# Abrasion Resistance of Fabrics: Accelerotor Method

**Developed in 1959 by AATCC Committee RA29; revised 1966, 1984, 2005; reaffirmed 1974, 1977, 1989; editorially revised 1978, 1985, 1986, 1995, 2008; editorially revised and reaffirmed 1994, 1999, 2004, 2011.**

## 1. Purpose and Scope

1.1 This test method is intended for evaluating the resistance of fabrics and other flexible materials to abrasion (see 14.1).

## 2. Principle

2.1 An unfettered fabric specimen is driven by an impeller (rotor) along a zigzag course in a generally circular orbit within a cylindrical chamber, so that it repeatedly impinges on the walls and abradant liner of the chamber while at the same time being continually subjected to extremely rapid, high velocity impacts. The specimen is subjected to flexing, rubbing, shock, compression, stretching and other mechanical forces during the test. Abrasion is produced throughout the specimen by rubbing of yarn against yarn, fiber against fiber, surface against surface and surface against abradant.

2.2 Evaluation is made on the basis of weight loss of the specimen or grab strength loss of the (woven) specimen when broken at an abraded fold line. Generally, flat woven fabrics may be evaluated by either method. Tufted and other fabrics with raised surfaces, and knit fabrics, are evaluated by the weight loss method.

2.3 Changes in other fabric characteristics may also be useful for evaluating abrasion resistance with the Accelerotor (see 14.1).

## 3. Terminology

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

## 4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedures and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers MUST be consulted for specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Good laboratory practices should be followed. Wear safety glasses in all laboratory areas.

4.2 The door of the Accelerotor must be kept closed whenever the motor is running. Manufacturer's safety recommendations should be followed when operating laboratory testing equipment.

4.3 A face mask is recommended for operators who work regularly with the Accelerotor to guard against inhalation of fiber dust.

## 5. Uses and Limitations

5.1 The results obtained by this method are affected by duration; the size, shape and angular velocity of the rotor; and by the type of liner used. These effects are interrelated, and testing conditions may be varied to produce different degrees of abrasion in a test specimen. For example, it may require only 2 or 3 min at 209.44 rad/s (2000 rpm) with the standard offset rotor to produce a reasonable degree of abrasion in a delicate or fragile fabric, while a heavier or more durable fabric may require 6 min at 314.16 rad/s (3000 rpm).

5.2 When fabrics curl or, for other reasons, do not move about freely in the test chamber, testing should be discontinued.

5.3 The results of this test should not be equated with service life.

## 6. Apparatus and Materials

6.1 Accelerotor (Fig. 1; see 14.3) equipped with the following parts:

6.1.1 Rotor, offset (elongated S-shape), 114 mm (4.5 in.) (Fig. 2) (see 14.4 for descriptions of alternate rotors).

6.1.2 Collar insert, plastic, lined with 3.2 mm (0.125 in.) polyurethane foam.

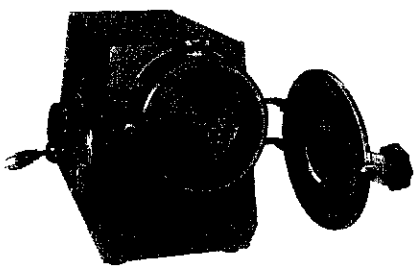

**Fig. 1—Accelerotor fitted with abrasive liner over foam rubber cushion and with 114 mm (4.5 in.) S-shape rotor.**

**Fig. 2—Elongated S-shape rotor.**

6.2 Liner, fine abrasive, 500J grit aluminum oxide cloth (see 14.3; an alternate abrasive liner is described in 14.5).

6.3 Neon lamp or other stroboscopic device.

6.4 Timer, automatic, accurate to ± 1 s.

6.5 White glue.

6.6 Pinking shears and marking templates, or cutting dies (see 14.8).

6.7 Brush, nylon, for cleaning Accelerotor chamber or small portable vacuum cleaner for chamber and specimens.

6.8 Thread, size E, Type I, Class 1 or 2, Fed. Spec. V-T-295.

6.9 Cotton fabric, 78 × 76 print cloth (carded yarns) 1.2 m (46 in.) wide, about 8 m/kg (4 yd/lb), bleached and desized, free from blueing, optical bleach or finishing materials.

6.10 Analytical balance accurate to ± 0.001 g.

## 7. Test Specimens

7.1 In the absence of applicable specifications, take a minimum of three specimens from each sample to be tested not nearer the selvage than one-tenth the width of the fabric or 64 mm (2.5 in.). Select specimens that are representative of the whole sample to be tested.

