Designation: D 4158 – 92

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

This standard is issued under the fixed designation D 4158; 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 resistance to abrasion of a wide range of textile materials using the uniform abrasion testing machine.

NOTE 1—Other procedures for measuring the abrasion resistance of textile fabrics are given in: Test Methods D 3884, D 3885, D 3886, D 4157, and AATCC 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 problems, 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:*

D 123 Terminology Relating to Textiles[2]

D 1776 Practice for Conditioning Textiles for Testing[2]

D 3884 Test Method for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double Head Method)[3]

D 3885 Test Method for Abrasion Resistance of Textile Fabrics (Flexing and Abrasion Method)[3]

D 3886 Test Method for Abrasion Resistance of Textile Fabrics (Inflated Diaphragm Method)[3]

D 4157 Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)[3]

2.2 *Other Documents:*

AATCC 93, Impeller Tumble 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.

3.2 For definitions of other terms used in these methods, refer to Terminology D 123.

4. Summary of Test Method

4.1 Abrasive action is applied uniformly in all directions in the plane of the surface of the specimen about every point in it. The settings of the machine, method of mounting specimens, conditions of test (as, dry or wet), and criteria to be used in evaluating abrasive wear in the test, depend upon the nature of the specimen to be tested and the use to be made of the test results. Resistance to abrasion is evaluated by various means which are described in Section 12, Evaluation of Abrasion.

5. Significance and Use

5.1 The resistance to abrasion of textile materials is affected by many factors in a very complex and as yet little understood manner. The abrasion machine covered in this test method provides a very sensitive means for studying the influence of the involved factors. The machine should therefore be used primarily as a research instrument. The results may not only shed much needed light on this complex problem but may also provide information on the effects of mechanical and chemical treatments on fibers, yarns, and fabrics, and on the influence of variations in yarn and fabric construction on the properties of the final textile product. The results of comparative tests of the abrasion resistance of several fabrics of similar types are often very useful in the evaluation of the serviceability of fabrics for a specific end use. In many instances, the relative results obtained with this machine on a series of fabrics agreed well with those obtained by the supplier of the fabrics, based upon performance in end use. The experimenter, however, should be constantly on the alert for anomalous results which can be attributed in most instances to uncontrolled factors in manufacturing or other processes. Specific instances of this type have been described.[5,6] Others may be encountered as the

[1] This method is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.60 on Fabric Test Methods, Specific.

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[2] *Annual Book of ASTM Standards*, Vol 07.01.

[3] *Annual Book of ASTM Standards*, Vol 07.02.

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

[5] Schiefer, H. F. and Krasny, J. F., "Note on the Disintegration of Wool in Abrasion Tests," *Textile Research Journal*, Vol 19, January 1950, pp. 802–809; *Journal of Research*, Nat. Bureau Standards, Vol 44, January 1950, pp. 9–14 (*Research Paper RP 2054*).

[6] Shiefer, H. F., Crean, L. E. and Krasny, J. F. "Improved Single-Unit Schiefer Abrasion Testing Machine," *Journal of Research*, Nat. Bureau Standards, Vol 42, May, 1949, pp. 259–269. *ASTM Bulletin*, No. 159, July 1949, pp. 73–78 (*TP133*).

machine is used more extensively and a greater variety of textiles have been tested. These anomalous results are frequently very fruitful in the attainment of more durable and satisfactory fabrics. As a rule they are not attributable to a faulty operation of the testing machine or carelessness of the operator. These results should not be discarded but should be studied very intensively, for an understanding of the factors which cause such anomalous results adds immeasurably to a better understanding to this complex problem and to its more intelligent application.

5.2 Test Method D 4158 for the determination of the abrasion resistance of textile fabrics, uniform abrasion method, may be used for the acceptance testing of commercial shipments of textile fabrics but caution is advised since technicians may fail to get good agreement between results on certain fabrics. Comparative tests as directed in 5.2.1 may be desirable.

5.2.1 In case of a dispute arising from differences in reported test results when using Test Method D 4158 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 Student's *t*-test and an acceptable probability level chosen by the two parties before the testing began. 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 The machine,[7] shown in Figs. 1 and 2, consists of an abrading mechanism, specimen supporting mechanism, and driving mechanism. Essentially, the surface of the abradant lies in a plane parallel to the plane surface supporting the specimen and presses upon the specimen. The abradant and specimen rotate in the same direction at very nearly but not quite the same angular velocity (250 rpm) on noncoaxial axes which are parallel to 0.0025 mm (0.0001 in.). The small difference in speed is to permit each part of the specimen to come in contact with a different part of the abradant at each rotation.

