Designation: D4157 – 13 (Reapproved 2017)

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

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 (ε) 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:*[2]

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 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: Accelerotor Method[3]

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.

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[1] 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.

Current edition approved July 15, 2017. Published August 2017. Originally approved in 1982. Last previous edition approved in 2013 as D4157 – 13. DOI: 10.1520/D4157-13R17.

[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.

[3] 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,* [4] (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 ± 2 mm (3 ± 0.1 in.) at the rate of 90 ± 1 cycles (double rub) per min.

6.1.2 *Four Specimen Holding Arms,* to permit testing of several specimens sumultaneously; 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 ±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 ± 25 g/m^2 (14 to 15.8 oz/yd^2).

6.2.1.2 *Weave Type*—plain weave.

6.2.1.3 *Fabric Count*—41 ± 1 end/in. × 28 ± 1 pick/in.

6.2.1.4 *Yarn Size*—7/2 cotton count ± 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.

[4] 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 brisstle, 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.

7.3 Take a laboratory sampling unit from each roll or piece of fabric in the lot sample that is full width and at least 50 cm (20 in.) long and not taken any closer to the end of the roll or piece of fabric than 1 m (1 yd).

7.4 Sample shipment of garments as agreed upon between purchaser and seller.

8. Number and Preparation of Test Specimens

8.1 In the absence of any applicable material specifications, take 12 specimens, 6 warp (machine direction) and 6 filling, (across machine direction) from each sample to be tested.

8.2 *Preparation of Specimens:*

8.2.1 Cut the test specimens 73 mm (2⅞ in.) by 245 mm (9⅝ in.). Specimens should be cut with flares or wings. The long dimensions are cut parallel to the warp yarns for warpwise (machine direction) abrasion and parallel to the filling yarns for filling-wise (cross-machine direction) abrasion. For woven fabrics do not cut two warp specimens from the same warp yarns or two filling specimens from the same filling yarns. If the fabric has a pattern, ensure that the specimens are representative sampling of the pattern.

8.2.2 Cut test specimens both in the length and widthwise directions of the fabric. Cut specimens representing a broad distribution diagonally across the length and the width of the fabric.

8.2.3 Ensure specimens are free of folds, creases or wrinkles. Take no specimens within 10 % of the selvage.

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

8.2.5 Seal edges when required to prevent raveling. The specimen edges may be sealed by use of rubber glue or by sewing using the stitch described in Test Method D5034.

9. Conditioning

9.1 For the tests made as described, precondition the specimens by bringing them to approximate moisture equilibrium in the standard atmosphere for preconditioning, then bring the specimens to moisture equilibrium for testing in the standard atmosphere for testing. Equilibrium is considered to have been reached when the increase in weight of the specimen in successive weightings made at intervals of not less than 2 h does not exceed 0.1 % of the weight of the specimen.

10. Preparation, Maintenance, and Calibration of Test Apparatus

10.1 Prepare and verify calibration of the abrasion tester using directions supplied by the manufacturer.

10.2 Verify that the rubber pads extend below their holders.

10.3 Verify that the entire lower surface of the rubber pad is in contact with the cylinder section, and that no space is observed. If space(s) are observed, reshape the lower pad surface as directed. Pads should be changed at least once a year.

10.3.1 If wire screen abradant is used, remove and clean with the nylon brush. Clean cylinder. Insert and clamp 50 grit sand paper to the cylinder. Remove all pressure from the pad and lock the specimen holding arm in position. Run the tester in 50 cycle increments. Inspect for spaces between the lower surface of the pad and the cylinder after each 50 cycles. Continue until the entire surface of the pad conforms to the shape of the cylinder section. The wear pattern on the sand paper can assist in determining conformance.

10.4 At lease on a weekly schedule: clean surface of the cylinder section and the steel screen by brushing and then using the mild detergent solution. Clean out vacuum system. Inspect the pads for wear and refurbish as directed in 10.3.1 as required.

10.5 After each test: brush the rubber pads to remove any loose fibers, etc. Using the nylon brush, clean the surface of the cylinder section and the steel screen by brushing and wiping with a cloth. If disposable abradants are used, such as emery paper or cotton duck, replace after each test.

10.6 Calibration of the Oscillatory Cylinder machine should be performed as specified in the appendix of this method.

11. Procedure

11.1 Test the conditioned specimens in the standard atmosphere for testing textiles, which is 70 ± 2°F (21 ± 1°C) and 65 ± 2 % relative humidity.