7.2 Size of Specimens.

7.2.1 Method A (Evaluation by weight loss)—Cut specimens of heavier or bulkier fabrics smaller than those of lighter fabrics to minimize variations in impact produced when the specimens hit the chamber wall or abradant liner. Table I is a guide to the relationship between fabric weight, in grams per square meter (ounces per square yard), and specimen size. Specimens may be taken with the edges parallel to the warp and filling (courses and wales) or on the bias.

7.2.2 Method B (Evaluation by strength loss)—The specimen size is 100 × 150 mm (4 × 6 in.) with the greater dimension in the direction of the yarns to be broken. Take specimens with their edges parallel to the warp and filling yarns.

7.3 Specimen Preparation.

7.3.1 Method A—Cut a specimen with

Table I—Selection of Specimen Size

| Weight Range of Fabrics[a] | Size of Specimens[b] |
|---|---|
| 300-400 (9-12) | 95 (3.75) |
| 200-300 (6-9) | 115 (4.5) |
| 100-200 (3-6) | 135 (5.25) |
| less than 100 (3) | 150 (6) |

[a] Grams per square meter (ounces per square yard)
[b] Millimeters (inches) square

pinking shears or die (see 14.8). If woven fabric is die-cut parallel to yarns, ravel 3.2 mm (0.125 in.) along each edge. Place the specimen on plastic sheet (to protect bench top) and apply a 3.2 mm (0.125 in.) strip of adhesive to each cut or raveled edge (Fig. 3) (see 14.4 and 14.9). Allow the adhesive to dry at room temperature.

7.3.2 Method B—Cut specimens 100 × 300 mm (4 × 12 in.) (twice the length required for the grab breaking strength test). Number each specimen at both ends, and then cut in half. Use one half for a control to determine the original grab breaking strength, and the other to determine grab breaking strength after abrading. Apply adhesive to the edges of the specimens to be abraded as in Method A. Then fold each specimen perpendicular to the long dimension and 50 mm (2 in.) from one end, making it into a 100 × 100 mm (4 × 4 in.) square. Attach the 50 × 100 mm (2 × 4 in.) flap with a seam 6 mm (0.25 in.) from its edge to the body of the specimen (Fig. 4). Use 4 stitches to the centimeter (11 stitches per inch).

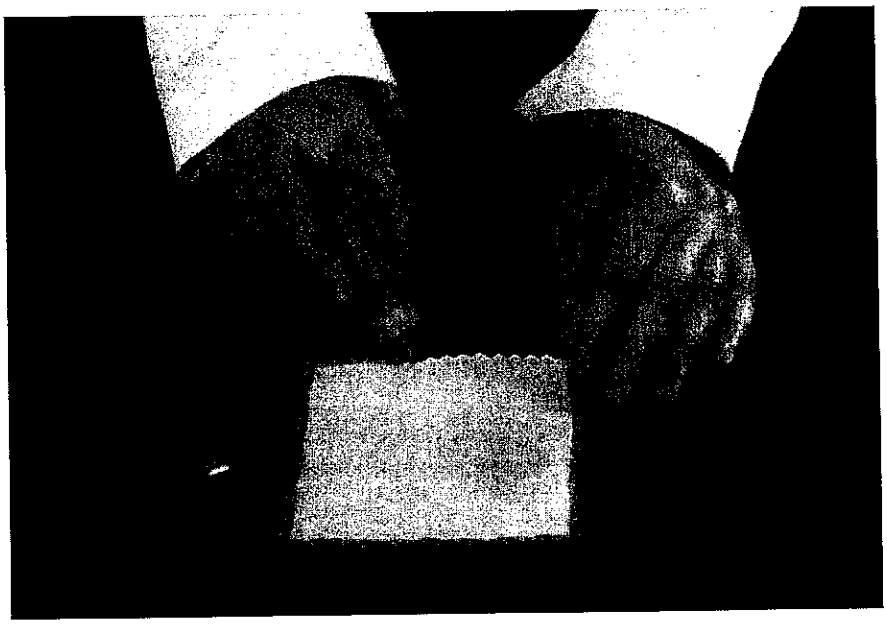

Fig. 3—Application of adhesive (see 6.5) to pinked edges of specimen from plastic squeeze bottle.

