn floor covering.

3.1.14 *gage*, *n—of tufted pile yarn floor covering*, the average distance between adjacent binding sites in the widthwise direction.

3.1.15 *gage*, *n—of a tufting machine*, the average centerline distance between the needles.

3.1.16 *needles per unit width*, *n—for tufted pile yarn floor covering*, the number of binding sites per unit of floor covering width; needles being the means of inserting the pile yarn into the backing fabric.

3.1.17 *pile*, *n—for pile yarn floor covering*, the texture surface composed of many tuft legs bound to a backing fabric in an orderly and repetitive array.

3.1.17.1 *Discussion*—A particular floor covering may be all cut pile, or all loop pile and in either case the pile may be of essentially one pile level or multilevel. A particular floor covering may also contain both cut pile areas and loop pile areas which may be of the same pile level or different pile levels. Areas of intermingled cut and loop pile or intermingled high- and low-level pile may also occur.

3.1.18 *pile, cut*, *n—for pile yarn floor covering*, pile in which the legs of any one tuft element are not connected to the legs of any other tuft element.

3.1.19 *pile, level*, *n—for pile yarn floor covering*, pile in which all tuft legs are of substantially the same length.

3.1.20 *pile, loop*, *n—for pile yarn floor covering*, pile in which, for each loop, a tuft leg of one tuft element is connected to a tuft leg of another tuft element at another binding site so as to form a loop which projects above the backing fabric between the binding sites of the connected tuft elements.

3.1.21 *pile, multilevel*, *n—for pile yarn floor covering*, pile in which some tuft legs are substantially longer than others.

3.1.22 *pile yarn, buried*, *n—for coated pile yarn floor covering*, that portion of the pile tuft elements which remains after the tuft legs have been removed by shearing.

3.1.22.1 *Discussion*—The buried pile yarn is composed of the pile yarn in the backing and a short stubble of yarn projecting above the backing.

3.1.23 *pitch*, *n—for woven pile yarn floor covering*, the number of binding sites in 27 in. (686 mm) of width.

3.1.24 *rug*, *n*—a textile floor covering of limited area which is complete in itself and is intended for use as a partial covering of a floor or another floor covering.

3.1.25 *tuft*, *n—in pile fabrics*, those cut or uncut loops which are attached to the backing fabric at one binding site and which form part of the fabric face.

3.1.25.1 *Discussion*—A tuft may consist of one or more tuft elements.

3.1.26 *tuft element, n.—for pile yarn floor covering*, a segment of yarn bound to a backing fabric at a binding site so that two portions (legs) of the yarn project above the backing fabric, one portion on each side of the binding site. See Fig. 1.

3.1.26.1 *Discussion*—In loop pile floor covering, the tuft element extends from the midpoint of the loop on one side of the binding site to the midpoint of the loop on the other side of the binding site.

3.1.26.2 In most pile yarn floor coverings both legs of the tuft element are immediately adjacent to the same binding site. In some pile yarn floor coverings the yarn segment extends from one leg past a number of binding sites before the second leg of the tuft element projects above the backing fabric.

3.1.27 *tuft height*, *n—for pile yarn floor covering*, the length of a tuft leg.

3.1.28 *tuft leg*, *n—for pile yarn floor covering*, one of the two portions of a tuft element that project above the backing fabric on the pile side of the floor covering. See Fig. 1.

3.1.29 *tuft length*, *n—for pile yarn floor covering*, the length of a tuft element measured while extended in a straight line under zero tension.

3.1.30 *wires per unit length*, *n—for woven pile yarn floor covering*, the number of binding sites per unit of floor covering length; wires in the widthwise direction being the usual means of forming the pile.

3.1.31 For the definition of other textile terms used in these methods, refer to Terminology D 123D 123.

4. Significance and Use

4.1 The characteristics that can be determined by these test methods are useful in quality and cost control during the manufacture of pile yarn floor covering. Both appearance and performance can be affected by changes in these characteristics.

4.2 Although these test methods are useful for acceptance testing of commercial shipments as the best available methods, between-laboratory precision has not yet been determined. If there is a disagreement arising from differences in values reported by the purchaser and the supplier when using the methods of this standard for acceptance testing, the statistical bias, if any, between the laboratory of the purchaser and the laboratory of the supplier should be determined with each comparison of test results being based on adjacent test samples cut from one shipping roll of the floor covering.

5. Sampling Units and Test Specimens

5.1 *Sampling Units*:

5.1.1 *Uncoated Floor Covering*—The basic sampling unit of uncoated floor covering is a production roll.

5.1.2 *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.

5.2 *Lot Sample*—Take a lot sample as directed in Recommended Practice E 122E 122 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 the supplier.

5.3 A test sample 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 100 mm (4 in.) longer than the specimens required for the tests being conducted. Do not cut a test sample of coated floor covering from a seam end of a production roll.

5.4 A test specimen is a designated area of a test sample that may be marked on or cut from the test sample as directed in a test method. For test samples 305 cm (120 in.) 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 the test sample. For test samples at least 152 cm (60 in.) wide but less than 305 cm, two 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. For test samples less than 152 cm wide, only one specimen, in the middle of the width, is required for a test method.

5.5 Where it is known that systematic variations in a floor covering characteristic may occur in bands 46 cm (18 in.) 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.

5.6 When a full width test sample is not available, take specimens as directed in 5.4 and state in the report the width available and the number of test specimens taken.

