1. SCOPE

1.1 This method is intended for determining the abrasion resistance of cloths in terms of percent change in breaking strength, or breaking strength after a given period of abrasion, or the number of abrasion cycles required to produce a specified state of destruction. It is used to evaluate cloth durability when the specimen is subjected to rotary rubbing action under controlled conditions of pressure and abrasive action.

2. TEST SPECIMEN

2.1 The specimen shall be not greater than 1/4 inch (6 mm) in thickness. The specimens shall be taken from areas of the fabric not represented by the same warp or filling yarns. A 1/4 inch (6 mm) diameter hole shall be punched in the center of the specimen.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, 10 specimens from each of the warp and filling directions shall be tested from each sample unit.

4. APPARATUS AND METHOD CITED

4.1 Apparatus. (Figure 5306)

4.1.1 Rotary platform, double head abraser. An abrasion machine comprising in general of a housing of compact design, a removable flat circular specimen-holder, a pair of pivoted arms to which are attached the abrasive wheels, a motor for rotating the platform and specimen, a fan for cooling the motor, and a counter for indicating the revolutions of the specimen-holder is so mounted as to produce a circular surface travel of an essentially flat specimen in the plane of its surface. The abrasive wheels, which are attached to the free end of the pivoted arms, rotate and have, when resting on the specimen, a peripheral engagement with the surface of the specimen, the direction of travel of the periphery of the wheels and of the specimen at the contacting portions being at acute angles and the angle of travel of one wheel periphery being opposite to that of the other. Motion of the abraser wheels, in opposite directions, is provided by rotation of the specimen and the associated friction therefrom.
4.1.1.1 **Specimen holder.** The specimen-holder is supported by an adapter which is motor-driven and provides motion for the circular travel of the specimen-holder.

4.1.1.2 **Load adjustment weights.** A load adjustment for varying the load of the abraser wheels on the specimen. The pivoted abraser arms without auxiliary weights or counterweights apply a load against the specimen of 500 grams (1.1 lbs) per wheel. Addition of weights by the manufacturer increases the load to 1,000 grams (2.2 lbs). A counterweight attachment permits reduction of load against the specimen to 250 grams (0.55 lb) and 125 grams (0.27 lb) per wheel.

4.1.1.3 **Clamping rings.** Clamping rings for securing the specimen to the specimen-holder, one for use with lighter weight fabrics, and a larger one for use with heavier fabrics.

4.1.1.4 **Wheels.**

4.1.1.4.1 **Types.** Abraser wheels of the rubber-base or vitrified-base types. Both types of wheels are manufactured in different grades of abrasive quality. The wheels shall be leadbushed, 1/2 inch (13 mm) thick and approximately 2 inches (51 mm) in diameter. The wheels customarily used for testing textiles are the rubber-base resilient type composed of abrasive grains encushioned in rubber. Consequently, they are distorted during operation of the abraser. Accordingly, the wheels are mounted so as to compensate for this distortion and it is important that they be set as prescribed in 4.1.1.5.1.

Vitrified-base wheels are the hard abrasive type. They may be cut with a diamond point to alter the roughness of the wheel, the stroke of cut determining the degree of grit. The position of these wheels is not critical but it is recommended that they be set as prescribed in 4.1.1.5.1.

4.1.1.4.2 **Selection for test.** Since there exists variation in abrasive quality between and within rubber-base wheels of the same grade, a method shall be followed in the selection of wheels for a particular test that will reduce this variation. All rubber-base wheels shall be tested individually on a selected reference fabric. They shall be grouped in sets of three pairs such that the average abrasiveness of the three falls within a specified tolerance. The wheels shall then be used in sets as established. The specimens of fabric shall be grouped in three sets, the members of the set being selected at random from the whole area of the sample. Each set shall be abraded with one of the three pairs of wheels, and the report shall be based on the average for the three sets.

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In the use of vitrified-base wheels, both wheels of the pair to be used shall be similar in abrasion characteristics. This shall be checked on a selected reference fabric. Once a satisfactory pair is obtained, it may be used for an indefinite period of time without changing its abrasive quality. Experience has shown that a single pair can be used for at least 1 year in constant use without changing in abrasive quality.

4.1.1.4.3 Resurfacing and cleaning. Due to uneven wear and clogging of the surface crevices with fiber particles, sizing, finishing materials, and the like, the abrading wheels shall be resurfaced or cleaned at established intervals during tests, the frequency of which depends on the type of material being tested and the type of wheel used. Rubber-base wheels wear unevenly during use and clog up as abrading progresses, thus requiring resurfacing and cleaning at appropriate intervals. Resurfacing disks (Carborundum-coated paper) of various degrees of coarseness are available for this purpose. These are mounted on the resurfacing platform which replaces the specimen-holder on the center shaft. A stiff brush may be used for removing loose particles from the surface of the wheels. A resurfacing and cleaning schedule shall be adopted for tests on various materials. The specimen shall be abraded for 2 specified number of revolutions of the table, such as 300 (or some other number, depending on the surface being abraded), after which the wheels shall be resurfaced for a specified number of revolutions of the table, such as 30, with the abrasive paper and then brushed clean. The specimen shall again be replaced and the sequence of abrading and resurfacing shall be continued to completion of the test. The resurfacing disks should be used for a definite number of revolutions of the table and discarded. On rubber-base wheels of medium coarseness, it has been found that 6 or 7 resurfacing of 30 revolutions of the table each were the limit of utility of the disks.

