INTERNATIONAL

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Standard Test Method for Abrasion Resistance of Textile Fabrics (Flexing and Abrasion Method)[1]

This standard is issued under the fixed designation D 3885; 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[2] covers the determination of the abrasion resistance of woven or nonwoven textile fabrics using the flexing and abrasion tester.

1.2 This test method applies to most woven and nonwoven fabrics providing they do not stretch excessively. It is not applicable to floor coverings.

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 shown in parentheses. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with this test method.

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.*

NOTE 1—For other test methods for abrasion resistance of textiles refer to Test Methods D 3884, D 3886, D 4157, D 4158, D 4966, and AATCC93.

2. Referenced Documents

2.1 *ASTM Standards:* [3]

D 76 Specification for Tensile Testing Machines for Textiles
D 123 Terminology Relating to Textiles
D 1776 Practice for Conditioning and Testing Textiles
D 2904 Practice for Interlaboratory Testing of a Textile Test Method that Produces Normally Distributed Data
D 2906 Practice for Statements on Precision and Bias for Textiles
D 3884 Guide for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
D 3886 Test Method for Abrasion Resistance of Textile Fabrics (Inflated Diaphragm Apparatus)
D 4157 Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)
D 4158 Guide for Abrasion Resistance of Textile Fabrics (Uniform Abrasion)
D 4850 Terminology Relating to Fabric
D 4966 Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)
D 5035 Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)

2.2 *AATCC Test Method:*

AATCC 93 Abrasion Resistance of Fabrics: Accelerotor Method[4]

3. Terminology

~~3.1*Definitions:*~~

~~3.1.1*abrasion*, *n*—the wearing away of any part of a material by rubbing against another surface.~~

~~3.1.2*abrasion cycle*, *n*—one complete movement across the surface of a textile.~~

~~3.1.2.1*Discussion*—The complete movement for an abrasion cycle is dependent on the action of the abrasion machine and the test method used. It may consist of one back-and-forth unidirectional movement or one circular movement, or a combination of~~

[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 Stoll, R.G.," Improved Multipurpose Abrasion Tester and its Application for the Evaluation of 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] Available from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

~~both. For the flexing and abrasion method it is commonly called a double stroke as defined in 3.1.4.~~

~~3.1.3*breaking force*, *n*—the maximum force applied to a material carried to rupture. (Compare *breaking point, breaking strength*.)~~

~~3.1.4*double-stroke*, *n— in flexing and abrasion testing*, an abrasion cycle that consists of one forward and one backward motion.~~

~~3.1.5*flexibility*, *n*—that property of a material by virtue of which it may be flexed or bowed repeatedly without undergoing rupture.~~

~~3.1.6*standard atmosphere for preconditioning textiles*, *n*—a set of controlled conditions having a temperature not over 50°C (122°F), with respective tolerance of ±1°C(2°F), and a relative humidity of 5 to 25 ± 2% for the selected humidity, so that drying can be achieved prior to conditioning in the standard atmosphere for testing textiles.~~

~~3.1.7*standard atmosphere for testing textiles*, *n*—laboratory conditions for testing fibers, yarns, and fabrics in which air temperature and relative humidity are maintained at specific levels with established tolerances.~~

~~3.1.7.1*Discussion*—Textile materials are used in a number of specific end-use applications that frequently require different testing temperatures and relative humidities. Specific conditioning and testing of textiles for end-product requirements can be carried out using Table 1 in Practice D1776.~~

~~3.1.8For definitions of other textile terms used in this test method, refer to Terminology D123.~~

3.1 For all terminology related to D13.59, Fabric Test Methods, General, see Terminology D 4850.

3.1.1 The following terms are relevant to this standard: abrasion, abrasion cycle, breaking force, duoble-stroke, flexibility, standard atmosphere for preconditioning textiles, standard atmosphere for testing textiles.

3.2 For all other terminology related to textiles, see Terminology D 123.

4. Summary of Test Method

4.1 Abrasion resistance is measured by subjecting the specimen to unidirectional reciprocal folding and rubbing over a specific bar under specified conditions of pressure, tension, and abrasive action. Resistance to abrasion is evaluated by either determining the percent loss in breaking force of an abraded specimen compared to an unabraded specimen or the cycles to rupture, or both.

5. Significance and Use

5.1 This test method is not recommended for acceptance testing of commercial shipments because information on between-laboratory precision is known to be poor.

5.1.1 If there are differences of 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 to be used are as homogenous as possible, are drawn from the material from which the disparate test results were obtained, and are randomly assigned in equal numbers to each laboratory for testing. Other fabrics 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 measurement of the resistance to abrasion of textile fabrics is very complex. The resistance to abrasion is affected by many factors that include the inherent mechanical properties of the fibers; the dimensions of the fibers; the structure of the yarns; the construction of the fabrics; the type, kind, and amount of treatment added to the fibers, yarns, or fabric; the nature of the abradant; the variable action of the abradant over the specimen area abraded; the tension on the specimen; the pressure between the specimen and the abradant; and the dimensional changes in the specimen.