5.7 A test result is the average of the measurements made on a set of test specimens as described in 5.4, 5.5, or 5.6. In these methods, directions are given only for obtaining a test result from one test sample. The value representative of the lot being sampled will be the average of the test results for all the test samples in the lot sample.

6. Conditioning

6.1 When required, condition the test specimens or the test sample in the standard atmosphere for testing textiles (21 ± 1°C (70 ± 2°F) at 65 ± 2 % relative humidity) for 12 h or until the mass changes no more than 0.1 % in 2 h.

7. Total Mass per Unit Area

7.1 *Scope*—This method applies to both uncoated and coated floor covering.

7.2 *Summary of Method*—The total mass per unit area is determined by weighing test specimens of the measured area. Test specimens are cut from a conditioned test sample and then measured, or are cut from an unconditioned test sample and then conditioned before measuring, so that the area of each test specimen is measured after conditioning. Each conditioned test specimen is weighed and the mass per unit area is calculated as the ratio of the test specimen mass to the test specimen area.

7.3 *Apparatus*:

7.3.1 *Balance*, having a capacity and sensitivity to weigh to the nearest 0.1 % of the test specimen mass or to the nearest 0.01 g, whichever is larger.

NOTE 1—Weighing to the nearest 0.1 % means weighing to the nearest 0.01 g for test specimens weighing 10 to 100 g, to the nearest 0.1 g for 100 to 1000 g, and to the nearest 1 g for more than 1000 g. A100-g, 254 by 254-mm (10.0 by 10.0-in.) test specimen has a mass per unit area of 1550 g/m^2 (457 oz/yd^2) while a 1000-g, 457 by 457-mm (18.0 by 18.0-in.) test specimen has a mass per unit area of 4784 g/m^2 (141.1 oz/yd^2).

7.3.2 *Means for Cutting and Measuring Test Specimens*, as directed for the procedure selected in Annex A1.

7.4 *Conditioning*—Condition the test specimens as directed in Section 6 before measuring and weighing. For Annex A1 Procedures No. 2 and No. 3, condition the test sample before cutting the test specimens.

7.5 *Sample and Test Specimens*:

7.5.1 Take the test sample and the test specimens as directed in Section 5.

7.5.2 For level pile floor covering, the test specimens shall be at least 254 by 254 mm (10.0 by 10.0 in.).

7.5.3 For multilevel pile floor covering the test specimens shall comprise a full pattern repeat or a whole number multiple of a full pattern repeat in each direction, but no less than as directed in 7.5.2. If the pattern repeat is not known and cannot be determined readily, use 457 by 457 mm (18.0 by 18.0 in.) for the test specimen dimensions.

7.6 *Procedure*:

7.6.1 *Preparation of Specimens*—Follow the selected procedure of Annex A1.

7.6.2 *Test Specimen Mass*—Weigh each test specimen to the nearest 0.1 % (or less) of the test specimen mass, *M* (see Note 1).

7.7 *Calculation*:

7.7.1 *Test Specimen Total Mass per Unit Area*—Calculate the total mass per unit area for each test specimen to the nearest 0.3 g/m^2 (0.01 oz/yd^2) using Eq 1.

$$W = M \times K/(B \times L) \quad (1)$$

where:

W = total mass per unit area of the test specimen, g/m^2 (oz/yd^2),
M = mass of the test specimen, g (oz),
K = appropriate conversion factor in Table 1,
B = average width of the test specimen to the nearest 0.3 mm (0.01 in.), and
L = average length of the test specimen to the nearest 0.3 mm (0.01 in.).

TABLE 1 Conversion Factors for Mass per Unit Area

From	To	
	g/m^2	oz/yd^2
oz/in.^{2}	43 940	1296.0
oz/mm^2	28.350 × 10^6	836 100
g/in.^{2}	1550.0	45.72
g/mm^2	10^6	29 490

NOTE 2—When the template or clicking die procedure of Annex A1 is used, a standard area value of $B \times L$ may be used in place of values of B and L determined by direct measurement of the specimens. Round this standard area value to the nearest 65 mm^2 (0.1 in.^{2}).

7.7.2 Calculate the average total mass per unit area for all test specimens of the test sample to the nearest 3 g/m^2 (0.1 oz/yd^2).

7.8 *Report*:

7.8.1 State the test sample was tested as directed in Test Method D 418 for determining total mass per unit area. Describe the material or product sampled and the method of sampling used.

7.8.2 Report the average total mass per unit area.

7.9 *Precision and Accuracy*:

7.9.1 *Precision*—The precision of the procedure in Test Methods D 418 for determining total mass per unit area is being established.

7.9.2 *Bias*—The procedure in Test Methods D 418 for determining total mass per unit area has no known bias and may be used as a referee method.

8. Component Masses per Unit Area

8.1 *Scope*—This test method applies only to uncoated floor covering.

8.2 *Summary of Test Method*—The test specimens used for determining the total mass per unit area as directed in Section 7 are dissected into the component parts of the floor covering, separating the pile yarn from the backing fabric and, if required, separating the yarns composing the backing fabric one from the other. Each component is weighed separately and the component mass per unit area calculated for each component as the ratio of the component mass to the test specimen area.

8.3 *Apparatus*—Balance, having a capacity and sensitivity to weigh each component to the nearest 0.1 % of the component mass or to the nearest 0.01 g, whichever is the larger. See Note 1.

8.4 *Conditioning*—Condition the test specimens as directed in Section 6 before measuring.

8.5 *Test Specimens*—Use the test specimens prepared for determining total mass per unit area as directed in Section 7 or prepare test specimens as directed in 7.5 and 7.6.

