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Standard Guide for Abrasion Resistance of Textile Fabrics (Rotary ~~Platform, Double-Head~~Platform Abrader Method)[1]

This standard is issued under the fixed designation D3884; 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 guide covers the determination of the abrasion resistance of textile fabrics using the rotary ~~platform, double-head tester (RPDH).~~ platform abrader.

NOTE 1—Other procedures for measuring the abrasion resistance of textile fabrics are given in Test Methods D3389, D3885, D3886, D4157, D4158, D4685, D4966, and AATCC 93. To determine the abrasion resistance of leather, refer to Test Method D7255.

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.~~standard. No other units of measurement are included in this standard.

1.2.1 *Exception*—English units are used when referencing rotational speed.

1.3 *This standard does not purport to address all of the safety ~~problems,~~concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate ~~safety~~ safety, health, and ~~health~~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:*[2]

D123 Terminology Relating to Textiles
D1776 Practice for Conditioning and Testing Textiles
D3389 Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader)
D3885 Test Method for Abrasion Resistance of Textile Fabrics (Flexing and Abrasion Method)
D3886 Test Method for Abrasion Resistance of Textile Fabrics (Inflated Diaphragm Apparatus)
D4157 Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)
D4158 Guide for Abrasion Resistance of Textile Fabrics (Uniform Abrasion)
D4685 Test Method for Pile Fabric Abrasion
D4850 Terminology Relating to Fabrics and Fabric Test Methods
D4848 Terminology Related to Force, Deformation and Related Properties of Textiles

[1] This guide is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.60 on Fabric Physical Test ~~Methods, Specific~~Methods B.

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[2] 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.

D4966 Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)
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)
D7255 Test Method for Abrasion Resistance of Leather (Rotary Platform, Abraser Method)
G195 Guide for Conducting Wear Tests Using a Rotary Platform Abraser

2.2 *Other Documents:*

AATCC 93 Abrasion Resistance of Fabrics: ~~Accelerator~~Accelerotor Method[3]

3. Terminology

3.1 For all terminology relating to D13.60, Fabric Test Methods, Specific, refer to Terminology D4850. For the definition of breaking force, refer to Terminology D4848.

~~3.1.1 The following terms are relevant to this standard: abrasion, abrasion cycle, breaking force.~~

3.2 *Definitions:*

3.2.1 The following terms are relevant to this standard: abrasion, abrasion cycle, breaking force.

3.2.2 *resurface, v*—procedure of cleaning and refreshing the running surface of an abrasive wheel prior to use or during testing.

3.3 For all other terminology related to textiles, refer to Terminology D123.

3.4 *Acronyms:*

3.4.1 *CAMI*—Coated Abrasives Manufacturers Institute

4. Summary of Test Method

4.1 A specimen is abraded using rotary rubbing action under controlled conditions of pressure and abrasive action. The test specimen, mounted on a turntable platform, turns on a vertical axis, against the sliding rotation of two abrading wheels. The wheels shall be mounted in such a way that when they are in contact with the rotating test specimen, they rotate in opposing directions. One abrading wheel rubs the specimen outward toward the periphery and the other, inward toward the ~~center.~~ center while a vacuum system removes wear debris generated during the test. The resulting abrasion marks form a pattern of crossed arcs over an area of approximately 30 cm^2. Resistance to abrasion is evaluated by various means which are described in Section 13.

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.~~

~~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 specimens.~~

5.1 ~~Abrasion tests are all subject to variation due to changes in the abradant during specific tests. The abradant must accordingly be discarded at frequent intervals or checked periodically against a standard. With disposable abradants, the abradant is used only once or discarded 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. Similar abradants used in different laboratories will not 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~~ The measurement of the ~~relative amount of abrasion may also~~ resistance to abrasion of textile and other materials is very complex and may be affected by ~~the method of evaluation and may be influenced by the judgment of the operator.~~ a number of factors, including:

5.1.1 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.

[3] Available from American Association of Textile Chemists and Colorists (AATCC), P.O. Box 12215, Research Triangle Park, NC 27709, http://www.aatcc.org.

5.1.2 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 specimens.

5.1.3 Changes in the abradant during specific tests.

NOTE 2—The abradant must accordingly be discarded at frequent intervals or checked periodically against a standard. With disposable abradants, the abradant is used only once or discarded 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. Similar abradants used in different laboratories will not 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.

