



# Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform, Double-Head Abrader)<sup>1</sup>

This standard is issued under the fixed designation D 3389; 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.

## 1. Scope

1.1 This test method covers the determination of the resistance to abrasion of fabrics coated with rubber or plastics. The abrasion is measured by mass loss.

1.2 Two methods are covered as follows:

1.2.1 *Method A*—Abrasion to end point (Sections 8-10).

1.2.2 *Method B*—Abrasion for a specified number of cycles with determination of loss in mass (Sections 11-13).

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*

D 4483 Practice for Determining Precision for Test Method Standards in the Rubber and Carbon Black Industries<sup>2</sup>

## 3. Summary of Test Method

3.1 Abrasion resistance of fabrics coated with rubber or plastics is measured by subjecting the specimen to the rotary-rubbing action of two abrasive wheels under controlled conditions of pressure by the use of the revolving platform, double-head (RPDH) abrader.<sup>3</sup> This action is maintained by the use of abrasive wheels.

## 4. Significance and Use

4.1 Abrasion resistance tests are intended to measure the abrasive properties of a material. This may be correlated to expected end use performance.

## 5. Time Lapse Between Manufacturing and Testing

5.1 For all test purposes, the minimum time between manu-

facturing and testing should be 16 h.

5.2 For non-product tests the maximum time between manufacturing and testing should be 4 weeks. For evaluation intended to be comparable, the tests, as far as possible, should be carried out after the same time interval.

5.3 For product tests, whenever possible, the time between manufacturing and testing should not exceed 3 months. In all other cases, tests should be made within 2 months of the date of receipt by the customer.

## 6. Apparatus

6.1 *Abrasion Apparatus* (RPDH), comprised of a removable flat circular specimen holder, a pair of pivoted arms to which the abrasive wheels are attached, 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. The specimen holder shall be mounted to produce a circular surface travel of an essentially flat specimen in the plane of its surface at a uniform angular velocity. The abrasive wheels, which are attached to the free end of the pivoted arms, shall 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 abrasive wheels, in opposite directions, shall be provided by rotation of the specimen and the associated friction therefrom.

6.1.1 The specimen holder shall be supported by an adapter that is motor-driven and that provides motion for the circular travel of the specimen holder.

6.1.2 A clamping ring shall be used to secure the specimen to the specimen holder.

6.1.3 The abrasive wheels shall be mounted on independently pivoted arms, which provide free-floating action to compensate for any minor unevenness in the specimen and ensure uniform pressure of the abrasion wheels against the specimen at all times (selection of abrasive wheels to be made by the purchaser and vendor).

6.1.4 The apparatus shall be provided with a vertical-force adjustment (weights) for varying the vertical force of the abrader wheels on the specimen. The pivoted abrader arms without auxiliary masses or counterweights apply a vertical force against the specimen of 2.45 N (250 gf) per wheel. A start

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D-11 on Rubber and is the direct responsibility of Subcommittee D11.37 on Coated Fabrics and Rubber Thread.

Current edition approved Feb. 15, 1994. Published May 1994. Originally published as D 3389 – 75. Last previous edition D 3389 – 87.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 09.01.

<sup>3</sup> The Taber Abrader and Wheels, manufactured by the Teledyne Taber Instrument, Co., North Tonawanda, NY, meets these requirements.

on the rear end of the abrading arm may be used to carry a counter-weight when it is desired to reduce the wheel load from 2.45 N (250 gf) to 1.23 N (125 gf) when testing delicate materials.

6.2 *Auxiliary Apparatus*—A stiff brush shall be provided for removal of loose particles from the surface of the wheels and a small vacuum cleaner attachment to remove the loose particles from the specimen during the test. Compressed air, which shall be free of moisture and oil, should be used for cleaning the surface of the specimen. The air is delivered to a manifold or nozzle where the pressure shall be maintained at  $200 \pm 35$  kPa ( $30 \pm 5$  psi). The vacuum cleaner and air should be turned on and used throughout the test.

6.3 *Balance*, suitable for weighing to the nearest 1 mg.

6.4 *Wheel Bearings*—The abrader wheel bearings, that is, the two pairs of 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. The degree of freedom of rotation of these bearings, however, is not critical.

6.5 *Platform Position*—The vertical distance from the center of the pivot point of the abrader arms to the top of the specimen holder shall be approximately 25 mm (1.0 in.). This measurement is specified to prevent possibility of errors incurred by installing a thrust bearing or the like to support the specimen platform. Adaptions shall be made such 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.