8.6 *Procedure*:

8.6.1 Manually separate the pile yarn from the backing fabric in each test specimen.

8.6.2 In the case of woven and knitted floor covering also separate the backing yarns, if required.

8.6.3 Weigh each component to the nearest 0.1 % of the component mass, *M*. See Note 1.

8.7 *Calculation*:

8.7.1 For each component calculate the component mass per unit area for each test specimen to the nearest 0.3 g/m^2 (0.01 oz/yd^2), using Eq 2.

$$C = M \times K/(B \times L) \quad (2)$$

where:

C = component mass per unit area for the test specimen, g/m^2(oz/yd^2),
M = mass of the component removed from the test specimen, g (oz),
K = appropriate conversion factor in Table 1,
B = average width of the test specimen, mm (in.), and
L = average length of the test specimen, mm (in.).

8.7.2 Calculate the average component mass per unit area for each component to the nearest 3 g/m^2 (0.1 oz/yd^2) from the values of C obtained as directed in for all test specimens in the test sample.

8.8 *Report*:

8.8.1 State the test sample was tested as directed in Test Methods D 418 for determining component masses per unit area. Describe the material or product sampled and the method of sampling used.

8.8.2 Report the average component mass per unit area for each component, using component names in common usage.

8.9 *Precision and Bias*:

8.9.1 *Precision*—The precision of the procedure in Test Methods D 418 for determining component masses per unit area is being established.

8.9.2 *Bias*—The procedure in Test Methods D 418 for determining component masses per unit area has no known bias and may be used as a referee method.

9. Pile Yarn Mass per Unit Area

9.1 *Scope*—This test method applies only to coated pile yarn floor coverings.

9.2 *Summary of Test Method*—One or two strip specimens are taken as directed in 9.7.2 from each test specimen such that the combined mass per unit area of the strip specimen(s) is within 1 % of the mass per unit area of the test specimen. The total mass of the selected strip specimens taken from all test specimens of the test sample is designated M. Most of the pile is shear from the strip specimens and discarded, leaving stubble specimens whose total mass is designated S. The buried pile yarn in the stubble specimens along with adhering coating material is manually removed from the backing fabric with the assistance of a solvent that dissolves or softens the coating material. Most of the adhering coating material is removed from the fiber of this buried pile yarn by further soaking in solvent and by abrasion. The total mass of this partially cleaned fiber from all the strip specimens is designated C. The amount of residual coating material on this fiber is determined by dissolving the partially cleaned pile fibers, leaving a residue of coating material. The mass of the residue is designated R. The mass of the pile yarn in the strip specimens equals the mass sheared from the strip specimens, $(M - S)$, plus the mass of the pile yarn buried in the backing, $(C - R)$.

9.3 *Apparatus*:

9.3.1 *Balance*, having a capacity and sensitivity such that weighings can be made to the nearest 0.1 % of the mass being weighed or to the nearest 0.01 g, whichever is the larger. See Note 1.

9.3.2 *Shear or Clipper*, capable of shearing close enough to the backing so as to leave a stubble of approximately 1.3 mm (0.05 in.).[7]

9.3.3 *Means for Cutting and Measuring Test Specimens*, as directed for the procedure selected in Annex A1.

9.3.4 *Means for Abrading Buried Pile Yarn in Solvent—Manual Method:*

9.3.4.1 *16-Mesh Screen*, with rim, approximately 200 mm (8 in.) in diameter.[8]

9.3.4.2 *Shallow Pan*, large enough to hold 16-mesh screen.

9.3.4.3 *Presser*, having a flat, firm surface approximately 38 mm (1.5 in.) wide.

9.3.5 *Means for Abrading Buried Pile Yarn in Solvent—Mechanical Method*:

9.3.5.1 *Container*, polyethylene, approximately 150 mm (6 in.) square at top and 130 mm (5 in.) square at bottom and 180 mm (7 in.) deep.

9.3.5.2 *Wire Mesh Screen Basket*, 16-mesh, approximately 114 mm (4.5 in.) square at top and 100 mm (4 in.) square at bottom and 130 mm (5 in.) deep.

9.3.5.3 *Spacer*, polyethylene ring, approximately 130-mm (5-in.) outside diameter and 50 mm (2 in.) high to fit the bottom of the polyethylene container and support the screen basket.

9.3.5.4 *Laboratory Stirrer.*[9]

9.3.5.5 *Shallow Tray*, of glass or plastic, resistant to solvent.

9.3.6 *Spatula*.

9.3.7 *Tweezers*.

9.3.8 *Laboratory Oven*, set at 105°C (221°F).

9.3.9 *Tea Strainer*, or similar sieve.

9.3.10 *Wire Mesh Screen*, 100-mesh, approximately 100 by 100 mm (4 by 4 in.).

9.3.11 *Gloves*, chemical-resistant.

9.3.12 *Brush*, steel.

9.3.13 *Steam Table*.

9.4 *Reagents*—All technical grade unless otherwise specified.

9.4.1 *Acetone*.

9.4.2 *Ammonium Thiocyanate*, 70.

9.4.3 *γ-Butyrolactone*.

9.4.4 *Chloroform*.

9.4.5 *m-Cresol*, clear.

9.4.6 *Decalin*.

9.4.7 *Dimethylacetamide*.

9.4.8 *Dimethylformamide*.

9.4.9 *Formic Acid*, 90 %.

9.4.10 *Hexafluoroisopropanol*.