5.1.4 The method of evaluation, which may be influenced by the judgment of the operator.

5.2 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 procedures and instruments that have been developed for abrasion resistance of fabrics may show a high degree of variability in results obtained by different operators and in different laboratories, however, they represent the procedures most widely used in the industry. Because there is a definite need for measuring the relative resistance to abrasion, this is one of the several procedures that is useful to help minimize the inherent variation in results that may occur.~~

5.3 Before definite predictions of fabric usefulness can be drawn from an abrasion test as made on the rotary ~~platform, double-head (RPDH)~~ platform abrader (Fig. 1), actual end-use trials should be conducted and related to the abrasion test. Different types of wear (for example, wear on men's clothing at cuffs, crotch, etc.) may correspond to different ratings of the ~~RPDH~~ rotary platform abrader test.

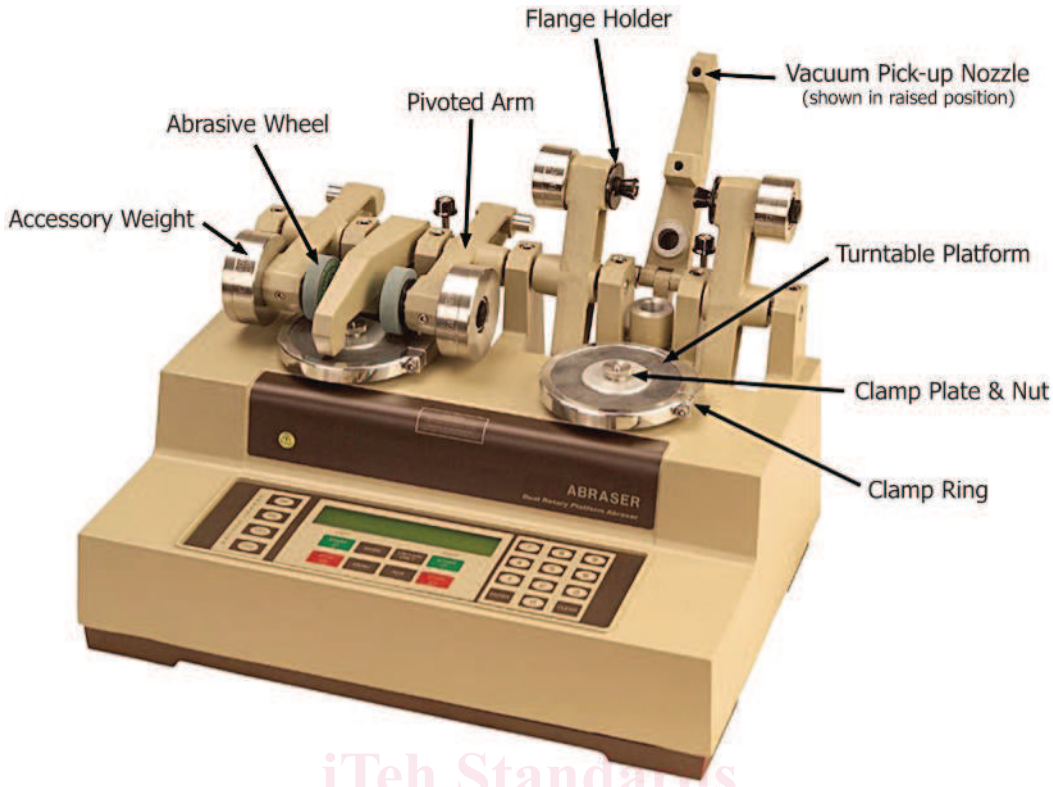
5.3.1 In making a comparison of different fabrics (that is, of different fibers, weights, etc.) the rotary platform abrader test will not always reveal a difference known to exist when the fabrics are actually used. Therefore, end-use trials should be conducted in conjunction with the abrasion test, at least as a guide for future testing of these fabrics.

5.3.2 Uncontrolled manufacturing or finishing variations occurring within a fabric or within lots of the same style of fabric can, however, be detected satisfactorily with the rotary platform abrader tester.

~~5.8 In making a comparison of different fabrics (that is, of different fibers, weights, etc.) the RPDH test will not always reveal a difference known to exist when the fabrics are actually used. Therefore, end-use trials should be conducted in conjunction with the RPDH abrasion test, at least as a guide for future testing of these fabrics.~~

~~5.9 Uncontrolled manufacturing or finishing variations occurring within a fabric or within lots of the same style of fabric can, however, be detected satisfactorily with the RPDH tester.~~

5.4 ~~Because of the conditions mentioned above, technicians frequently fail to get good agreement between results obtained on the same type of testing instrument both within and between laboratories, and the precision of these test methods is uncertain. This~~



NOTE 1—Vacuum suction system not shown.

