



Designation: D 4966 – 98 (Reapproved 2004)

Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)¹

This standard is issued under the fixed designation D 4966; 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 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 in SI units are provided as information only.

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 D 3884, D 3885, D 3886, D 4157, D 4158, and AATCC Test Method 93.

2. Referenced Documents

2.1 ASTM Standards:²

- D 123 Terminology Relating to Textiles
- D 1776 Practice for Conditioning Textiles for Testing
- D 3884 Test Method for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
- D 3885 Test Method for Abrasion Resistance of Textile Fabrics (Flexing and Abrasion Method)
- D 3886 Test Method for Abrasion Resistance of Textile Fabrics (Inflated Diaphragm Method)
- D 4157 Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)
- D 4158 Test Method for Abrasion Resistance of Textile Fabrics (Uniform Abrasion Method)

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.

2.2 AATCC Methods and Procedures:

Evaluation Procedure 1 Gray Scale for Color Change³
Test Method 93 Abrasion Resistance of Fabrics: Accelerator Method³

3. Terminology

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

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *abrasion, n*—the wearing away of any part of a material by rubbing against another surface.

3.2.2 *abrasion cycle, n*—total number of movements required to complete a geometric shape in a Martindale abrasion tester.

3.2.3 *cycle, n*—16 movements required for the completion of one Lissajous figure on a Martindale tester.

3.2.4 *lissajous figure, n*—a geometric figure that starts as a straight line, then becomes a widening ellipse and narrows to again become a straight line. There are 16 movements in one Lissajous figure.

3.2.5 *movement, n*—one rotation of the two outer gearing of the Martindale tester.

3.2.6 *standard atmosphere for preconditioning textiles, n*—an atmosphere having a relative humidity of 10 to 25 % and a temperature not over 122°F (50°C).

3.2.7 *standard atmosphere for testing, in textiles, n*—an atmosphere for testing in which the air is maintained at a relative humidity of 65 ± 2 % and at a temperature of 70 ± 2°F (21 ± 1°C).

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.

³ Available from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

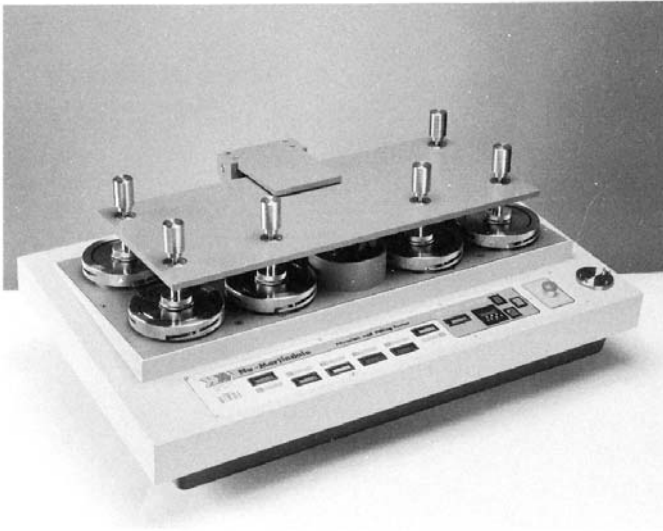


FIG. 1 Martindale Abrasion Tester

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 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 Student's *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 abrasant; variable action of the abrasant over the area of specimen abraded, the tension on the specimen, the pressure between the specimen and abrasant, and the dimensional changes in the specimen.

5.3 Abrasion tests are all subject to variation due to changes in the abrasant during specific tests. The abrasant must be changed accordingly at frequent intervals or checked periodically against a standard. With disposable abrasants, the abrasant is used only once or changed after limited use. With permanent abrasants that use hardened metal or equivalent

surfaces, it is assumed that the abrasant will not change appreciably in a specific series of tests, but obviously similar abrasants used in different laboratories will not likely change at the same rate due to differences in usage. Permanent abrasants 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, abrasants, 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*,⁴ a plain weave, crossbred, worsted wool fabric described in the finished state as in Table 1.

6.1.2 *Standard Felt*,⁴ of mass 22 ± 1.5 oz/yd² (750 ± 50 g/m²) and 0.12 ± 0.01 in. (3 ± 0.3 mm) thick.

⁴ Commercially available from Ahiba, 2175 Hawkins St., Charlotte, NC 28203.