9.4.11 *Hydrochloric Acid*, approximately 6 N. Carefully add 1 volume of concentrated hydrochloric acid (sp gr 1.19) to 1 volume of water.

[7] Sunbeam Model 510 Clipmaster with EA-1 SUR bottom blade, or equivalent.

[8] Standard sieve screen, Tyler Screen Scale: 16 mesh, U.S. Standard Sieve Series: 1 mm.

[9] Lightning Mixer Model F, RPM 0-1550, or equivalent, available from Mixing Equipment Co., Rochester, NY.

9.4.12 *Methyl Chloroform*, aerosol grade.

9.4.13 *Methylene Chloride*.

9.4.14 *Phenol*, 88 %.

9.4.15 *Sodium Hydroxide*, 5 ± 0.5. Dissolve the equivalent of 5.0 g of reagent grade NaOH in water and dilute to 100 mL.

9.4.16 *Tetrachloroethane*.

9.4.17 *Tetrahydrofuran*.

9.4.18 *Water*, Type IV grade of reagent water conforming to Specification D 1193D 1193.

9.4.19 *Xylene*, boiling point between 135 and 140°C (275 and 284°F).

9.5 *Safety Precautions*:

9.5.1 The reagents cited in 9.4 can cause damage to health and property if not used with proper precautions. Some are flammable. Some are corrosive. Some are known or suspected to be toxic, carcinogenic, mutagenic, teratogenic, or otherwise harmful to people. Table 2 lists the boiling point, flashpoint, and the 1981 ACGIH Threshold Limit Values for each reagent. The threshold limits are subject to change, and precautions should be adjusted accordingly.

9.5.2 Use hoods, gloves, and safety goggles according to the hazard presented by each reagent.

9.5.3 *It is the responsibility of whoever uses this test method to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.*

9.6 *Conditioning*—Condition the test specimens and strip specimens as directed in Section 6 before measuring and before weighing.

9.7 *Specimens*:

9.7.1 *Test Specimens*:

9.7.1.1 The number and location of the test specimens shall be as directed in Section 5.

NOTE 3—Before selecting test specimens, examine the back of the test sample for signs of variation in the amount of back coating. As far as possible, take test specimens at locations having neither high nor low amounts of back coating.

9.7.1.2 For level pile floor covering, the test specimens shall be at least 254 by 317 mm (10.0 by 12.5 in.).

9.7.1.3 For multilevel pile floor covering, the test specimens shall comprise a full pattern repeat or a whole number multiple of a full pattern repeat in each direction, but no less than as directed in 9.7.1.2. If the pattern repeat is not known and cannot be determined readily, use test specimens at least 457 by 457 mm (18.0 by 18.0 in.) in size.

9.7.2 *Strip Specimens*:

9.7.2.1 Strip specimens shall be 254 mm (10.0 in.) in the lengthwise direction and 64 mm (2.5 in.) in the widthwise direction.

9.7.2.2 Take one strip specimen from each test specimen for routine quality control and acceptance testing.

TABLE 2 Reagent Hazard Characteristics[A]

Reagent			Characteristics				
Common Name	Formal Name[B]	Number[B]	Boiling Point,[C] °C (°F)	Flash Point,[C] °C (°F)	Exposure Limits, TWA[D] ppm	Exposure Limits, TWA[D] mg/m³	Dominant Hazard(s)[E,F,G]
Acetone	2-propanone	67-64-1	56 (133)	–17 (1.4)	1000	2400	e, f
γ Butyrolactone	2(3H)-furanone, dihydro-	96-48-0	204 (399)	98 (209)	...	...	i
Ammonium thiocyanate	thiocyanic acid, ammonium salt	1762-94-4	170 (338) (decomposes)	...(...)	...	...	d
Chloroform	methane, trichloro-	67-66-3	61 (142)	...(...)	10	50	a, c, h, t
m-Cresol	phenol 3-methyl-	108-39-4	202 (396)	86 (187)	5	22	i, k, s
Decalin	naphthalene, deca- hydro-	91-17-8	192 (378)	58 (136)	...	...	i
Dimethylacetamide	acetamide, *N,N*-dimethyl-	127-19-5	166 (331)	70 (158)	10	35	h, s, t
Dimethylformamide	formamide, *N,N*-dimethyl-	68-12-2	153 (307)	58 (136)	10	30	g, i, s, t
Formic acid	formic acid	64-18-6	108 (226)	85 (185)	5	9	i, k
Hexafluoroisopropanol	2-propanol,1,1,1,3,3,3-hexafluoro-	920-66-1	58 (137)	...(...)	...	...	c, vk, m, t
Hydrochloric acid	hydrochloric acid	7647-01-0	109 (228)	...(...)	5	7	i, k
Methyl chloroform	ethane,1,1,1-trichloro-	71-55-6	74 (165)	...(...)	350	1900	a, h
Methylene chloride	methane, dichloro-	75-09-2	40 (104)	...(...)	100	360	a, h, z
Phenol	phenol	108-95-2	182 (359)	79 (174)	5	19	g, i, k, s
Sodium hydroxide	sodium hydroxide	1310-73-2	102 (216)	...(...)	...	2	i, k
Tetrachloroethane	ethane,1,1,2,2-tetrachloro-	79-34-5	146 (295)	...(...)	5	35	a, g, h, s
Tetrahydrofuran	furan, tetrahydro-	109-99-9	66 (151)	–14 (6)	200	590	c, e, f, m, t
Xylene	benzene, dimethyl-	1330-20-7	139 (282)	29 (84)	100	435	f

[A] The information in this table is provided to alert users to the hazards accompanying the use of these reagents. Each user must make his own decisions regarding the kind and extent of risk involved and what protective measures to enforce.