11.2 Select the abradant for a given end-use application. Refer to Table 1. Ensure the abradant is taut and secured squarely to the cylinder. In the absence of a specified abradant, ust the steel screen. If using #10 cotton Duck, be sure that a new piece of duck is used and that it is mounted on the machine with the short direction cut parallel to the warp direction. If the wire screen us being used, it should be preconditioned and should be discarded after 2 000 000 cycles or after the appearance of visible wear, whichever comes first.

11.3 Randomly reserve 4 warp and 4 filling unabraded specimens taken from the laboratory sampling unit for controls.

11.4 Handle the test specimens carefully to avoid altering the natural state of the material.

11.5 Set the sliding mass on the tension bar to the specified tension for a given end-use application. Refer to Table 1. In the absence of a specified tension, set to 8.9 N (2 lbf). Assure that the sliding mass is set to the appropriate tension.

11.6 *Specimen Mounting Options:*

11.6.1 *Option 1*—Place a specimen in the clamps of one arm with the long dimension parallel to the direction of the abrasion and the fabric face positioned to be in contact with the

TABLE 1 Typical Abradants, Pressures, and Tension for End-Use Applications

End Use Application	Abradant	Head Pressure, N (lbf)	Specimen Tension, N (lbf)
Upholstery General Contract	#10 Cotton Duck	13.4 N (3 lbf)	17.8 N (4 lbf)
Upholstery Heavy Duty	#10 Cotton Duck	13.4 N (3 lbf)	17.8 N (4 lbf)
Olefin Upholstery	Steel Screen	13.4 N (3 lbf)	17.8 N (4 lbf)

NOTE 1—Experience indicates that olefin fabrics are best tested with steel screen. Experience indicates that velvet fabrics are best tested on both the face and back.

abradant. Secure the specimen in the back clamp. Grasp the specimen at the front clamp, maintaining equal tension across the short direction and draw the specimen taut while bringing the weighted tension bar back into a horizontal position. Secure the front clamp. To obtain an even tension on all yarns, pull the specimen using a clamp with at least 1.5 in. wide jaws that meet squarely along their edge.

11.6.2 *Option 2*—Fasten the specimen in the forward clamp with the arm in the up position. Place the specimen through the rear clamp without tightening it. With the arm still in the up position, push on the tension bar and adjust the fabric in the bottom clamp. With one hand tighten the rear clamp maintaining the fabric in a position that with the arm down, the tension bar is level and has to be slightly adjusted.

11.7 Adjust the knurled screw on the top of the arm until the pressure bar rests in a horizontal position. This position is dependent on the thickness of the specimen. Check this with a spirit level.

11.8 Secure additional specimens in all of the test arms as directed in 11.4 – 11.7.

11.9 Set the automatic counter on the abrading machine to stop at the specified number of cycles. In the absence of a specified number of cycles, set to 3000. For longer tests, inspect every 5000 cycles.

11.10 Start the machine and abrade the specimens to the set number of cycles.

11.10.1 If the specimens stretch during the test, bring the scaled tension bar back into a horizontal position by adjusting the knurled screw behind the rear clamp and level using the spirit level.

11.11 Abrade a total of 2 warp wise (lengthwise) and 2 filling wise (widthwise) test specimens on each cycle. Test the number of specimens dictated by the material specifications.

11.12 After the specimens have been abraded to the set number of cycles or when other specified end point or failure occurs, evaluate by one or more of the procedures listed below.

12. Interpretation of Results

12.1 *Abrasion to Rupture*—Average the number of cycles to rupture for each sample using the following table:

Total Number of Cycles	Average to the Nearest
Under 200	10 cycles
200 to 1000 excl	25 cycles
1000 to 5000 excl	50 cycles
5000 and over	100 cycles

12.2 *Percentage Loss in Breaking Load*—Determine the breaking load of specimens abraded for a specified number of cycles, using Test Methods D5035, Ravel Strip Method. The abraded area of the specimens should be in the central portion of the raveled strip and be placed midway between the clamps of the tensile tester.

12.2.1 Determine the breaking load of an unabraded portion of the same sample, or control fabric, under the same conditions.

12.2.2 Compare the breaking load of the abraded specimens to that of the control specimens by calculating the loss in breaking load and report to the nearest 1.0 % using Eq 1:

$$\text{Loss in breaking load, } \% = 100(A - B)/A \quad (1)$$

where:

A = breaking load before abrasion, and
B = breaking load after abrasion.

