



Designation: D4157 – 13 (Reapproved 2017)

# Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)<sup>1</sup>

This standard is issued under the fixed designation D4157; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope

1.1 This test method covers the determination of the abrasion resistance of woven textile fabrics using the oscillatory cylinder tester. This test method may not be usable for some fabric constructions.

NOTE 1—Other procedures for measuring the abrasion resistance of textile fabrics are given in: Guides [D3884](#) and [D4158](#), and Test Methods [D3885](#), [D3886](#), 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 concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[D123 Terminology Relating to 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](#)

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[Fabrics \(Inflated Diaphragm Apparatus\)](#)

[D4158 Guide for Abrasion Resistance of Textile Fabrics \(Uniform Abrasion\)](#)

[D4850 Terminology Relating to Fabrics and Fabric Test Methods](#)

[D5034 Test Method for Breaking Strength and Elongation of Textile Fabrics \(Grab Test\)](#)

[D5035 Test Method for Breaking Force and Elongation of Textile Fabrics \(Strip Method\)](#)

2.2 *Other Document:*

[AATCC 93 Abrasion Resistance of Fabrics: Accelerator Method](#)<sup>3</sup>

## 3. Terminology

3.1 For all terminology relating to D13.59, Fabric Test Methods, General, refer to Terminology [D4850](#).

3.1.1 The following terms are relevant to this standard: *abrasion*, *abrasion cycle*, *in abrasion testing*, *breaking force*, *double-rub*, *in oscillatory cylinder abrasion testing*.

3.2 For all other terminology related to textiles, refer to Terminology [D123](#).

## 4. Summary of Test Method

4.1 Abrasion resistance is measured by subjecting the specimen to unidirectional rubbing action under known conditions of pressure, tension, and abrasive action. Resistance to abrasion is evaluated by various means which are described in Section [12](#).

## 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 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.

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

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 specimen.

5.3 Abrasion tests are all subject to variation due to changes in the abradant during specific tests. The abradant must accordingly be changed 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 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.

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 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 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. This test method provides a comparative measurement of the resistance of woven textile fabrics to abrasion, and may not necessarily predict the actual performance of fabrics in actual use.

5.7 If there are differences of practical significance between reported test results for two or more laboratories, comparative

tests should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, test samples that are as homogeneous as possible, drawn from the material from which the disparate test results were obtained, and randomly assigned in equal numbers to each laboratory for testing. 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 bias is found, either its cause must be found and corrected, or future test results must be adjusted in consideration of the known bias.

## 6. Apparatus

6.1 *Oscillatory Cylinder Abrasive Machine*,<sup>4</sup> (shown as Fig. 1) consisting of the following:

6.1.1 *Oscillating Cylinder Section*, equipped with edge clamps to permit mounting of a sheet of abrasive material over its surface, capable of oscillating through an arc of  $76 \pm 2$  mm ( $3 \pm 0.1$  in.) at the rate of  $90 \pm 1$  cycles (double rub) per min.

6.1.2 *Four Specimen Holding Arms*, to permit testing of several specimens simultaneously; each arm having a set of controlled tension clamps with the forward clamp attached to a force scaled tension bar, and a controlled pressure pad attached to a force scaled pressure bar.

6.1.3 *Calibrated Mass (340 g)*, that slides on the tension bar and attached on each arm forward clamp to adjust tension to the specimen in increments of 4.45 N (1 lbf) up to a total of 26.7 N (6 lbf).

6.1.4 *Thumb Screw*, that butts against the rear clamp of each arm to provide slack take-up of the specimen.

6.1.5 *Sponge Rubber Pressure Pad*, 51 by 51 mm (2.0 by 2.0 in.) with a tolerance of  $\pm 2.0$  mm (0.1 in.) shaped to the cylinder surface and fitted to the pressure bar.

6.1.6 *Calibrated Mass (150 g)*, that slides on the pressure bar and attached on each pressure pad to adjust and apply pressure to the specimen in increments of 4.45 N (1 lbf) up to a total of 15.575 N (3.5 lbf).

6.1.7 *Two Slotted Vacuum Pipes*, suspended over the cylinder drum to remove lint and dust particles.

6.1.8 *Automatic Cycle Counter*, with set and stop mechanism to record the number of cycles (double rubs) and stop the machine at a predetermined number of cycles.

6.2 *Abradant*:

6.2.1 *Cotton Duck # 10*, with the following characteristics:

NOTE 2—Apparatus and accessories are commercially available.

6.2.1.1 *Mass/Unit Area*— $500 \pm 25$  g/m<sup>2</sup> (14 to 15.8 oz/yd<sup>2</sup>).

6.2.1.2 *Weave Type*—plain weave.

6.2.1.3 *Fabric Count*— $41 \pm 1$  end/in.  $\times$   $28 \pm 1$  pick/in.

6.2.1.4 *Yarn Size*— $7/2$  cotton count  $\pm 1$  in both warp and filling.

6.2.1.5 *Air Permeability*—less than 4 cfm.

6.2.1.6 *Finish*—loom state; no warp size.

<sup>4</sup> Apparatus and accessories are commercially available.



FIG. 1 Oscillatory Cylinder Abrasion Tester

6.2.2 A two piece laminated screen assembly measuring 241 × 305 mm (9.5 × 12.0 in.) with a tolerance of ±2.5 mm (0.1 in.).

6.2.2.1 The outer screen, which comes in contact with the specimen, is a 50 × 70 stainless steel wire mesh made with a 0.19 mm (0.0075 in.) diameter wire. There are 50 wires per inch, which run perpendicular to the long axis of the test specimen, and 70 wires per inch that run parallel to the long axis of the test specimen.

6.2.2.2 The inner screen, which comes in contact with the drum, is a 16 × 16 stainless steel wire mesh made with 0.28 mm (0.011 in.) diameter wire. There are 16 wires per inch in both directions.

6.2.2.3 The two wire mesh screens are stapled together along the long edges so that the staples do not interfere with the clamping mechanism that holds the screen assembly in place.

6.2.3 *Grit Sandpaper*, to refurbish rubber pads.

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

6.2.5 *Mild Household Detergent Solution*.

6.2.6 *Air Supply*, with regulated nozzle.

6.2.7 *Digital Force Gage*.

## 7. Sampling

7.1 Take a lot sample as directed in the applicable material specification, or as agreed upon between 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). Consider rolls or pieces of fabric to be the primary sampling unit.