FIG. 1 Rotary Platform ~~Double Head~~ Abrader

~~test method is accordingly not recommended for acceptance testing in contractual agreements between purchaser and supplier because of the poor between-laboratory precision of the test method.~~These general observations apply to all types of fabrics, including woven, nonwoven, and knit apparel fabrics, household fabrics, industrial fabrics, and floor coverings.

~~5.11 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 used are to be 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 *Rotary ~~Platform, Double-Head (RPDH)~~ Platform Abrader*[4] ~~(~~ (Fig. 1), as described in G195 and consisting of the following ~~elements described in~~ elements:~~6.1.1 – 6.1.5~~

6.1.1 ~~Removeable,~~Removable, turntable specimen platform that includes a rubber pad, clamp plate and centrally located threaded post with knurled nut, and clamp ring to secure the specimen. The ~~specimen holder~~turntable platform shall be motor driven, and mounted so as to produce circular surface travel of a flat specimen in the plane of its surface.

6.1.2 Motor capable of rotating the turntable platform and specimen at a speed of either 72 r/min ± 2 r/min or 60 r/min ± 2 r/min.

6.1.3 Pair of pivoted arms to which the abrasive wheels and accessory weights are attached.

~~6.1.3 Motor capable of rotating the platform and specimen at a speed of 72 ±2 r/min.~~

[4] The sole source of supply of the apparatus known to the committee at this time is Taber Industries, 455 Bryant St. North Tonawanda, NY 14120. If you are aware of alternate suppliers, please provide this information to ASTM headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

6.1.4 Vacuum ~~nozzle~~ suction system and vacuum ~~cleaner~~ pick-up nozzle for removal of lint and debris ~~from specimen.~~ generated during testing. The height of the vacuum nozzle shall be adjustable and the nozzle will have two 8 mm openings – one opening positioned between the two wheels and over the wear path and the other placed diametrically opposite. The distance between the axes of the two openings shall be 76.0 ~~±1.0~~ mm ± 1.0 mm.

6.1.5 Counter for indicating the ~~revolutions of the specimen holder.~~ number of abrasion cycles (revolutions of the turntable platform).

6.2 *Abrasive ~~wheels,~~wheels*[4], which are attached to the free end of the pivoted arms and rotate freely about horizontal spindles.

6.2.1 The wheels shall be cylindrical shaped; have an external diameter between 51.9 mm and 44.4 mm; a width of 12.7 mm ± 0.3 mm; and include an axial hole 16.0 mm ± 0.1 mm to allow the wheel to be mounted to the flanged holder on the pivoted arm. The running surface of the wheel shall be 90° to the side. The wheels are either resilient or vitrified-based with both types of wheels consisting of hard particles embedded in a binder material and are manufactured in different grades of abrasive quality. Other types of wheels, which do not include hard particles embedded in a binder material, may also be used (see Appendix X1).

6.2.2 ~~Their internal faces shall be 52.4 ±1.0 mm apart and the hypothetical line through the two spindles shall be 19.05 ±0.3 mm away from the central axis of the turntable (see Fig. 2).~~ When resting on the specimen, the wheels will have 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 angles of travel of one wheel periphery being opposite to that of the other. Motion of the abrasive wheels, in opposite directions, is provided by rotation of the specimen and the associated friction therefrom.

~~6.2.2 The abrasive wheels[4] are either resilient or vitrified-based. Both types of wheels consist of hard particles embedded in a binder material and are manufactured in different grades of abrasive quality. The wheels shall be 12.7 ±0.3 mm thick and have an external diameter of 51.9 ±0.5 mm when new, and in no case less than 44.4 mm.~~

6.3 *Accessory ~~Loads,~~Weights,* ~~The RPDH abrader is provided with a load adjustment for varying the load of the abrader wheels on the specimen.~~ attached to the pivoted arms to increase or decrease the force at which the wheel is pressed against the specimen, exclusive of the mass of the wheel itself. The pivoted abrader arms without auxiliary weights or counter weights apply a load against the specimen of 250 g per wheel ~~(exclusive of the mass of the wheel itself). The manufacturer provides additional weights that~~ and additional weights can be used to increase the load to 500 g or 1000 g per ~~wheel, and a~~ wheel. A counterweight attachment ~~that~~ can be used to reduce the load on the ~~specimen to 125 g per wheel.~~specimen.

