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Standard Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Martindale Tester¹

This standard is issued under the fixed designation D 4970; 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.

^{ε1}Note—Footnote 3 was editorially corrected in August 2007.

1. Scope

1.1 This test method covers the determination of the resistance to the formation of pills and other related surface changes on textile fabrics using the Martindale tester. The procedure generally is applicable to all types of fabrics, being particularly suitable for woven fabrics.

NOTE 1—For other methods, if testing the pilling resistance of textiles, refer to Test Methods D 3511, D 3512, and D 3514.

1.2 This test method is not suitable for fabrics thicker than 3 mm (0.125 in.) because such fabrics cannot be mounted in the specimen holder.

1.3 The fabric may be laundered or dry cleaned before testing.

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

1.5 *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

D 123 Terminology Relating to Textiles

D 2514 Discontinued 1977; Tolerances for Fabrics Woven from All-Cotton or from Cotton Man-Made Fiber Blends

D 3511 Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Brush Pilling Tester

D 3512 Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Random Tumble Pilling Tester

Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Random Tumble Pilling Tester

D 4850 Terminology Relating to Fabric

D 7018 Terminology Relating to Glass Fiber and Its Products

3. Terminology

~~3.1 Definitions—For definitions of other textile terms used in this test method, refer to Terminology D 123.~~

~~3.2 Description of Terms Specific to This Standard:~~

~~3.2.1 cycle, *n*—in the Martindale tester, the sixteen movements required to complete one Lissajous figure.~~

~~3.2.2 fuzz, *n*—untangled fiber ends that protrude from the surface of a yarn or fabric.~~

~~3.2.3 movement, *n*—one rotation of the outer gearing of the Martindale tester.~~

~~3.2.4 pilling resistance, *n*—resistance to formation of pills on the surface of a textile fabric.~~

~~3.2.5 pills, *n*—bunches or balls of tangled fibers, which are held to the surface of a fabric by one or more fibers.~~

3.1 For all terminology relating to D 13.59, Fabric Test Methods, General, refer to Terminologies D 4850 and D 7018.

3.1.1 The following terms are relevant to this standard: cycle, fuzz, movement, pilling resistance, pills.

3.2 For all other terms related to textiles, refer to Terminology D 123.

¹ This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.60 on Fabric Test Methods, Specific. Current edition approved July-Dec. 1, 2007. Published August 2007-January 2008. Originally approved in 1999. Last previous edition approved in 2005 as D 4970 – 057.

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.

4. Summary of Test Method

4.1 Pilling and other changes in the surface appearance, such as fuzzing, that occur in normal wear are simulated on a laboratory testing machine. Fabrics are mounted on the Martindale Tester, and the face of the test specimen is rubbed against the face of the same mounted fabric in the form of a geometric figure, that is, a straight line, which becomes a gradually widening ellipse, until it forms another straight line in the opposite direction and traces the same figure again under light pressure for a specific number of movements. The degree of fabric pilling or surface appearance change produced by this action is evaluated by comparison of the tested specimen with visual standards that may be actual fabrics, or photographs of fabrics, showing a range of pilling resistance. The observed resistance to pilling is reported using an arbitrary rating scale.

5. Significance and Use

5.1 *Acceptance Testing*—This method of testing fabrics resistance to pilling is not recommended for acceptance testing. If it is used for acceptance testing, it should be used with caution because interlaboratory data are not available. In some cases the purchaser or supplier may have to test a commercial shipment of one or more specific materials by the best available method even though the method has not been recommended for acceptance testing. Although this test method is not recommended for acceptance testing, it is useful because it is used widely outside the United States.



FIG. 1 Martindale Abrasion Tester

5.2 If there is a disagreement arising from differences in values reported by the purchaser and the supplier when using this test method, the statistical bias, if any, between the laboratory of the purchaser and the laboratory of the supplier should be determined



FIG. 2 Apparatus for Fabric Evaluation

with comparison being based on testing specimens randomly drawn from one sample of material of the type being evaluated. Competent statistical assistance is recommended for the investigation of bias. A minimum of two parties should take a group of test specimens, which are as homogeneous as possible and which are from a lot of material of the type in question. The test specimens then should be assigned randomly in equal numbers to each laboratory for testing. The average test results from the two laboratories should be compared using an acceptable statistical protocol and probability level chosen by the two parties before the testing is started. Appropriate statistical disciplines for comparing data must be used when the purchaser and supplier cannot agree. If a bias is found, either its cause must be found and corrected, or the purchaser and the supplier must agree to interpret future results with consideration for the known bias.