6.6 *Platform Speed*—The speed of rotation of the platform shall be  $7.0 \pm 0.11$  rad/s ( $70 \pm 1$  rpm).

## 7. Test Specimens

7.1 Unless otherwise specified, make five tests on each sample of coated fabrics.

7.2 Cut circular test specimens approximately 110 mm (4½ in.) in diameter. Cut a 6-mm (¼-in.) hole in the center of the specimen. Take care in cutting out specimens. Use the best portion of the sample to be tested. It should be free of holes, blisters, or other imperfections.

### METHOD A—ABRASION TO END POINT

## 8. Procedure

8.1 Test the conditioned specimens in the standard atmosphere for testing,  $20 \pm 2.0^\circ\text{C}$  and  $65 \pm 2$  % relative humidity, unless otherwise specified. On thin flexible materials that cannot be clamped to the specimen holder, it will be necessary to cement (Note 1) these specimens to some other substrate. A10-ply white cardboard has been found satisfactory.

NOTE 1—A good rubber cement will be satisfactory; however, ensure that the cement used does not have any adverse effect on the fabric or coating. If a solvent-base cement is used, allow the assembly to condition at least overnight or until the assembly maintains constant mass.

8.2 Install the wheels on their respective flanged holders as indicated by the printing on the side of the wheel.

8.3 Determine the original mass of the specimen or the

assembly, or both. Place the test specimen with its coated side up over the rubber mat on the specimen holder. Secure the washer and knurled nut in place to hold the center of the specimen. Place the ring clamp over the specimen and tighten the screw of the ring clamp.

8.4 The tester is equipped with a counter that operates in conjunction with the turntable. Set the counter at zero.

8.5 Start the abrader and run to the end point. The end point shall be defined as that point just before abrading through the coating to the fabric. First decide number of revolutions and the vertical force to be used by testing a specimen from each sample. The quality and the thickness of the coating will indicate the required vertical force and the number of revolutions needed to measure the abrasion resistance of the coating. After establishing the required vertical force and number of revolutions, test the specified number of specimens for each sample. Do not abrade through the coating. This test method is for testing the abrasion resistance of the coating only.

8.6 *Cleaning of Specimen*—Clean the specimen of abrasive particles on a scheduled basis. The vacuum cleaner, compressed air, and a brush should be used for this purpose. Wipe the rubber mat clean after each test.

8.7 At the conclusion of the test, weigh the specimen and report the mass loss as milligrams loss per revolution.

## 9. Calculation

9.1 Since Method A is comparative and determines abrasion to an end point, no calculation is necessary; merely report the number of cycles taken from the counter.

9.2 If weight loss is also desired, follow the calculation procedure in Section 12, but using the number of cycles noted from 9.1.

## 10. Report

10.1 The report shall include the following:

10.1.1 Test conditions,

10.1.2 Number of specimens tested,

10.1.3 Type of wheels,

10.1.4 Total revolutions and vertical force used, and

10.1.5 Mass loss per revolutions, mg.

### METHOD B—ABRASION FOR SPECIFIED NUMBER OF CYCLES WITH DETERMINATION OF LOSS IN MASS

## 11. Procedure

11.1 Test the conditioned specimens in the standard atmosphere for testing,  $20 \pm 2.0^\circ\text{C}$  and  $65 \pm 2$  % relative humidity, unless otherwise specified. On thin flexible materials that cannot be clamped to the specimen holder, it will be necessary to cement (Note 1) these specimens to some other substrate. A10-ply white cardboard has been satisfactory.

NOTE 2—A good rubber cement will be satisfactory, however, ensure that the cement used not have any adverse effect on the fabric or coating. If a solvent-base cement is used, allow the assembly to condition at least overnight or until the assembly maintains constant mass.

11.2 Install the wheels on their respective flanged holders as indicated by the printing on the side of the wheel.

11.3 Determine the original mass of the specimen or the assembly, or both. Place the test specimen with its coated side up over the rubber mat on the specimen holder. Secure the washer and knurled nut in place to hold the center of the specimen. Place the ring clamp over the specimen and tighten the screw of the ring clamp.

11.4 The tester is equipped with a counter that operates in conjunction with the turntable. Set the counter at zero.

11.5 Start the abrader and run the number of cycles specified using the specified weights.

11.6 *Cleaning of Specimen*—Clean the specimen of abrasive particles on a scheduled basis. The vacuum cleaner, compressed air, and a brush should be used for this purpose. Wipe the rubber mat clean after each test.