~~6.4 *Auxiliary Apparatus*—Resurfacing discs (S-11), of carborundum-coated paper, are used to resurface the resilient wheels.~~

6.4 ~~*Abrasion Wheel Resurfacing Device,*~~ *Auxiliary Apparatus:* ~~for resurfacing vitrified based wheels or for correcting uneven wheel wear.~~

6.4.1 Resurfacing discs (S-11), for resurfacing resilient wheels. The resurfacing disc shall be silicon carbide coated abrasive paper with an average particle size of 92 µm (150 grit CAMI grade), approximately 102 mm in diameter with a 7 mm center hole.

6.4.2 Wheel refacer, with a diamond tool for resurfacing vitrified based wheels or for correcting uneven wheel wear.

6.4.3 Mounting card (optional), approximately 108 mm round with a 7 mm center hole and one side coated with pressure sensitive adhesive to secure the specimen.

6.4.4 Soft bristle brush, to remove loose fibers and debris from the surface of the abrading wheels.

6.4.5 AATCC Gray Scale for Color Change.

7. Sampling

7.1 Take a lot sample as directed in the applicable material specification, or as agreed upon by the ~~purchaser and seller.~~ interested parties. In the absence of such a specification or other agreement, take a laboratory sample as directed in 7.1.1. Consider rolls or pieces of fabric to be the primary sampling unit.

7.1.1 Take a laboratory sample that is the full width of the fabric and at least 50 cm ~~(approximately 20 in.)~~ long, from each roll or piece of fabric in the lot sample. The laboratory sample should be taken no closer than 1 m ~~(1 yd)~~ from the end of each roll or piece of fabric.

7.2 Sample shipments of garments as agreed upon by ~~purchaser and seller.~~the interested parties.

8. Number and Preparation of Test Specimens

8.1 If the number of specimens to be tested is not specified by a material specification or an agreement between ~~purchaser and seller,~~the interested parties, test five specimens.

8.1.1 If the number of specimens to be tested exceeds the number of laboratory samples, randomly select those laboratory samples from which more than one test specimen will be taken. If not, test one specimen per laboratory sample.

8.2 ~~Take specimens~~ In lieu of laboratory samples, specimens may be taken from garment samples as agreed upon by all interested parties.

8.3 Cut ~~ten~~ specimens approximately 15 cm ~~(6 in.) square, five for abrasion tests and five reserved for controls. For the five~~ square. For the specimens to be abraded, cut ~~a 6-mm~~ (or punch a 6.5 mm~~¼ in.~~) diameter hole in the center of the specimen. When determining residual or average breaking strength, cut an additional five specimens to be reserved for controls.

8.3.1 For fabric widths 125 mm ~~(5 in.)~~ or more, take no specimen closer than 25 mm ~~(1 in.)~~ from the selvage edge. Fabric widths less than 125 mm are not recommended.

~~8.3.2 For fabric widths less than 125 mm (5 in.), use the entire width for specimens.~~

8.3.2 Cut specimens representing a broad distribution diagonally across the width of the laboratory sampling unit. Take lengthwise specimens from different positions across the width of the fabric. Take widthwise specimens from different positions along the length of the fabric.

8.3.3 When breaking force or strength are to be measured, specimens must be appropriately marked to indicate which is the lengthwise or widthwise direction.

8.3.4 Ensure specimens are free of folds, creases, or wrinkles. Avoid getting oil, water, grease, etc. on the specimens when handling.

8.3.5 If the fabric has a pattern, ensure that the specimens are a representative sampling of the pattern.

9. ~~Preparation,~~ Calibration, and Verification of Apparatus

9.1 ~~*Wheel Position—*~~*Calibration—*~~The wheels should be spaced equally on both sides from the wheel-mounting flange to the center of the specimen holder. The distance from the inside of the~~Verify calibration of the rotary platform abrader as directed by the equipment manufacturer (see Appendix X2~~wheel mounting flange to the center of the specimen holder should be 38.9 ±0.5 mm (1.53 in.).~~).