[B] Toxic Substances Control Act Chemical Substance Inventory, Initial Inventory (May 1979), Vol 1.

[C] Approximate values from various sources.

[D] ACGIH-TLVs® Threshold Limit Values for Chemical Substances in Workroom Air adopted by ACGIH for 1981. TWA = time weighted average.

[E] This listing of dominant hazards is indicative, not exhaustive. Suspected as well as confirmed hazards are included in some cases.

[F] Legend:

a = anesthetic, narcotic
c = carcinogenic
d = forms cyanide fumes on decomposition or contact with acids
e = explosive
f = flammable
g = gastrointestinal
h = hepatoxic-liver
i = irritating
k = corrosive
m = mutagenic
s = skin penetrating
t = teratogenic, embryotoxic
v = very
z = carbon monoxide in blood

[G] Sources include: Documentation of the Threshold Limit Values, Fourth Edition 1980, ACGIH, Cincinnati, Ohio.

9.7.2.3 Take two strip specimens from each test specimen for referee testing, and for acceptance testing when the pile yarn mass per unit area is close to a minimum standard to be met or exceeded.

NOTE 4—Two strip specimens may be taken from each test specimen either as a pair at the same time or as directed in 9.7.2.2 on two separate occasions. In the latter case, two sets of analyses are performed but the masses obtained from each set, at each stage of the analysis, are combined as though the two strip specimens had been taken as a pair.

9.8 *Procedure*:

9.8.1 *Preparation of Specimens*—Follow the selected procedure in Annex A1.

9.8.1.1 Combination templates or clicking dies may be used to cut the strip specimens together with the test specimens. When a standard size test specimen template or clicking die is used on multilevel pile floor covering, the template or die may be designed to cut as many strip specimens from the test specimen as possible to provide extra strip specimens, if needed.

9.8.1.2 For floor coverings having gages 8 mm (5⁄16 in.) or greater and essentially straight lengthwise lines of binding sites (less than one-half gage lateral deviation from a straight line), angle the 254-mm (10-in.) specimen dimension approximately 0.24 rad (14°) to the lengthwise direction of the floor covering. The diagonal of the 64 by 254-mm (2.5 by 10.0-in.) specimen has this angle to the 254-mm (10-in.) side.

NOTE 5—With coarse gages and straight lengthwise lines of binding sites it is possible to lose a whole row of tufts by a small lateral shift in the location of the strip specimen location when the long dimension is parallel to the line of binding sites. Angling the strip specimen avoids this problem.

9.8.2 *Equivalent Mass for s Strip Specimens*:

9.8.2.1 Determine the total mass per unit area of each test specimen as directed in Section 7. Convert this to an equivalent mass for *s* strip specimens in grams using Eq 3.

$$E_i = AsW_i/K \quad (3)$$

where:

- i = numerical designation of an individual test specimen (1, 2, . . . n; where n = number of test specimens),
- E_i = equivalent mass of the s strip specimen(s) for the ith test specimen, g,
- A = nominal area of one strip specimen, 16 000 mm^2 (25 in.^{2}),
- s = number of strip specimens taken from each test specimen, 1 or 2,
- W_i = total mass per unit area of the ith test specimen, g/m^2 (oz/yd^2), and
- K = appropriate conversion factor from Table 1, converting g/mm^2 (g/in.^{2}) to the units of W_i.

9.8.2.2 Calculate 1 % limiting values for acceptable masses for *s* strip specimens using Eq 4 and 5.

$$\text{Upper Limit} = 1.01E_i \quad (4)$$

$$\text{Lower Limit} = 0.99E_i \quad (5)$$

9.8.3 *Strip Specimen Selection*—Weigh the strip specimen(s) from each test specimen to the nearest 0.01 g. Select *s* strip specimen(s) from each test specimen whose combined mass is between the upper and lower 1 % limiting values calculated in 9.8.2.2 for that test specimen. Cut additional strip specimens, if necessary. Record the total mass of all selected strip specimens from all test specimens as *M*.

9.8.4 *Stubble Specimens*:

9.8.4.1 Shear the pile yarn on the selected strip specimens down to a stubble of approximately 1.3 mm (0.05 in.), removing and discarding all loose pile fiber.

NOTE 6—In shearing, avoid including in the pile fiber any removed back coating projections and fiber from fiber layers needle-punched into the backing fabric of tufted floor covering. Stop shearing before this occurs even if the pile stubble has not been reduced to 1.3 mm (0.05 in.). In subsequent steps, care must be exercised to keep the layer fiber separate from the pile fiber.

9.8.4.2 Weigh all the stubble specimens from all test specimens together to the nearest 0.01 g and record as the stubble specimen mass, *S*.

NOTE 7—When separate pile yarn mass per unit area estimates are required for individual test specimens, weigh the stubble specimen(s) from each test specimen separately and conduct the subsequent steps of the procedure treating the stubble specimens from each test specimen separately. When individual stubble specimen weighings are required, as for the pile thickness determination on multilevel pile yarn floor covering, add the masses obtained for all stubble specimens together to obtain the value of *S*.