6.1.1 The abrading mechanism consists of the abradant mounted at the lower end of a shaft, weights placed upon the upper end of the shaft to produce constant pressure between abradant and specimen throughout the test, lever and cam for raising and lowering the abradant, shaft, and weights. A counterweight for balancing the abradant and abradant shaft is needed when tests are to be carried out at low pressure.

6.1.2 The specimen-supporting mechanism provides for tension mounting of thinner, more flexible materials and rigid mounting of thick, stiff materials. For the first, a plastic pressure foot 12.7, 25.4, 31.3, 38.1, 50.8 mm (½, 1, 1¼, 1½, or 2 in.) in diameter, as called for, shall be mounted at the upper end of the specimen shaft to fix the area of the specimen to be abraded. A conical clamp seat fitted to the shaft rotates with it but is free to move vertically on the shaft. A cam is provided for raising and lowering the clamp seat. The specimen clamp shown unassembled in Fig. 3 fits on the seat (*C*, Fig. 3) and can be fastened to it by merely rotating it slightly to engage the two pins in the slots. The clamp and specimen assembly can be removed quickly for examining the specimen and measuring the wear and returned to the machine without unclamping the specimen. When the clamp seat is lowered by turning the cam, the combined weight of the clamp seat and specimen clamp is suspended by the specimen over the presser foot. This places the specimen under constant tension throughout the test with take-up of any stretch in the specimen. Different tensions may be applied to the specimen by changing the weight of the clamp seat, for example, by adding auxiliary weights. For rigid mounting of thick, stiff cloths such as carpeting and felts, the specimen clamp and mounting aids shown in Fig. 4 shall be used and the assembly screwed onto the specimen shaft in place of the presser foot and specimen clamp seat (*E*, Fig. 2).

6.1.3 The driving mechanism consists of a motor-driven auxiliary drive shaft connected to the abradant shaft and specimen shaft by spur gears.

6.1.4 The machine shall be equipped with a resettable counter (*G*, Fig. 2) to indicate the number of rotations in a test; sensitive microswitch (*H*, Fig. 2) to stop the machine automatically when a tension-suspended specimen is worn through; thickness gage (*I*, Fig. 2), when specified, for indicating changes in thickness of the specimen during a test.

6.1.5 *Abradant*—The working surface of the abradant disk shall be sufficiently greater in diameter than the specimen