~~9.2 *Wheel Bearings—*The abrader wheel bearings, installed in the free end of the pivoting arms to support the abrader wheels, should not stick when caused to spin rapidly by a quick driving motion of the forefinger.~~

~~9.3 *Platform Position—*The vertical distance from the center of the pivot point of the abrader arms to the top of the specimen holder should be approximately 25 mm (1 in.). The specimen platform should rotate in the plane of its surface, with no visible wobble. This can be checked with a dial indicator at the top outer edge of the platform.~~

~~9.4 *Platform Speed—*The platform should rotate at the speed stated in 6.1.3.~~

~~9.5 *Load*—The load to use is dependent on the type of textile fabric being tested, and should be agreed upon by the interested parties.~~

~~9.6 *Vacuum Suction*—The vacuum suction force should be adjusted to lift the abraded particles, but not lift the specimen. A setting of 75 – 100 has been found to be sufficient and should be used, unless otherwise agreed upon by the interested parties. At a vacuum level of 100, the suction force shall be 137 millibar (55 in. of water column) or greater, as measured by a vacuum gage.~~

~~9.7 *Selection of Wheels*—The abrasive wheels are manufactured in different grades and selection of which wheel type to use must be agreed upon by the interested parties. A wheel selection guide is presented in Appendix A to help with this selection process.~~

10. Standardization of Abrading Wheels

10.1 *Preparation of resilient abrading wheels*—To ensure that the abrading function of the wheels is maintained at a ~~constant~~consistent level; prepare the resilient wheels following 10.1.1 – ~~10.1.4~~10.1.5

10.1.1 Prior to testing, ensure the expiration date has not passed. Resilient wheels shall not be used after the date stamped on them.

10.1.2 Mount the selected resilient wheels on their respective flange holders, taking care not to handle them by their abrasive surfaces. Adjust the load on the wheels to the load agreed upon between the interested ~~parties.~~parties for testing (see 12.5).

10.1.3 Mount the resurfacing disc (S-11) on the turntable platform and affix using the clamp plate and nut, and clamp ring. Lower the abrading heads carefully until the wheels rest on the resurfacing disc. Place the vacuum pick-up nozzle in position and adjust it to a distance of 7 ~~±1 mm~~ mm ± 1 mm above the surface of the disc.

10.1.4 Set the counter to 'zero' and adjust the vacuum suction force to 100.

10.1.5 If the vacuum system does not turn on automatically at the start of the test, start the vacuum suction and then the turntable. Resurface the wheels by running them for the appropriate number of cycles against the resurfacing disc as shown in Table 1. Each resurfacing disc is good for one 25 or 50 cycle resurfacing operation, after which it must be discarded.

NOTE 3—*New Set of Wheels (break-in ~~procedure)~~ procedure)*—~~The composition of resilient wheels can make them subject to slight changes of form.~~ Before placing in service a new set of resilient wheels ~~they must be subjected to~~ perform two (2) resurfacings of 50 cycles to ensure perfect contact of the abrading faces with the specimen surface. The resurfacing disc is used only once (maximum of 50 cycles), therefore this initial resurfacing of new wheels will require two (2) resurfacing discs.

NOTE 4—*Starting a test with previously used ~~wheels~~wheels*—~~—~~Before testing a specimen with previously used wheels, resurface 25 or 50 cycles on a new resurfacing disc. When the previous test was short in duration (<1,000 cycles), resurfacing of 25 cycles is sufficient. When the previous test was 1,000 cycles or more, a resurfacing of 50 cycles is recommended. Wheels that have not been used for an extended period of time may require a break-in resurfacing like a new set of wheels.

NOTE 5—*Resurfacing during ~~testing~~testing*—~~—~~To maintain consistency and avoid clogging of wheel faces, the wheels may need to be cleaned or resurfaced periodically during the ~~test. Remove the specimen and resurface the wheels for 25 or~~ test for 50 cycles with a new resurfacing disc. ~~The sample should be carefully replaced on the specimen holder after resurfacing of the wheels. To prevent the integrity of the test from being jeopardized when removing and replacing the sample, specimens may be affixed to a mounting card (see Note 5).~~

TABLE 1 Preparation of Resilient Abrasive Wheels

Wheel Status	Resurfacing Cycles
~~Wheel Status~~	~~Resurfacing Cycles~~
New	2 resurfacings of 50 cycles
~~Used (previous test < 1 000 cycles)~~	~~25 or 50 cycles~~
Used	25 or 50 cycles
~~Used (previous test > 1 000 cycles)~~	~~50 cycles~~
~~During Test (after every 1 000 cycles)~~	~~25 or 50 cycles~~
During Test	50 cycles