5.3 The measurement of the relative amount of abrasion can be affected by the method of evaluation and is often influenced by the judgment of the operator. It is recognized that with this test method other means of evaluation besides cycles to rupture and breaking strength have been used by the industry, such as color change, appearance change, and so forth. Experience has shown these to be highly variable parameters and they are not recommended without exact criteria identified in an applicable material specification or contract. Consequently, the criteria of breaking strength and cycles to rupture are the recommended means of evaluation because they are considered the least variable and interlaboratory agreement is likely to be obtained more easily.

5.4 Abrasion tests are subject to variations due to changes in the abradant bar during specific tests. The abradant bar is considered a permanent abradant that uses a hardened metal surface. 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 may also change due to pickup of treatments or other material from test fabrics and must accordingly be cleaned at frequent intervals. Consequently, depending upon its usage, the abradant bar must be checked periodically against a standard.

5.5 The resistance of textile materials to abrasion as measured by this test method does not include all the factors which account for wear performance or durability in actual use. While the abrasion resistance stated in terms of the number of cycles and durability (defined as the ability to withstand deterioration or wearing out in use, including the effects of abrasion) are frequently related, the relationship varies with different end uses. Different factors may be necessary in any calculation of predicted durability from specific abrasion data.

5.5.1 Laboratory tests may be reliable as an indication of relative end use 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, the results should not be relied upon for prediction of performance during actual wear life for specific end uses unless there are data showing the specific relationship between laboratory abrasion tests and actual wear in the intended end use.

5.6 This test method is useful for pretreating material for subsequent testing for strength or barrier performance.

5.7 The pressure and tension used is varied, depending on the mass and nature of the material and the end-use application. Whenever possible, all materials that are to be compared with each other should be tested under the same pressure and tension.

5.8 When abrasion tests are continued to total destruction, abrasion resistance comparisons are not practical for fabrics having a different mass because the change in abrasion resistance is not directly proportional to the change in the fabric mass.

5.9 All the test methods and instruments that have been 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 most widely used in the industry. Because there is a definite need for measuring the relative resistance to abrasion, this test method is one of several standardized test methods that is useful to help minimize the inherent variation that may occur in results.

5.10 These general observations apply to most fabrics, including woven and nonwoven fabrics that are used in automotive, household, and wearing apparel applications.

6. Apparatus

6.1 *Flex Abrasion Testing Machine*[5] (see Figs. 1 and 2), consisting of the following:

6.1.1 *Balanced Head and Flex Block Assembly*, that has two parallel, smooth plates.

6.1.1.1 The balanced head is rigidly supported by a double-lever assembly to provide free movement in a direction perpendicular to the plate of the flex block. This head must remain stationary during the test and must be balanced to maintain a uniform vertical pressure from the dead weights.

6.1.1.2 The flex block is capable of reciprocating at 115 ± 10 double strokes per minute of 25 ± 2-mm (1 ± 0.1-in.) stroke length.

6.1.1.3 Clamps are secured to the front of each plate of the head and flex-block assemblies to permit mounting of the specimen. The clamps have surfaces that prevent slippage of the specimen and permit the specimen after it has been folded over the abradant bar to be centrally positioned and aligned with its long direction parallel to the reciprocating flex bar.

6.1.2 *Flexing Bar Yoke*, sufficiently rigid to prevent distortion during the specimen loading and capable of applying tension to the rigidly secured flexing bar with the force acting parallel to the surface of the head and block assembly plates and perpendicular to the fold of the specimen such that an evenly distributed tension is provided across the fold of the specimen.

6.1.2.1 A positioning device is provided to position the flexing bar and yoke assembly while loading the specimen such that the edge of the flexing bar is parallel to the fold of the specimen during the test. The positioning device is capable of moving into contact with the yoke prior to loading the specimen and moving away from contact with the yoke just prior to starting the test machine.

6.1.3 *Thumb Screw*, that allows moving the clamp to provide slack take-up of the specimen.

[5] Apparatus and accessories are commercially available.