11.7 At the conclusion of the test, weigh the specimen and report the mass loss as milligrams loss per revolution.

## 12. Calculation

12.1 Calculate the loss in mass as follows:

Mass loss per revolution, g = original mass (before test) – final mass (after test)/number of revolutions

Example:

12.3596 Original Mass, g

12.2829 Final Mass, g

0.0767 Mass Loss, g for 500 revolutions

$$g = \frac{0.0767 \times 1000 \text{ mg/g}}{500} = 0.153 \text{ mg per revolution} \quad (1)$$

## 13. Report

13.1 The report shall include the following:

13.1.1 Test conditions,

13.1.2 Number of specimens tested,

13.1.3 Type of wheels,

13.1.4 Total revolutions and vertical force used, and

13.1.5 Mass loss per revolutions, mg.

## 14. Precision and Bias (Method B)<sup>4</sup>

14.1 This precision and bias section has been prepared in accordance with Practice D 4483. Refer to Practice D 4483 for terminology and other statistical calculation details.

14.2 A Type 1 (interlaboratory) precision was evaluated in 1985. Both repeatability and reproducibility are short term, a period of a few days separates replicate test results. A test result is the value, as specified by this test method, obtained on 5 determinations or measurements of the property of parameter in question.

14.3 Three different materials were used in the interlaboratory program. These materials were tested in four laboratories on two different days.

14.4 The results of the precision calculations for repeatability and reproducibility are given in Table 1, in ascending order of material average or level, for each of the materials evaluated.

14.5 Repeatability, *r*, varies over the range of material levels as evaluated. Reproducibility varies over the range of material levels evaluated.

14.6 The precision of this test method may be expressed in the format of the following statements which use what is called an “appropriate value” of *r*, *R*, (*r*), or (*R*), that is, that value to be used in decisions about test results (obtained with the test method). The appropriate value is that value of *r* or *R* associated with a mean level in Table 1 closest to the mean level under consideration at any given time, for any given material in routine testing operations.

14.7 *Repeatability*—The repeatability, *r*, of this test method has been established as the appropriate value tabulated in Table 1. Two single test results, obtained under normal test method procedures, that differ by more than this tabulated *r* (for any given level) must be considered as derived from different or nonidentical sample populations.

14.8 *Reproducibility*—The reproducibility, *R*, of this test method has been established as the appropriate value tabulated in Table 1. Two single test results obtained in two different laboratories, under normal test method procedures, that differ by more than the tabulated *R* (for any given level) must be considered to have come from different or nonidentical sample populations.

14.9 Repeatability and reproducibility expressed as a percentage of the mean level, (*r*) and (*R*), have equivalent application statements as above for *r* and *R*. For the (*r*) and (*R*) statements, the difference in the two single test results is expressed as a percentage of the arithmetic mean of the two test results.

<sup>4</sup>Supporting data are available from ASTM Headquarters. Request RR:D 11-1044.

**TABLE 1 Type 1 Precision (Method B)**

NOTE:

<i>Sr</i>	=	repeatability standard deviation.
<i>r</i>	=	repeatability = 2.83 of the square root of the repeatability variance.
( <i>r</i> )	=	repeatability (as percentage of material average).
<i>SR</i>	=	reproducibility standard deviation.
<i>R</i>	=	reproducibility = 2.83 of the square root of the reproducibility variance.
( <i>R</i> )	=	reproducibility (as percentage of material average).

Material	Average	Within Laboratories			Between Laboratories		
		<i>Sr</i>	<i>r</i>	( <i>r</i> )	<i>SR</i>	<i>R</i>	( <i>R</i> )
Material A	0.62	0.0784	0.2219	36.047	0.2636	0.7461	121.204
Material B	0.21	0.0248	0.0701	34.013	0.1413	0.3999	193.940
Material C	0.78	0.0548	0.1552	19.852	0.2554	0.7228	92.451
Pooled Values <sup>4</sup>	0.53	0.0571	0.1615	30.213	0.2271	0.6427	120.228

<sup>4</sup>No values omitted.

14.10 *Bias*—In test method terminology, bias is the difference between an average test value and the reference (or true) test property value. Reference values do not exist for this test method since the value (of the test property) is exclusively defined by the test method. Bias, therefore cannot be determined.

## 15. Keywords

15.1 abrasion; coated fabrics; mass loss; plastics; rubber

*The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or [service@astm.org](mailto:service@astm.org) (e-mail); or through the ASTM website ([www.astm.org](http://www.astm.org)).*