12.3 *Evaluation for Visual Changes*—Abrade the specimen a specified number of cycles and then evaluate visually for the effect of the abrasion on luster, color, napping, pilling, etc.

12.3.1 *Option 1*—The end point is reached on a woven fabric when two or more yarns have broken, or on a knitted fabric when a hole appears.

12.3.2 *Option 2*—The end point is reached when there is a change in shade or appearance that is sufficient to cause a customer to complain. Changes of shade can arise from a variety of causes, for example, loss of raised finish from a fabric or of boucle loops or effects from fancy (novelty) yarns. Where different types of fibers are dyed differently in an intimate blend, differential loss of yarn or fiber can cause pronounced changes in shade or appearance. In this case, the end point is assessed against the AATCC Gray Scale for Color Change as agreed upon between purchaser and seller.

12.3.3 The end point is reached when the shade change is assessed as the AATCC Gray Scale rating of 3 or lower.

13. Report

13.1 State that the specimens were tested as directed in ASTM Test Method D4157. Describe the material or product sampled and the method of sampling used.

13.2 Depending on the test option used, report the following information:

13.3 Type of abradant used, tension, and load adjustment.

TABLE 2 Textured Woven Fabric

	1	2	3	4	5	6	Avg
	Op1	Op2	Op1	Op2	Op1	Op2	
Station 1	8500	7500	8500	8500	8500	8000	8250
Station 2	9000	7000	8000	9000	8500	8000	8250
Station 3	8000	7500	7500	8000	8500	7000	7750
Station 4	9000	8000	9000	8000	9000	8000	8500
Average	8625	7500	8250	8375	8625	7750	

Sample Statistics Textured Woven

	Operator 1	Operator 2	Pooled
Number of Observations	12	12	24
Average	8125	8150	8187.5
Variance	460227	295455	377841
Std. Deviation	678.401	543.557	614.688
Median	8000	8250	8000

Difference between Means = 125
Conf. Interval for Diff in Means: 95 %
Equal Vars. Operator 1- Operator 2- 645.553 395.553 22 Degree of Freedom
Unequal Vars. Operator 1- Operator 2- 646.993 396.993 21.0
Degree of Freedom
Ratio of Variances = 1.55769
Conf. Interval for Ratio of Variances: 0 %
Operator 1/Operator 2
Hypothesis Test for HO: Diff = 0
Computed *t* statistic = -0.498117
Vs Alt: NE
Sig. Level = 0.623345 At Alpha = 0.05 So Do Not Reject HO

TABLE 3 Print Cloth

	Op1	Op2	Op1	Op2	Op1	Op2	Avg
Station 1	1500	1500	1500	1500	1500	1500	1500
Station 2	2000	1500	1500	1500	2000	2000	1750
Station 3	1500	1500	1500	1500	1500	2000	1583
Station 4	1500	1500	1500	1500	2000	2000	1667
Average	1625	1500	1500	1500	1750	1875	

	Operator 1	Operator 2	Pooled
Number of Observations	12	12	24
Average	1625	1625	1625
Variance	51136.4	51136.4	51136.4
Std. Deviation	226.134	226.134	226.134
Median	1500	1500	1500

Difference Between Means = 0
Conf. Interval For Diff In Means: 95 %
Equal Vars Op 1 - Op 2 191.503 191.502 Degrees of Freedom 22
Unequal Vars. Op 1 - Op 2 191.503 191.503 Degrees of Freedom 22.0
Ratio of Variances = 1
Conf. Interval for Ratio of Variances: 0 %
Operator 1/Operator 2
Hypothesis Test for HO: Diff = 0
Computed *t* statistic = 0
Vs Alt: NE
Sig. Level 1
At Alpha = 0.05 So do not reject the HO

TABLE 4 Special Effects Fabrics Four Specimen Averages Four Labs, 2 Operators

NOTE 1—Radar Plot Illustrates Variation that are Fabric Specific

Geometric Fabric, Jacquard Woven Tapestry
Stripe Fabric, Dobbie Woven Stripe
Ballistic Fabric, Nylon Filament
Print Cloth, 80 × 80 Cotton Fabric

13.4 Average number of cycles required to rupture the specimen, if determined.

13.5 Average percentage loss (reported to the nearest percent) of breaking load obtained after abrasion for one or more specified number of cycles, if determined.

13.6 Effect of abrasion on luster, color, napping, pilling, thickness, etc., at a given number of cycles, recorded by qualitative or comparative ranking, if determined.