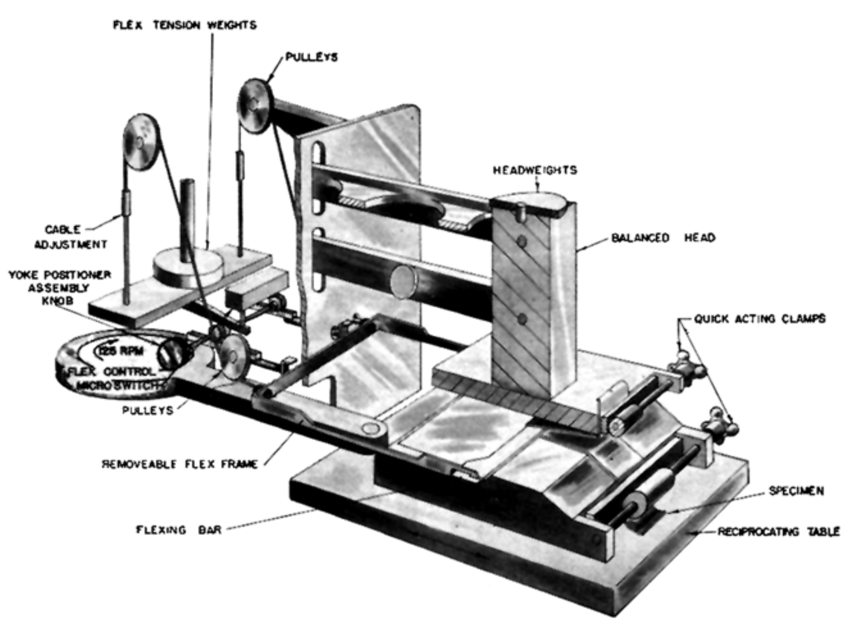

FIG. 1 Schematic Diagram of Flexing and Abrasion Tester

FIG. 2 Commercial Flexing and Abrasion Tester

6.1.4 *Machine Stopping Mechanism* , a microswitch, or equivalent, to stop the machine, actuated by the release of the tension on the specimen when it ruptures.

6.1.5 *Cycle Counter*, to record the number of cycles (double strokes) and stop the machine at fabric failure.

6.1.6 *Automatic Shutoff*, as part of the cycle counter or in-line timer, or equivalent, with set and stop mechanism capable of stopping the machine at a predetermined number of cycles.

6.1.7 *Calibrated Tension Weights* , with individual masses of 250, 500, and 1000 g (½ , 1, and 2 lbf) that can provide up to a total of 2500 g (5 lbf) that fit on a weight rack that is attached by cables to the yoke to adjust tension to the specimen. Individual weight tolerances are ±1 %.

6.1.8 *Calibrated Head Weights*, with individual masses of 250, 500, and 1000 g (½ , 1, and 2 lbf) that can provide up to a total of 2500 g (5 lbf) that fits on the balanced head, to apply pressure to the specimen. Individual weight tolerances are ±1 %.

6.2 *Working Flex Bar*, used for testing, 1.6 ± 0.4 by 11.2 ± 1.6 mm (1⁄16 ± 1⁄64 by 7⁄16 ± 7⁄16 in.) in cross section, made with tool steel tipped with an edge of cemented carbide. The top, bottom, and edge of the bar that is in contact with the specimen is finished by grinding and polishing, leveling off the microscopic projection without breaking the edges of the bar. The bar is capable of firmly attaching to the yoke.

6.3 *Standardized Master Flex Bar* , to standardize the working flex bar, including storage container to prevent bar damage, available from the manufacturer.

6.4 *Calibration Ribbon*[5], fused acetate ribbon, 25 mm (1 in.) wide, available from the manufacturer.

6.5 *Tensile Testing Machine*, of the CRE, CRL, or CRT type conforming to Specification D 76, with respect to force indication, working range, capacity, and elongation indicator and designed for operation at a speed of 300 ± 10 mm/min (12 ± 0.5 in./min); or, a variable speed drive, change gears, or interchangeable full-scale force range as required to obtain 20 ± 3 s time-to-break.

6.6 *Nylon Brush*, medium bristle, or equivalent.

6.7 *Acetone*, or other appropriate solvent to clean the flex bar (see 7.1)

7. Hazardous Materials

7.1 Solvents used in this test method may be hazardous. Refer to the manufacturer's material safety data sheets for information on use, handling, storage, and disposal of solvents used with this test method.

8. Sampling and Test Specimens

8.1 *Primary Sampling Unit*—Consider rolls of fabric or fabric components of fabricated systems to be the primary sampling unit, as applicable.

8.2 *Laboratory Sampling Unit*—As a laboratory sampling unit take from rolls at least one full-width piece of fabric that is 1 m (1 yd) in length along the selvage (machine direction), after removing a first 1 m (1 yd) length. For fabric components of fabricated systems use the entire system

8.3 *Test Specimens*— From each laboratory sampling unit, cut 4 warp-wise (lengthwise) and 4 filling-wise (widthwise) test specimens at least 200 mm (8 in.) long. For woven fabrics, cut specimens either 32 mm (1¼ in.) wide if there are 50 yarns per