## 8. Accelerotor

8.1 Adjustment of Tachometer.

8.1.1 Rotor—Select and install appropriate rotor. The 114 mm (4.5 in.) offset rotor is standard) (see 14.4).

8.1.2 Neon Lamp—To check the accuracy of the tachometer, the neon lamp is used as a simple stroboscope to view the spinning rotor. With the test chamber door closed and the neon bulb held close to the window of the door, the rotor gives distinct patterns at several useful speeds. With some practice, the following patterns will be recognized: If the neon lamp is being operated on 60 Hz AC, at 188.50 rad/s (1800 rpm) the rotor appears as a stationary distinct two-bladed figure. At 377 rad/s (3600 rpm) the hub of the rotor appears as a stationary blur, with two slight lobes apparent on the sides of the hub. If the neon lamp is operated on 50 Hz AC, as in many European countries, the above described test patterns will appear at 157.08 and 314.16 rad/s (1500 and 3000 rpm). If the tachometer does not read the appropriate speed, turn the small screw on the dial face to correct it.

8.1.3 Stroboscope—Set the stroboscope dial at 314.16 rad/s (3000 rpm). Close the Accelerotor door, turn the unit on, and bring the speed of the rotor to a point at which it appears as a stationary, two-bladed figure. If the tachometer does not read 314.16 rad/s (3000 rpm), turn the small screw on its dial face to correct it.

8.2 Liners (see 14.5).

8.2.1 Installation of Liners—Place liner into collar insert and, with the fingers, work liner around the insert wall until it fits snugly and smoothly without any crease.

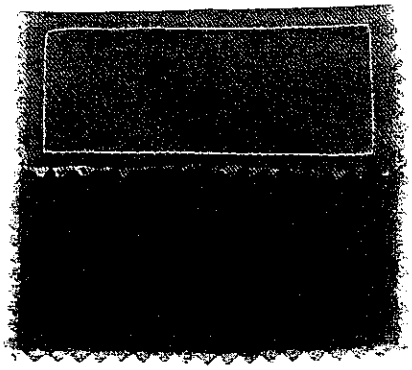

Fig. 4—Specimen prepared for testing by Method B.

8.2.2 Break-in of Fresh Liner—Insert the prepared collar insert into the Accelerotor equipped with the selected rotor. Break in the abrasive liner by running two successive 114 mm (4.5 in.) square specimens of 78 × 76 finish-free cotton print cloth (see 6.9), edged with adhesive. Close the door, start the Accelerotor, and maintain rotor speed at 314.16 rad/s (3000 rpm) for 6 min. Replace with the second specimen and continue until total running time is 12 min. Stop the Accelerotor and remove the specimen. Brush or vacuum the abrasive liner to remove detritus.

8.2.3 Reversal of Line—For greater reproducibility, it is recommended that after six test specimens have been run, the collar assembly be removed from the Accelerotor and reversed so that the rim which was next to the door is placed at the back of the chamber.

8.2.4 Change of Liner—It is recommended that an abrasive liner be discarded after 12 specimens have been run If the liner has not been subjected to severe duty, it may be used for more than 12 tests. To check the condition of a liner determine the weight loss of finish-free 78 × 76 cotton print cloth (see 6.9) at the beginning of a series of tests and after intervals of six test specimen runs. The life of some abrasive liners can be extended to a considerable degree by laying them on a flat surface and scrubbing them with the nylon brush and soapy water to remove finishes or other materials deposited on them by some fabrics. After washing, the liners should be thoroughly rinsed with water and dried before their effectiveness is rechecked.

## 9. Conditioning

9.1 Let prepared specimens reach approximate moisture equilibrium in the standard atmosphere for preconditioning and then condition them in the standard atmosphere for testing textiles, as specified in ASTM D 1776, Standard Practice for Conditioning and Testing Textiles.

## 10. Testing Procedures

10.1 Method A—Weight Loss

10.1.1 Weigh the conditioned specimen (see 9) on an analytical balance (see 6.10).

10.1.2 Set up Accelerotor with the elongated, S-shaped, offset, 114 mm (4.5 in.) long rotor, and a fine abrasion, 500J grit aluminum oxide cloth (see 14.4, 14.5 and 14.7).

10.1.3 Crumple the test specimen and place it in the chamber.

10.1.4 Close the door (see 4), start the Accelerotor and timer, and maintain accurately, ± 10.48 rad/s (100 rpm), at the selected speed for the desired time. The operating speed usually is maintained at 314.16 ± 10.48 rad/s (3000 ± 100 rpm) for a period of time sufficient to abrade the specimen substantially without tearing it; e.g., 2-6 min (see 14.7).