13.7 If any other means of evaluating the effect of abrasion is used, describe the particular method employed.

14. Precision and Bias

14.1 The precision and bias study presented is intended to represent typical plain, dobby and jacquard woven fabrics in wide use in the commercial upholstery industry. It is recognized that the degree of variability will be dependent on the type of fabrics being tested. therefore certain types of complex weaves and repeats such as in highly decorative materials or fabrics containing certain novelty yarns (for example, yarns with special effects such as nub, flakes, beads or loops) are not included in this study. For these materials, the precision and bias shall be determined using a program agreed upon between buyer and seller.

14.2 *Single Lab Test Data*—A single lab test was run in 2000 in which randomly drawn specimens of Textured Woven and Print Cloth fabrics were tested as directed by Test Method D4157. The laboratory used 2 operators, each of whom tested 12 specimens of each fabric. The components of variation as expressed in an ANOVA analysis are listed in Tables 2 and 3.

15. Keywords

15.1 abrasion; woven fabric

APPENDIXES

(Nonmandatory Information)

X1. OSCILLATORY CYLINDER ABRASION TESTER CALIBRATION PROCEDURE

X1.1 Purpose

X1.1.1 The purpose of this calibration procedure is to provide a method of calibration to control the accuracy of the Oscillatory Cylinder Abrasion Tester.

X1.2 Measurement Standards/Equipment

X1.2.1 Mark-10 Digital Force Gauge (Model EG-100) or Futek- calibrated and certified at least yearly.

X1.3 Procedure

X1.3.1 The tension applied to the fabric mounted in the Abrasion Tester is caused by the mechanical lever and weight assembly. The tension is checked by pushing with the Mark 10 Digital force Gauge at the fabric attachment clamp. To obtain the required pounds of tension the weight in the horizontal bar (extended graduated bar) can be repositioned. When the desired tension is obtained the knurled knob on the movable weight is tightened and the position of the weight on the bar is marked and secured.

X1.3.2 The compressive force applied by the abrasion pad is caused by a mechanical lever and weight assembly. The compressive force is checked by weighing the entire abrasion pad shaft. This is done by placing a strap under the pad and extending it above the shaft and attaching this strap to the Mark 10 digital force gauge. To obtain the required compressive force, the weight on the horizontal bar (pressure bar) can be repositioned. When the desired tension is obtained the knurled knob on the moveable weight is tightened and the position of the weight on the bar is marked and secured.

X1.4 Interval and Source

X1.4.1 The calibration/verification of the abrasion tester is to be performed by the calibration team, test lab supervisor, qualified technician or approved subcontractor. A record is maintained that identifies the abrasion tester and lists the date for each instance of calibration. The abrasion tester shall be identified with the calibration status stating at least the date calibrated, the next due date and the person responsible for calibrating.

Normative Information

X2. OSCILLATORY CYLINDER ABRASION TESTER CALIBRATION PROCEDURE

X2.1 Measurement Standards and Equipment

X2.1.1 Mark-10 digital Force gauge or Futek, or equivalent, NIST certified.

X2.2 Procedure

X2.2.1 The mechanical lever and weight assembly causes the tension applied to the fabric that is mounted in the abrasion tester. A mechanical lever and weight assembly causes the compressive force applied to the abrasion pad. Perform the calibration procedure as follows:

X2.2.2 *Tension Arm*—Push the digital force gauge at the fabric attachment clamp and check the tension. If required, loosen the knurled knob on the moveable weight and position on the horizontal tension bar (extended graduated bar) until the required tension is shown on the force gauge. Tighten the knurled know and mark the position of the weight for future reference.

X2.2.3 *Pressure Bar*—Using a strap, or other means, (having essentially no appreciable weight) as a sling, place under the pad and extend it above the shaft, attaching it to the force gauge. If required, loosen the knurled knob on the moveable weight and position on the horizontal pressure bar (extended graduated bar) until the required tension is shown on the force gauge. Tighten the knurled knob and mark the position of the weight for future reference.

X2.2.4 *Calibration Interval*—Verify and calibrate the test apparatus on a periodic basis using a qualified calibration team, or other qualified personnel or subcontractor at site. Maintain a record of the verification and if any adjustments were made. On this record show the identity of the test apparatus, dates calibration performed, values obtained, adjustments made and date of next calibration. Also, identify the apparatus as of calibration status, date calibrated, date of next calibration and person responsible.