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

This standard is issued under the fixed designation D 3512; 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—Editorial changes were made in August 2007

1. Scope

1.1 This test method covers the resistance to the formation of pills and other related surface changes on textile fabrics using the random tumble pilling tester. The procedure is generally applicable to all types of woven and knitted apparel fabrics.

NOTE 1—For other test methods for the pilling resistance of textiles, refer to Test Methods D 3511, D 3514, and D 4970.

1.2 Some fabrics that have been treated with a silicone resin may not be satisfactorily tested by this procedure because the silicone resin may transfer onto the cork liners in the test chamber and cause erroneous results.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as the standard. Within the text, the inch-pound units are to be regarded as the standard. Within the text, the inch-pound units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

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

D 123 Terminology Relating to Textiles

D 1776 Practice for Conditioning and Testing Textiles

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

D 3514 Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Elastomeric Pad

D 4850 Terminology Relating to Fabric

D 4970 Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Martindale Tester⁷

E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions

2.2 ASTM Adjuncts:

12-435120-00 Set of 5 Photographic Standards for Random Tumble Pilling Test³

3. Terminology

3.1 Definitions:

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

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

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

3.1.4 For definitions of other textile terms used in this test method, refer to Terminology D 123.

3.1 For all terminology related to D 13.59, Fabric Test Methods, General, see Terminology D 4850.

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

3.2 For all other terminology related to textiles, see 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 1976. Last previous edition approved in 2005/2007 as D 3512 - 05(2007)^{ε1}.

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 Available from ASTM International Headquarters. Order Adjunct No. ADJD3512.

4. Summary of Test Method

4.1 Pilling and other changes in surface appearance, such as fuzzing, that occur in normal wear are simulated on a laboratory testing machine. Pills are caused to form on fabric by a random rubbing action produced by tumbling specimens in a cylindrical test chamber lined with a mildly abrasive material. To form pills with appearance and structure that resemble those produced in actual wear, small amounts of short-length gray cotton fiber are added to each test chamber with the specimens. The degree of fabric pilling is evaluated by comparison of the tested specimens 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 for resistance to pilling is not recommended for acceptance testing. If it is used for acceptance testing, it should be used with caution because the between-laboratory precision is poor. In some cases the purchaser and the supplier may have to test a commercial shipment of one or more specific materials by the best available test method, even though the test method is not recommended for acceptance testing.

5.1.1 If there are differences or 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, the test samples should be used that are as homogeneous as possible, drawn from the material from which the disparate test results were obtained, and randomly assigned in equal numbers to each laboratory for testing. Other materials with established test values may be used for this purpose. The test results from the two laboratories should be compared using a statistical test for unpaired data, at a probability level chosen prior to the testing series. If a bias is found, either its cause must be found and corrected, or future test results must be adjusted in consideration of the known bias.

5.2 The pilling of textile fabrics is a very complex property because it is affected by many factors which may include type of fiber or blends, fiber dimensions, yarn and fabric construction, fabric finishing treatments and refurbishing method. Testing before refurbishing may be advisable. 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 any series of standards.

5.3 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 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 calculating.

5.4 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 (no pilling) to 1 (very severe pilling).

5.5 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.

6. Apparatus and Materials

6.1 *Random Tumble Pilling Tester*⁴ (Fig. 1):

6.1.1 *Cork Cylinder Liners*, about 146 mm (5.75 in.) wide by 452 mm (17.81 in) long cut from 1.5-mm (.063-in.) thick flat sheets of Type P2117A material conforming to Classification System F104, Appendix X2. The original surface of the liner, produced by slicing the material, should be used without any further treatment such as sanding. Store liners in original packaging in a cool, dry place.

6.1.2 *Air Injection Device* to give 14-21 kPa (2-3 psi) air pressure in each test chamber, either included in new testers or a modification to older testers.

6.2 *Adhesive*⁴, white all-purpose, for sealing edges of specimens (see 7.1).

6.3 *Plastic Bottle*, with dispensing spout and cap, for use with diluted adhesive.

6.4 *Vacuum Cleaner*, home canister type, to clean specimens after testing.

6.5 *Cotton Sliver*,⁵ 4301 tex, fine American Upland, or equivalent, for improving visibility of pills on specimens.

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

⁴ Apparatus and accessories are commercially available.

⁵ Cotton dyed to a medium gray shade before carding using a colorfast reactive black dye and standard reactive dyeing procedure. Cotton sliver is available commercially.



FIG. 1 Random Tumble Piling Tester

<https://standards.iteh.ai/catalog/standards/sist/aac06424-465a-474e-a11f-5a86c00b41cc/astm-d3512-07>

TABLE 1 Viewing Apparatus and Options

Apparatus	Specimen Preparation
ASTM Lightbox (Fig. 1) ^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.

6.7 *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.

6.8 *Rating Standards:*

6.8.1 *Fabric*—A series of tested specimens of a specific fabric type which shows degree of pilling or other distortion, or both, for each type of fabric to be tested. Store the fabric rating standards and handle them under conditions that will preserve their original form and appearance.

6.8.2 *Photographic*— A set of five photographs, 105-mm square (4.13 in.), numbered 1 to 5 illustrating varying degrees of pilling from “very severe pilling” to “no pilling” such as Adjunct D 3512.³The photos should have a dull matte finish and be of the same size as the tested specimen.

6.9 *Facilities for Laundering Samples* —If needed.