Vitrified-base wheels do not wear unevenly and consequently require no resurfacing unless the surface is accidently chipped or otherwise marred. The crevices of the surface clog during use and, during the test, should be cleaned of loose particles at specified intervals, such as every 300 revolutions of the table. Compressed air has been found to be most suitable for this purpose and is recommended. Vitrified-base wheels are not recommended for use on fabrics with surface coatings which clog the wheels too rapidly and cannot be removed with ease. If such material requires special solvents for removal or necessitates resurfacing of the wheels, such practice would not be recommended and the wheels should not be used.

4.1.1.5 Machine adjustments.

4.1.1.5.1 Wheels. In mounting rubber-base wheels, their position with respect to the center of the specimen-holder is critical. The lateral distance from the left-hand wheel-mounting flange to the center of the specimen-holder shall be 1-1/64 inches (25.8 mm) and from the same point to the right-hand wheel-mounting flange the distance shall be 1-5/64 inches (27.4 mm).
The position of vitrified-base abrasive wheels with respect to the center of the specimen-holder shall be equally spaced on both sides 1-3/64 inches (26.6 mm) from the wheel-mounting flange to the center of the specimen-holder.

4.1.1.5.2 Platform. The vertical distance from the center of the pivot point of the abraser arms to the top of the specimen-holder shall be approximately 1 inch (25 mm). This measurement is specified to prevent the possibility of errors incurred by installing a thrust bearing or the like to support the specimen-platform. Such adaptations shall be made so that the platform will remain at the above specified level. The specimen-platform shall rotate in the plane of its surface.

If it fails to do so and exhibits a tendency to wobble, the holder and adapter shall be replaced or a thrust bearing installed to support the specimen-holder.

4.1.1.5.3 Load. In order to reduce the load of the abraser wheels on the specimen, a counterweight attachment is provided. The use of this counterweight is not recommended, since studies in this regard have indicated variability in results due to the unequal counter-weighting of the individual arms.

4.1.1.5.4 Abraser wheel bearings. The abraser wheel bearings, that is, the two pair of bearings installed in the free end of the pivoting arms to support the abraser wheels, should not stick when caused to spin rapidly by a quick driving motion of the forefinger. The degree of freedom of rotation of these bearings, however, is not critical.

4.1.2 A means of removing dust, lint, and any disintegrated or worn away cloth from the test specimen by brushing or by vacuum, shall be specified in the procurement document.

4.1.3 A counter for recording the number of rotations of the specimen-platform.

4.2 Method Cited.

Method 5100, Strength and Elongation, Breaking of Woven Cloth; Grab Method.

5. PROCEDURE

5.1 Unless otherwise specified in the procurement document, the speed of the specimen-platform shall be 70 revolutions per minute.

5.2 The number and type of abrasive wheel and the magnitude of the counterweights shall be as specified in the procurement document.
5.3 Unless otherwise specified in the procurement document, the face surface of the specimen (weave face, finished side, coated side, etc.), shall be the surface to abrade.

5.4 The end point of the abrasion shall be (1) the number of rotations of the specimen-platform or (2) the state of destruction, as specified in the procurement document.

5.5 The test specimen shall be placed over the rubber mat on the specimen-holder. The ring clamp shall be placed over the specimen with the screw of the clamp at one end of the warp diameter and then pressed halfway down on the specimen-holder, the screw partly tightened, the clamp then pressed down as far as possible, and the screw tightened firmly. The washer and knurled nut shall then be secured in place to hold the center of the specimen.

5.6 The specimen-platform shall be rotated at the required speed and the specimen abraded to the required end point.

5.6.1 The specimen shall be cleaned of lint and abrasive particles on a scheduled basis as with the resurfacing and cleaning of the abraser wheels. The specimen shall not be removed from the specimen-holder until the entire test is completed. The rubber mat shall be wiped clean after each test.

5.7 When the number of rotations is specified as the end point, the abrasion resistance in each of the warp and filling direction shall be determined by the residual breaking strength or the change in breaking strength as specified in the procurement document.

5.8 When the residual breaking strength is required, the breaking strength of the abraded specimen shall be determined and when the change in breaking strength due to abrasion is required, the breaking strength of the original and abraded materials shall be determined in each of the warp and filling directions. The breaking strength shall be determined by Method 5100 except that the gage length shall be 1 inch (25 mm) and the abrasion path shall be placed midway between the jaws.

5.9 When the state of destruction is required, the number of rotations required to produce specified destructions shall be read from the counter.

6. REPORT

6.1 When the end point is a specified number of cycles, the abrasion resistance of the sample unit shall be expressed as residual breaking strength or change in breaking strength.

6.1.1 Residual breaking strength shall be the average of the results obtained from the specimens tested in each of the warp and filling directions and shall be reported separately to the nearest 1 pound (to the nearest 1 N).
6.1.2 Change in breaking strength shall be the average of the results obtained from the specimens tested in each of the warp and filling directions respectively and shall be reported separately to the nearest 1.0 percent.

\[
\text{Change in breaking strength, percent} = \frac{0 - A}{0} \times 100
\]

where:

\( O \) = breaking strength before abrasion.
\( A \) = breaking strength after abrasion.

6.2 When the end point is a required state of destruction, the abrasion resistance of the sample unit shall be the average of the number of cycles obtained from the specimens tested in each of the warp and filling directions respectively and shall be reported to the nearest 10 cycles.

6.3 Each individual value used to calculate the average shall also be reported.

7. NOTES

7.1 An abrasion machine of the type described may be obtained from Taber Instrument Co., 455 Bryant Street, North Tonawanda, NY 14120.
ROTARY ABRASION, DOUBLE HEAD

FRONT END VIEW

TOP VIEW

FABRIC AFTER TEST

ABRASIVE WHEELS

ROTATING SAMPLE PLATFORM 70 R.P.M.

TOGGLE SWITCH

OUTLET PLUG

SIDE VIEW

FIGURE 5306

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