Designation: D3886 – 99(Reapproved 2011)$^{\varepsilon 1}$

Standard Test Method for Abrasion Resistance of Textile Fabrics (Inflated Diaphragm Apparatus)[1]

This standard is issued under the fixed designation D3886; 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—The Terminology section was updated in June 2011.

1. Scope

1.1 This test method[2] covers the determination of the resistance to abrasion of woven and knitted textile fabrics, both conditioned and wet, using the inflated diaphragm tester. This procedure is not applicable to floor coverings.

NOTE 1—Other procedures for measuring the abrasion resistance of textile fabrics are given in Test Methods D3884, D3885, D1175 and AATCC Test Method 93.

1.2 The values stated in SI units are to be regarded as standard; the values in English units are provided as information only and are not exact equivalents.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D123 Terminology Relating to Textiles
D1175 Method of Test for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder and Uniform Abrasion); Replaced by D 4157, D 4158 (Withdrawn 1981)[4]
D1776 Practice for Conditioning and Testing Textiles
D2904 Practice for Interlaboratory Testing of a Textile Test Method that Produces Normally Distributed Data (Withdrawn 2008)[4]
D2906 Practice for Statements on Precision and Bias for Textiles (Withdrawn 2008)[4]
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)
D4850 Terminology Relating to Fabrics and Fabric Test Methods

2.2 *AATCC Standard:*

Test Method 93 Abrasion Resistance of Fabrics: Accelerator Method[5]

3. Terminology

3.1 For all terminology related to D13.60, Fabric Test Methods, Specific, see Terminology D4850.

3.2 The following term is relevant to this standard: abrasion.

3.3 For definitions of all other textile terms see Terminology D123.

4. Summary of Test Method

4.1 A specimen is abraded by rubbing either unidirectionally or multidirectionally against an abradant having specified surface characteristics. A specimen is held in a fixed position and supported by an inflated rubber diaphragm which is held under constant pressure. A specimen is abraded by rubbing either unidirectionally or multidirectionally against an abradant having specified surface characteristics. The resistance to abrasion is determined using Option 1, the number of cycles to wear a hole in the specimen, or Option 2, visual assessment of the specimen surface after a specified number of cycles.

5. Significance and Use

5.1 The measurement of the resistance to abrasion of textile and other materials is very complex. The resistance to abrasion is affected by many factors, such as the inherent mechanical properties of the fibers; the dimensions of the fibers; 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] This test method is based upon the development described by R. G. Stoll, in "Improved Multipurpose Abrasion Test and Its Application for the Wear Resistance of Textiles," *Textile Research Journal* , July 1949, p. 394.

[3] 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] The last approved version of this historical standard is referenced on www.astm.org.

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

structure of the yarns; the construction of the fabrics; and the type, kind, and amount of finishing material added to the fibers, yarns, or fabric.

5.2 The resistance to abrasion is also greatly affected 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 of the specimen, the pressure between the specimen and abradant, and the dimensional changes in the specimens.

5.3 Abrasion tests are all subject to variation due to changes in the abradant during specific tests. The abradant must accordingly be discarded at frequent intervals or checked periodically against a standard. With disposable abradants, the abradant is used only once or discarded 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. Similar abradants used in different laboratories will not change at the same rate, due to differences in usage. Permanent abradants may also 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 may also be affected by the method of evaluation and may be influenced by the judgment of the operator.

frequently related, the relationship varies with different end uses, and different factors may be necessary in any calculation of predicted durability from specific abrasion data. 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 measuring abrasion resistance may show a high degree of variability in results obtained by different operators and in different laboratories; however, they represent the test methods now most widely in use.

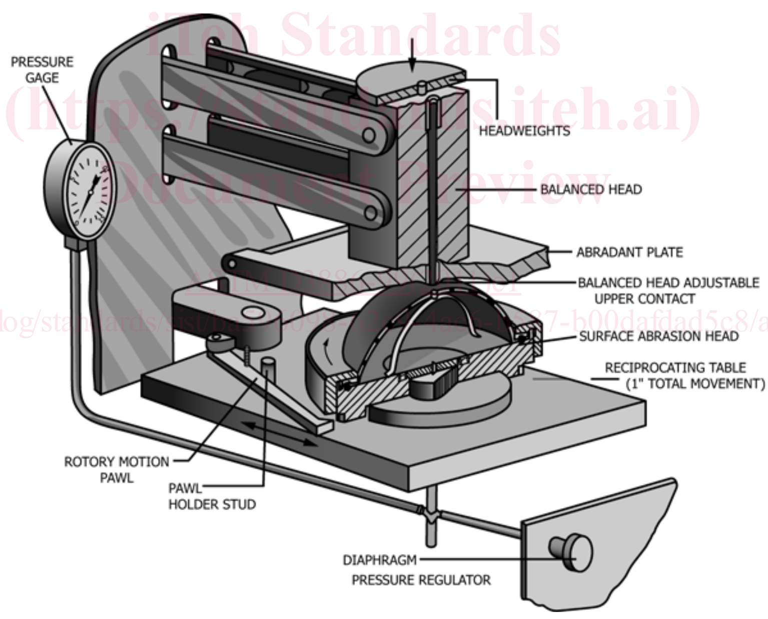

FIG. 1 Schematic Diagram of Inflated Diaphragm Abrasion Tester

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) are

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

5.8 Because of the conditions mentioned above, technicians frequently fail to get good agreement between results obtained on the same type of testing instrument both within and between laboratories, and the precision of these test methods is uncertain.

5.9 Test Method D3886 is not recommended for acceptance testing of commercial shipment because of the poor between-laboratory precision.

5.9.1 In cases 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 which are as homogeneous as possible and which are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using appropriate statistical analysis for unpaired data and an acceptable probability level chosen by the two parties before the testing begins. 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 the light of the known bias.

6. Apparatus

6.1 *Inflated Diaphragm Abrasion Tester*[6], shown in Fig. 1 and Fig. 2 with the following essential parts:

6.1.1 *Surface Abrasion Head*—The specimen is mounted in a circular clamp over a rubber diaphragm by means of a clamping ring and a tightening collar. The circular opening of the clamping ring is 94.0 ± 1.3 mm (3.70 ± 0.05 in.) in diameter and that of the collar 95.3 mm (3.75 in.) or more. The height from the surface of the clamped-in specimen to the upper edge of the tightening collar shall not exceed 9.5 mm (3⁄8 in.). The clamping area of the body of the clamp and the ring should have gripping surfaces to prevent slipping of the specimen and leakage of air pressure during the test. Means should be provided for supplying air pressure to the body of the clamp so that the pressure under the diaphragm can be controlled between 0 and 41 kPa (0 and 6 psi) with an accuracy of ±5 % of range.

6.1.2 *Diaphragm*—The rubber diaphragm should be 1.40 ± 0.25 mm (0.055 ± 0.010 in.) in thickness. A metallic contact pin 3.2 mm (1⁄8 in.) in diameter is sealed into the center of the diaphragm flush with the diaphragm surface. Provision should be made for a flexible electrical connection from this contact pin to the ground of the machine. The strain distribution on the diaphragm must be uniform so that when inflated without the specimen, it assumes the shape of a section of a sphere. Pressure can be controlled from 0 to 41 kPa (0 to 6 psi).

6.1.3 *Driving Mechanism*—The design of the driving mechanism is such that the circular clamp makes a reciprocal motion of 115 ± 15 double strokes per minute of 25-mm (1-in.) stroke length. Provision shall be made for rotation of the

[6] Apparatus is available commercially.

FIG. 2 One Type of Commercial Inflated Diaphragm Abrasion Tester