Designation: D4966 – 12$^{\varepsilon 1}$

StandardTest Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)[1]

This standard is issued under the fixed designation D4966; 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.

ε[1] NOTE—In Section 10.6, the referenced paragraphs for Options 1 and 2 were corrected to 11.1 and 11.2 in February 2013.

1. Scope

1.1 This test method covers the determination of the abrasion resistance of textile fabrics using the Martindale abrasion tester. Fabrics of all types may be tested by this method but difficulties may arise with fabrics with a pile depth greater than 0.08 in. (2 mm).

1.2 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.

1.3 *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.*

NOTE 1—For other current test methods of testing the abrasion resistance of textiles refer to Test Methods D3884, D3885, D3886, D4157, D4158, and AATCC Test Method 93.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

D1776 Practice for Conditioning and Testing Textiles

D3884 Guide for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)

D3885 Test Method for Abrasion Resistance of Textile Fabrics (Flexing and Abrasion Method)

D3886 Test Method for Abrasion Resistance of Textile Fabrics (Inflated Diaphragm Apparatus)

D4157 Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)

D4158 Guide for Abrasion Resistance of Textile Fabrics (Uniform Abrasion)

D4850 Terminology Relating to Fabrics and Fabric Test Methods

2.2 *AATCC Methods and Procedures:*

Evaluation Procedure 1 Gray Scale for Color Change[3]

Test Method 93 Abrasion Resistance of Fabrics: Accelerator Method[3]

3. Terminology

3.1 For all terminology relating to D13.60, Fabric Test Methods, Specific, refer to Terminology D4850.

3.1.1 The following terms are relevant to this standard: abrasion, abrasion cycle, Lissajous figure, rub, standard atmosphere for preconditioning textiles, standard atmosphere for testing, in textiles.

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

4. Summary of Test Method

4.1 Abrasion resistance is measured by subjecting the specimen to rubbing motion 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 known conditions of pressure and abrasive action. Resistance to abrasion is evaluated by various means which are described in Section 11.

5. Significance and Use

5.1 *Acceptance Testing*—this test method is not considered satisfactory for acceptance testing of commercial shipments of fabric. The between-laboratory precision of this test method is poor and, because of the nature of abrasion testing itself, technicians frequently fail to obtain results in agreement on the

[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.

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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] Available from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

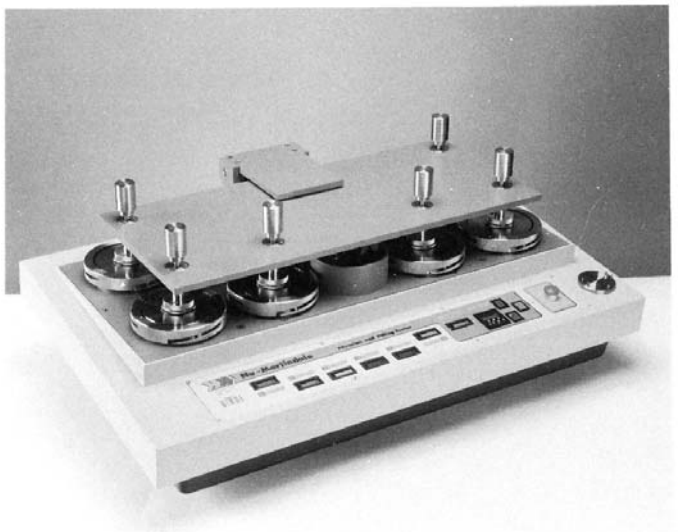

FIG. 1 Martindale Abrasion Tester

same type of testing instrument, both within and between laboratories. Although this test method is not recommended for acceptance testing, it is useful because it is used widely, especially outside the United States.

5.1.1 In case of a dispute arising from differences in reported test results when using this test method for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that 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 results from the two laboratories should be compared using Students t-test for unpaired data and an acceptable probability level chosen by the two parties before the testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results in light of the known bias.

5.2 The resistance to abrasion also is affected greatly by the conditions of the tests, such as the nature of abradant; variable action of the abradant over the area of specimen abraded, the tension on the specimen, the pressure between the specimen and abradant, and the dimensional changes in the specimen.

5.3 Abrasion tests are all subject to variation due to changes in the abradant during specific tests. The abradant must be changed accordingly at frequent intervals or checked periodically against a standard. With disposable abradants, the abradant is used only once or changed after limited use. With permanent abradants that use hardened metal or equivalent surfaces, it is assumed that the abradant will not change appreciably in a specific series of tests, but obviously similar abradants used in different laboratories will not likely change at the same rate due to differences in usage. Permanent abradants also may change due to pick up of finishing or other material from test fabrics and must accordingly be cleaned at frequent intervals. The measurement of the relative amount of abrasion also may be affected by the method of evaluation and may be influenced by the judgment of the operator.

5.4 The resistance of textile materials to abrasion as measured on a testing machine in the laboratory is generally only one of several factors contributing to wear performance or durability as experienced in the actual use of the material. While “abrasion resistance” (often stated in terms of the number of cycles on a specified machine, using a specified technique to produce a specified degree or amount of abrasion) and “durability” (defined as the ability to withstand deterioration or wearing out in use, including the effects of abrasion) frequently are related, the relationship varies with different end uses, and different factors may be necessary in any calculation of predicted durability from specific abrasion data.

5.4.1 Laboratory tests may be reliable as an indication of relative end-use performance in cases where the difference in abrasion resistance of various materials is large, but they should not be relied upon where differences in laboratory test findings are small. In general, they should not be relied upon for prediction of actual wear-life in specific-end uses unless there are data showing the specific relationship between laboratory abrasion tests and actual wear in the intended end-use.

5.5 These general observations apply to all types of fabrics, including woven, nonwoven, and knit apparel fabrics, household fabrics, industrial fabrics, and floor coverings. It is not surprising, therefore, to find that there are many different types of abrasion testing machines, abradants, testing conditions, testing procedures, methods of evaluation of abrasion resistance, and interpretation of results.

5.6 All the test methods and instruments so far developed for abrasion resistance may show a high degree of variability in results obtained by different operators and in different laboratories; however, they represent the methods now most widely in use.

5.7 Since there is a definite need for measuring the relative resistance to abrasion, standardized test methods are desirable and useful and may clarify the problem and lessen the confusion.

6. Apparatus and Materials

6.1 *Martindale Abrasion Tester,*[4](Fig. 1) with the following replaceable items:

6.1.1 *Standard Abradant Fabric,* a plain weave, crossbred, worsted wool fabric described in the finished state as in Table 1.

6.1.2 *Standard Felt,* of mass 22 ± 1.5 oz/yd^2 (750 ± 50 g/m^2) and 0.12 ± 0.01 in. (3 ± 0.3 mm) thick.

6.1.3 *Polyurethane Foam Backing,* 0.12 ± 0.04 in. (3 ± 0.01 mm) thick, 1.94 lbf/ft^3 (29 to 31 kg/m^3) density, and 38.23 to 47.22 lbf (170 to 210 N) hardness.

6.1.4 *Fabric Punches or Press Cutters,*[4]1.5 in. (38 mm) and 5.5 in. (140 mm) in diameter.

6.1.5 *AATCC Gray Scale for Color Change.*[3]

[4] Apparatus and accessories are commercially available.