9.8.5 *Separation of Buried Pile Yarn from Backing*—The objective of this operation is to separate the buried pile yarn of each selected stubble specimen from the backing fabric(s) and some of the back coating materials. The steps to be followed will vary with the type of floor covering construction: tufted, woven, or knitted; the type of backing fabric: jute, woven polypropylene, with or without needlepunched fiber, and non-woven polypropylene; and the type of back coating: latex, hot melt, polyurethane, poly(vinyl chloride), and rubber foam. Variations of composition within each type of coating will require variations in treatment, as well. Frequently used procedures are detailed in 9.8.5.1-9.8.5.8.

9.8.5.1 First remove most of any attached cushion manually by slicing with a knife and by abrasion with the steel brush, taking care not to remove pile fiber from the yarn in the backing.

9.8.5.2 Remove the backcoating material as directed in 9.8.5.3 for poly(vinyl chloride) coatings, 9.8.5.4 for hot melt coatings, and 9.8.5.5 for latex coatings. See 9.5 and Table 2 for safety precaution information.

9.8.5.3 *Poly(Vinyl Chloride) Coatings*—Remove poly(vinyl chloride) coatings by placing the stubble specimen in a beaker containing tetrahydrofuran at room temperature. Use a spatula to scrape off the softened PVC coating. Proceed to 9.8.5.8.

9.8.5.4 *Hot Melt Coatings*—Remove hot melt coatings with methyl chloroform; warm as necessary. If there is a secondary backing, proceed to 9.8.5.6, otherwise to 9.8.5.7 and 9.8.5.8.

9.8.5.5 *Latex Coatings*—Soften the latex in latex coated tufted floor covering by placing the stubble specimen in chloroform, methyl chloroform or methylene chloride for approximately 10 min at room temperature. Proceed to 9.8.5.6-9.8.5.8.

NOTE 8—A woven polypropylene primary backing often can be

stripped from the rest of the backing of a tufted floor covering with little or no solvent treatment.

9.8.5.6 Peel the secondary backing from the primary backing, repeating the solvent immersion, if necessary.

9.8.5.7 Scrape buried yarn, together with any coating material adhering to the yarn from the primary backing or the secondary backing, or both, with a spatula. Tweezers may be necessary in some instances.

9.8.5.8 Accumulate the separated buried pile yarn in a beaker and cover it with solvent. Combine the buried yarn from all of the selected stubble specimens for the remaining steps of the procedure.

9.8.6 *Cleaning of Buried Pile Yarn*—Remove the back coating material from the buried pile yarn by immersing the yarn in the solvent and abrading the yarn. Two methods are suggested.

9.8.6.1 *Manual Method*—After 10 to 60-min immersion in solvent, place the buried yarn on the flat 16-mesh screen in the flat tray and abrade the yarn by passing the rubbing with the presser so as to force separated coating particles to pass through the screen while retaining the opened buried yarn fibers on the screen surface.

9.8.6.2 *Mechanical Method*—Place the buried pile yarn in the 16-mesh screen basket and put the basket in the square polyethylene container filled with solvent. Subject the yarn to power stirring for approximately 30 min. The yarn should circulate vertically while stirring. Adjust the amount of yarn per batch as needed to obtain proper circulation.

9.8.6.3 *Other Methods*—As new back coatings are developed, other solvents and methods may be required to remove the bulk of the back coating material from the fiber. The loss in fiber mass shall be less than 0.1 % when the new method is applied to fiber alone, without back coating.

9.8.6.4 Repeat the selected abrasion cleaning process until the buried pile yarn has been separated into individual fibers which are visually clean of coating particles. Periodically transfer the fiber to cleaner solvent with the tea strainer or sieve. Pour the spent solvent through the strainer to catch any fiber remaining and discard the accumulated coating particles, after inspecting to ensure no fiber adheres to them. Use 9.8.6.1 when 9.8.6.2 or 9.8.6.3 does not provide sufficient cleaning. With some coating formulations, rice-like particles will persist even after repeated abradings. When the quantity stabilizes, proceed to the next step.

9.8.6.5 Rinse fiber with solvent and allow most of the solvent to evaporate from the fiber in a hood either at room temperature or on a steam table.

NOTE 9—This step is not necessary if a properly ventilated explosion-proof oven is used for the next step.

9.8.6.6 Place the rinsed fiber (substantially free of solvent) on a heat-resistant surface in an oven at 105°C (221°F) for at least 60 min to complete the solvent vaporization.

9.8.6.7 Check fiber for tackiness and subject the fiber to further abrasive immersion if tackiness is found.

9.8.6.8 Condition tack-free fiber for at least 4 h in the standard atmosphere of Section 6.

9.8.6.9 Weigh conditioned fiber to the nearest 0.01 g and record as buried pile yarn mass, *C*.

9.8.7 *Fiber Dissolving*:

9.8.7.1 Select the appropriate fiber solvent and dissolving conditions from Table 3. Place the cleaned fiber in a beaker and cover with the selected solvent. Follow the specified dissolving conditions. See 9.5 and Table 2 for safety precaution information.

NOTE 10—As new back coatings are used in pile yarn floor covering, it may be necessary to use special techniques involving other reagents to accomplish the final separation of fiber from back coating materials. When this is the case, test to determine whether the fiber-dissolving reagent, as used, dissolves the back coating material appreciably. The loss in back coating mass shall be less than 1 % when the fiber-dissolving solvent is applied to back coating material in the absence of fiber.