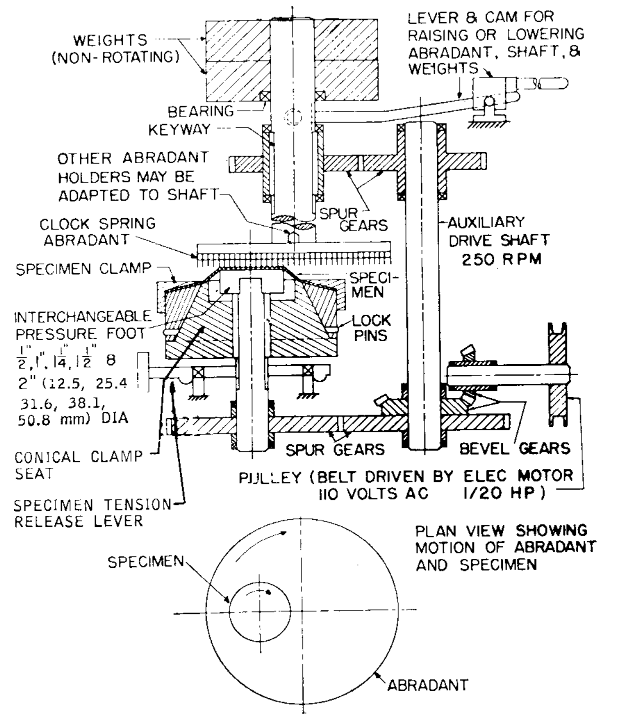
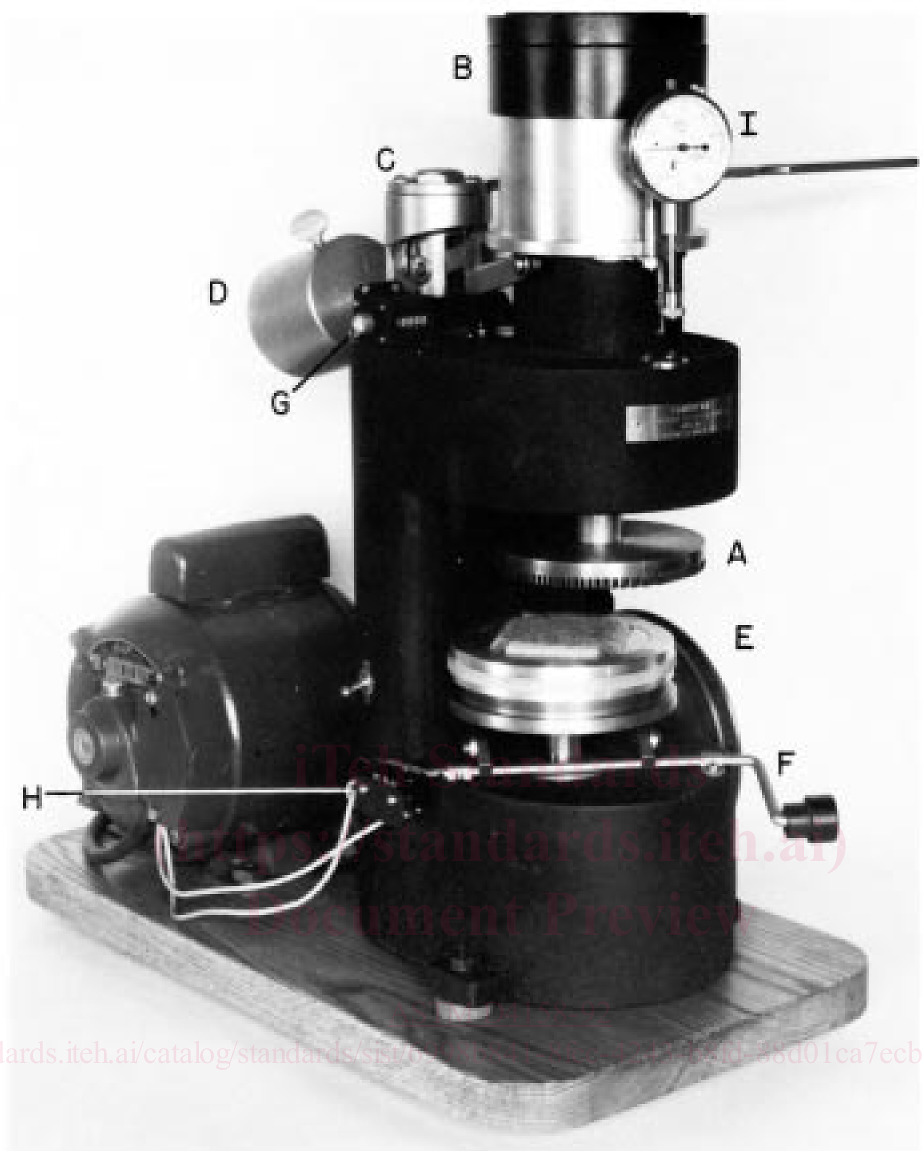


FIG. 1 Schematic Diagram of Uniform Abrasion Testing Machine

[7] The Schiefer machine meets these requirements and is manufactured by Frazier Precision Co., Gaithersburg, Md.



A—Abradant.
B—Weights on abradant shaft.
C—Cam and lever system for raising the abradant shaft, abradant, and weights.
D—Counterweight for balancing abradant and abradant shaft when tests are to be made at low pressures.
E—Specimen in place ready for test.
F—Cam for raising and lowering the specimen clamp seat
G—Counter.
H—Microswitch.
I—Thickness gage.

FIG. 2 Uniform Abrasion Testing Machine

supporting the surface that the latter lies entirely inside the periphery of the abradant during a test. A spring steel blade abradant (*B*, Fig. 3), which is essentially constant in its action for a long period of use, shall be used for woven, felted, pile, and knitted fabrics and a cross-cut tungsten tool steel blade abradant (*A*, Fig. 3) for coated fabrics, unless otherwise specified in the material specification. Emery cloth, sandpaper, duck, canvas, or other cloth in a suitable holder may be specified.

7. Sampling

7.1 Take a lot sample as directed in the applicable material specification, or as agreed upon by the purchaser and seller. In the absence of such a specification or other agreement, take a laboratory sample as directed in 7.2.

7.2 Take a laboratory sample from each roll or piece of fabric in the lot sample. The laboratory sample should be full width and at least 50 cm (approximately 20 in.) long and should not be taken any closer to the end of the roll or piece of fabric than 1 m (1 yd).

7.3 Sample shipments of garments as agreed upon by purchaser and seller.

8. Selection and Number of Test Specimens

8.1 In the absence of any applicable material specifications, take five specimens from each sample to be tested.