10.1.5 Stop the Accelerotor at the end of the time (± 2 s) and remove the test specimen.

10.1.6 Brush or vacuum the liner to remove detritus.

10.1.7 Shake or vacuum the specimen free of detritus.

10.1.8 Condition the tested specimen (see 9.1).

10.1.9 Reweigh the specimen on an analytical balance to ± 0.001 g.

10.2 Method B—Strength Loss

10.2.1 Perform Steps 10.1.2 through 10.1.7.

10.2.2 Remove stitching thread to restore specimen to 100 × 150 mm (4 × 6 in.) dimensions.

10.2.3 Condition specimen as directed in 9.1.

10.2.4 Determine breaking strength by the Grab Method given in ASTM D 5034, Test for Breaking Force and Elongation of Textile Fabrics (Grab Test), placing the abraded fold of the test specimen parallel to and equidistant from the jaws of the tensile tester (see 14.6). The specimen must break along the fold for a valid test.

10.2.5 Determine breaking strength on conditioned (see 9.1) original (unabraded) (see 7.3.2) specimen.

## 11. Calculations and Evaluation

11.1 Method A—Weight Loss. Calculate the percent loss in weight for each specimen to ± 0.1%.

11.2 Method B—Strength Loss. Calculate the percent strength loss for each pair (see 7.3.2) of specimens.

11.3 Calculate the average for each method.

## 12. Report

12.1 Method A—Report the average percent weight loss for the three test specimens.

12.2 Method B—Report the average percent strength loss for the three test specimens.

12.3 The report must state the exact conditions employed; i.e., rotor speed, time, size and type of rotor and type of liner. For Method A also state the specimen size used.

## 13. Precision and Bias

13.1 *Precision.* Precision for this test method has not been established. Until a precision statement is generated for this test method, use standard statistical techniques in making any comparisons of test results for either *within-laboratory* or *between-laboratory* averages.

13.2 *Bias.* The abrasion resistance of fabrics (Accelerotor method) can be defined only in terms of a test method. There is no independent method for determining the true value. As a means of estimating this property, the method has no known bias.

## 14. Notes

14.1 Although they are not included as part of the standard procedure, changes in such characteristics as air permeability, light transmission, visual appearance, hand, etc., could be used for evaluation, depending on the type of fabric and its intended end-use.

14.2 For additional information see: T. F. Cooke, Abrasion Testing with the Accelerotor: Reproducibility in Interlaboratory Tests, *American Dyestuff Reporter*, Vol. 47, No. 20, 1958, pp679-83; H. W. Stiegler, H. E. Glidden, G. J. Mandikos and G. R. Thompson, "The Accelerotor for Abrasion Testing and Other Purposes," *American Dyestuff Reporter*, Vol. 45, No. 19, 1956, pp685-700.

14.3 Available from SDL Atlas L.L.C., 3934 Airway Drive, Rock Hill, SC 29732-9200, tel: 803-329-2110, fax: 803-329-2133, e-mail: info@sdlatlas.com; web site: www.sdlatlas.com.

14.4 For special applications, pitched-blade rotors 108 mm (4.25 in.), 114 mm (4.50 in.) and 121 mm (4.75 in.) long and a 108 mm (4.25 in.) offset S-shaped rotor are available (see 14.8).

14.5 For special applications, a medium fine abrasive, 240J grit aluminum oxide cloth liner is available (see 14.8). The liner is installed the same way as the fine abrasive, 500J grit aluminum oxide cloth (see 8.2).

14.6 Tensile strength tester as described in ASTM D 76, Standard Specifications for Tensile Testing Machines for Textiles.

14.7 By mutual agreement, the rate and type of abrasion produced in the Accelerotor may be varied by the alternate use of the medium fine abrasive, 240J grit aluminum oxide cloth liner, the use of the shorter S-shaped rotor or the use of one of the 0.26 rad (15 deg.) pitched-blade rotors, and variations of the rotor speed from 157.08 ± 10.48 to 418.88 ± 10.48 rad/s (1500 ± 100 to 4000 ± 100 rpm), but details of these must be made a part of the report of test results.

14.8 It is convenient to mark specimens for cutting by means of square templates made of metal, plastic or cardboard. If available, cutting dies of appropriate dimensions may also be used; however, die-cut specimens should be raveled prior to the edge sealing (see 14.9).

14.9 To prevent loss of specimen weight by fraying, white glue is applied to the pinked or raveled edges of all specimens from a plastic squeeze bottle (see Fig. 3). The cement strip should not exceed 3.2 mm (0.125 in.) in width. For fabrics which have been die-cut, or cannot be pinked, specimens should be raveled 3.2 mm (0.125 in.) along each edge and adhesive applied as above.