TABLE 3 Solvents for Dissolving Pile Fibers[A]

Fiber Type	Solvent	Procedure
Acrylic	70 % ammonium thiocyanate solution	15 min @ boil
	γ-butyrolactone	15 min @ 60°C (140°F)
	dimethylacetamide	15 min @ 25°C (77°F), then bring to boil
	dimethylformamide	15 min @ 25°C (77°F), then bring to boil
Modacrylic	acetone	15 min @ 40 to 50°C (104 to 122°F)
	γ-butyrolactone	15 min @ 25°C (77°F)
	dimethylformamide	15 min @ 25°C (77°F)
Nylon	*m*-cresol	15 min @ 95°C (203°F)
	formic acid, 90 %	15 min @ 25°C (77°F)
	hydrochloric acid, 6*N*	15 min @ 25°C (77°F)
Polyester	*m*-cresol	15 min @ boil
	hexafluoroisopropanol	15 min @ 25°C (77°F)
	equal parts of 88 % phenol and tetrachloroethane	warm to 50°C (122°F), 15 min
Polypropylene	xylene	15 min @ boil
	decalin	15 min @ 135°C (275°F)
Wool	sodium hydroxide, 5 %	15 min @ boil

[A] Different varieties of the generic fiber types may respond differently to the same solvent. The best combination of solvent and dissolving conditions often must be found by trial and error. As new back coatings are developed, new solvents and dissolving conditions may be required to avoid dissolving the back coating while dissolving the fiber.

9.8.7.2 Collect the residue on the 100-mesh screen and rinse with water for aqueous solvents and with acetone for organic solvents.

9.8.7.3 Examine residue for presence of pile fibers and subject the residue to the above dissolving procedure until all sign of fiber is gone.

9.8.7.4 For nonaqueous solvents allow most of the solvent to evaporate from the rinsed residue in a hood, either at room temperature or on a steam table (see Note 9).

9.8.7.5 Place the residue in an oven at 105°C (221°F) for 60 min to remove the remaining solvent.

9.8.7.6 Condition dried residue for at least 4 h in the standard atmosphere as directed in Section 6.

9.8.7.7 Weigh residue to the nearest 0.01 g and record as coating residue, *R*.

9.9 *Calculation*:

9.9.1 Calculate the average pile yarn mass per unit area to the nearest 3 g/m^2 (0.1 oz/yd^2) using Eq 6.

$$P = K(M - S + C - R)/A \quad (6)$$

where:

P = average pile yarn mass per unit area, g/m^2 (oz/yd^2),
K = dimensional conversion factor from Table 1, converting from g/mm^2 (g/in.^{2}) to desired reporting units,
M = total mass of the selected strip specimens from all test specimens, g,
S = total mass of all stubble specimens, g,
C = mass of cleaned buried yarn, g,
R = mass of coating residue, g, and
A = combined measured area of all strip specimens, mm^2 (in.^{2}).

NOTE 11—When separate estimates are required for individual test specimens, record the mass of the strip specimen(s) selected from each test specimen as M_i and obtain values of S_i, C_i and R_i for each test specimen as directed in Note 7. A value of the pile yarn mass per unit area for each test specimen can then be calculated by substituting M_i, S_i, C_i and R_i for *M, S, C* and *R*, respectively, in Eq 6 and using the measured area of the strip specimens of each test specimen for *A*.

9.9.2 An example of a typical calculation is presented in Annex A2.

9.10 *Report*:

9.10.1 State the test sample was tested as directed in Test Methods D 418 for determining pile yarn mass per unit area. Describe the material or product sampled and the method of sampling used. Report the number of strip specimens taken from each test specimen.

9.10.2 Report the average pile yarn mass per unit area.

9.11 *Precision and Bias*:

9.11.1 *Precision*—The precision of the procedure in Test Methods D 418 for determining pile yarn mass per unit area is being established.

9.11.2 *Bias*—The procedure in Test Methods D 418 for determining pile yarn mass per unit area has no known bias and may be used as a referee method.

10. Pile Thickness—Level Pile

10.1 *Scope*—This test method applies only to level pile coated pile yarn floor covering.

10.2 *Summary of Test Method*—The total thickness of an unsheared strip specimen is measured as the distance between two parallel plates exerting a specified pressure on the specimen, *T*. 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 specimen, *B*. The difference ($T - B$) between the two measurements is the pile thickness.

10.3 *Apparatus*:

10.3.1 *Shear or Clipper*, capable of shearing close enough to the backing to leave a stubble of no more than 1.3 mm (0.05 in.),[7]

10.3.2 *Thickness Measuring Instrument*:

10.3.2.1 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 25 mm (1 in.) from the plate.

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

10.3.2.3 Having means for indicating the vertical distance between the presser foot and the plate to the nearest 0.03 mm (0.001 in.), and

10.3.2.4 Capable of developing and indicating a force up to 2.77 N (0.6 lbf) between the presser foot and the plate.[10]

10.4 *Conditioning*—Keep the strip specimens (or the test specimens from which the strip specimens are cut) with the pile free of all contact with other materials for at least 12 h before measuring the thickness.

10.5 *Specimens*:

10.5.1 *Test Specimens*:

10.5.1.1 The number and location of the test specimens shall be as directed in Section 5.

10.5.1.2 The test specimens shall be 254 mm (10.0 in.) in the lengthwise direction by 317 mm (12.5 in.) in the widthwise direction.

10.5.2 *Strip Specimens*—Use only one strip specimen from each test specimen prepared and selected as directed in Section 9.

10.6 *Procedure*:

10.6.1 *Total Thickness*:

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

10.6.1.2 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 then read zero ±0.03 mm (±0.001 in.). If the reading is not within this range, make an adjustment appropriate to the type of instrument being used.