5.3 The pilling of textile fabrics is a very complex property because it is affected by many factors that include: type of fiber or blends, fiber dimensions, yarn and fabric construction, and fabric finishing treatments. The pilling resistance of a specific fabric in actual wear varies more with general conditions of use and individual wearers than in replicate fabric specimens subjected to controlled laboratory tests. This experience should be borne in mind when adopting levels of acceptability for a series of standards.

5.4 Finishes and fabric surface changes may exert a large effect on pilling. It is recommended that fabrics be tested after laundering or drycleaning, or both. Testing before refurbishing also may be advisable. Prior agreement between interested parties should determine the state of the test.

5.5 Pills vary appreciably in size and appearance and depend on the presence of lint and degree of color contrast. These factors are not evaluated when pilling is rated solely on the number of pills. The development of pills may be accompanied by other surface phenomena, such as loss of cover, color change, or the development of fuzz. Since the overall acceptability of a specific fabric is dependent on both the characteristics of the pills and the other factors affecting the surface appearance, it is suggested that fabrics tested in the laboratory be evaluated subjectively with regard to their acceptability and not rated solely on the number of pills developed. A series of standards, based on graduated degrees of surface change of the fabric type being tested, may be set up to provide a basis for subjective ratings. The visual standards are most advantageous when the laboratory test specimens correlate closely in appearance with worn fabrics and show a similar ratio of pills to fuzz. Counting the pills and weighing their number with respect to their size and contrast, as a combined measure of pilling resistance, is not recommended because of the excessive time required for counting, sizing, and calculation.

5.6 The degree of fabric pilling is evaluated by comparing the tested specimens with visual standards, which may be actual fabrics or photographs of fabrics, showing a range of pilling resistance. The observed resistance to pilling is reported on an arbitrary scale ranging from 5 to 1 (no pilling to very severe pilling).

5.7 This test method is applicable to a wide variety of woven and knitted fabrics that vary in pilling propensity as a result of variations in fiber, yarn and fabric structure, and finish. The applicability of this test method to nonwoven fabrics has not been determined.

6. Apparatus and Materials

6.1 *Martindale Tester*³ (see Fig. 1).

6.2 *Standard Felt*, of mass $750 \pm 50 \text{ g/m}^2$ ($22 \pm 1.5 \text{ oz/yd}^2$) and $3 \pm 0.3 \text{ mm}$ ($0.12 \pm 0.01 \text{ in.}$) thick.

6.3 *Polyurethane Foam Backing*³, $0.12 \pm 0.04 \text{ in.}$ ($3 \pm 0.01 \text{ mm}$) thick, 1.94 lbf/ft^3 ($29 \text{ to } 31 \text{ kg/m}^3$) density, and 38.23 to 47.22 lbf ($170 \text{ to } 210 \text{ N}$) hardness.

6.4 *Apparatus for Fabric Evaluation* — Facilities for illumination (cool white fluorescent tube) and simultaneous viewing test specimens and fabric or photographic rating standards. Apparatus and options for visual evaluation are listed in Table 1.

6.4

6.5 *Standard In-House Pilling Test Fabric*, having an established pilling resistance rating for checking machine performance. No universal standard fabric is available. Each test facility must decide on an appropriate fabric.

³ Apparatus and accessories are available commercially.

TABLE 1 Viewing Apparatus and Options

Apparatus	Specimen Preparation
ASTM Lightbox (Fig. 2) ^A	0.78 rad (45°)
Lightbox ^B	0.78 rad (45°)
Lightbox ^B	flat
Lightbox ^B	critical angle
As determined by the buyer and supplier	

^AThe source of supply of the apparatus known to the committee at this time is Standard Scientific Supply Co., 601 West Market Street, Bethlehem, PA 18018–5208. If you are aware of alternate suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

^BAvailable commercially.