[10] Schiefer Compressometer, available from Frazier Precision Instrument Co. Inc., 210 Oakmont Ave., Gaithersburg, MD 20760, or any of many CRE tensile testing machines for textiles equipped with an appropriate load-measuring mechanism. See Specification D 76, Tensile Testing Machines for Textiles, *Annual Book of ASTM Standards*, Vol 07.01.

10.6.1.3 For each strip specimen, raise the presser foot and center the specimen, pile 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 689 ± 21 Pa (0.100 ± 0.003 psi) is exerted on the specimen. Read the distance between the presser foot and the plate to the nearest 0.03 mm (0.001 in.) and record as the total thickness, *T*.

10.6.2 After measuring the total thickness, shear the pile on each strip specimen down to a stubble measuring approximately 1.3 mm (0.05 in.).

NOTE 12—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 1.3 mm (0.05 in.). 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.

10.6.3 *Backing Thickness*:

10.6.3.1 Attach the 25.40-mm (1.000-in.) 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.

10.6.3.2 Check the instrument zero as directed in 10.6.1.2.

10.6.3.3 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 5170 ± 69 Pa (0.75± 0.01 lbf/in.^{2}) is exerted on the specimen. Read the distance between the presser foot and the plate to the nearest 0.03 mm (0.001 in.) and record as the backing thickness, *B*.

10.7 *Calculation*:

10.7.1 For each strip specimen calculate the pile thickness using Eq 7.

$$P = T - B \tag{7}$$

where:

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

10.7.2 Average the values of P obtained for all strip specimens taken from the test sample and record to the nearest 0.3 mm (0.01 in.).

10.8 *Report*:

10.8.1 State the test sample was tested as directed in Test Methods D 418 for determining the pile thickness of level pile floor covering. Describe the material or product sampled and the method of sampling used.

10.8.2 Report the average pile thickness.

10.9 *Precision and Bias*:

10.9.1 *Precision*—The precision of the procedure in Test Methods D 418 for determining the pile thickness of level pile floor covering is being established.

10.9.2 *Bias*—The procedure in Methods D 418 for determining the pile thickness of level pile floor covering has no known bias and may be used as a referee method.

11. Pile Thickness—Multilevel Pile

11.1 *Scope*—This test method applies only to multilevel pile coated pile yarn floor covering.

11.2 *Summary of Test Method*—The thickness and mass are measured on each selected strip specimen in the unsheared condition and after removing approximately 25, 50, 75 % and all of the pile down to a stubble by shearing. Net pile thicknesses at the 25, 50, and 75 % levels are calculated by subtracting the stubble specimen thickness from the thicknesses measured at each of the other stages. Net pile masses are calculated by subtracting the mass of the stubble specimen from the four other weighings. The 25, 50, and 75 % net masses are expressed as a percent of the net pile mass of the unsheared specimen and the 25, 50, and 75 % net thicknesses are plotted against these net mass percentages. A smooth curve is drawn through the three plotted points. The net pile thickness corresponding to 50 % net mass is read from the smooth curve and doubled to obtain the average pile thickness.

11.3 *Apparatus*:

11.3.1 *Balance*, capable of weighing to the nearest 0.01 g.

11.3.2 *Shear or Clipper*, capable of shearing close enough to the backing so as to leave a stubble of no more than 1.3 mm (0.05 in.).[7,11]

11.3.3 *Means for Adjusting the Height of the Shear*, such as shims or mechanical mount for shearing head.[11]

11.3.4 *Thickness Measuring Instrument*—As specified in 10.3.2.

11.3.5 *Graph Paper*, with 2-mm (0.1-in.) divisions.

11.3.6 *Drafting Curves*, such as set of French curves or flexible curve.[12]

11.4 *Conditioning*—Condition the strip specimens as directed in Section 6 before testing, with the pile free of all contact with other materials.

11.5 *Sample and Specimens*:

11.5.1 *Test Specimens*:

11.5.1.1 The number and location of the test specimens shall be as directed in Section 5.

11.5.1.2 The test specimens shall comprise a full pattern repeat or a whole number multiple of a full pattern repeat in each direction but no less than 254 mm (10.0 in.) in the lengthwise direction by 317 mm (12.5 in.) in the widthwise direction. If the pattern repeat is not known and cannot be determined readily, use 457 by 457 mm (18.0 by 18.0 in.) for the test specimen dimensions.

11.5.2 *Strip Specimens*—Obtain two strip specimens from each test specimen as directed in 9.7, 9.8.1, 9.8.2, and 9.8.3. Determine the total mass of all the strip specimens to the nearest 0.01 g and record as M_0, where the subscript zero indicates the strip specimens are unsheared.

11.6 *Procedure*:

11.6.1 *Total Thickness*—Measure the total thickness of each strip specimen as directed in 10.6.1 at three-high pile locations along the length of the strip specimen. Average the thickness values found for all strip specimens and record the average as T_0 to the nearest 0.03 mm (0.001 in.).

11.6.2 *Estimation of Shearing Levels*:

11.6.2.1 Obtain an approximate value of h, the stubble specimen thickness, from prior measurements of similar materials or by shearing a strip specimen from the same material. Subtract h from the average of the thickness measurement values T_0 to get z, the approximate total pile thickness.

[11] B & J Machinery Company FHA Shearing Machine, or equivalent.
[12] Keuffel & Esser Co. 1864-60 will fit most plots.