



Designation: D 1242 – 95a

Standard Test Methods for Resistance of Plastic Materials to Abrasion¹

This standard is issued under the fixed designation D 1242; 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 Department of Defense.

1. Scope

1.1 These test methods cover the determination of the resistance to abrasion of flat surfaces of plastic materials, measured in terms of volume loss, by two different types of abrasion-testing machines, as follows:

1.1.1 *Test Method A*—Loose abrasive, and

1.1.2 *Test Method B*—Bonded abrasive on cloth or paper (abrasive tape).

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

NOTE 1—There is no similar or equivalent ISO standard.

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

2. Referenced Documents

2.1 *ASTM Standards:*

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

D 883 Terminology Relating to Plastics²

D 4000 Classification System for Specifying Plastic Materials³

D 4805 Terminology of Plastics Standards⁴

E 11 Specification for Wire-Cloth Sieves for Testing Purposes⁵

3. Terminology

3.1 *Definitions*—For definitions of technical terms pertaining to plastics used in these test methods, see Terminology D 883 or Terminology D 4805.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *resistance to abrasion*—the ability of a material to withstand mechanical action such as rubbing, scraping, or erosion, that tends progressively to remove material from its surface.

4. Significance and Use

4.1 The measurement of the resistance to abrasion of plastic materials is very complex. The resistance to abrasion is affected by many factors such as the physical properties of the polymeric material, particularly hardness, resilience, and the type and degree of added filler such as cellulose fiber or pigment. Resistance to abrasion is also affected by conditions of the test, such as the nature of the abradant, action of the abradant over the area of the specimen abraded, and development and dissipation of heat during the test cycle.

4.2 Although laboratory measurement of the resistance to abrasion of a given material may be closely allied, in some instances, to material quality, results should not be used as an absolute index of ultimate life, particularly in view of varied end-use applications. Correlation of laboratory abrasion data with end-use performance depends upon the ability to assess those actions in service which affect durability, and it is for this reason that many different types of testing machines have been employed. Results from machines such as those described in these test methods are of value chiefly in the development of materials, and should not be used without qualification as a basis for commercial comparisons.

4.3 The procedures described in these test methods have been prepared in an attempt to standardize methods of test used for measuring abrasion resistance of plastic materials. It is believed that the standardization of such test methods, plus the addition of new test methods as developed, and subsequent choice of that test method most closely simulating service conditions, will provide a means of measuring durability of plastic materials for a given application. These test methods have been prepared in an attempt to attain these objectives.

4.4 For many materials, there may be a specification that requires the use of these test methods, but with some procedural modifications that take precedence when adhering to the specification. Therefore, it is advisable to refer to that material specification before using these test methods. Table 1 of

¹ These test methods are under the jurisdiction of ASTM Committee D-20 on Plastics and are the direct responsibility of Subcommittee D20.10 on Mechanical Properties.

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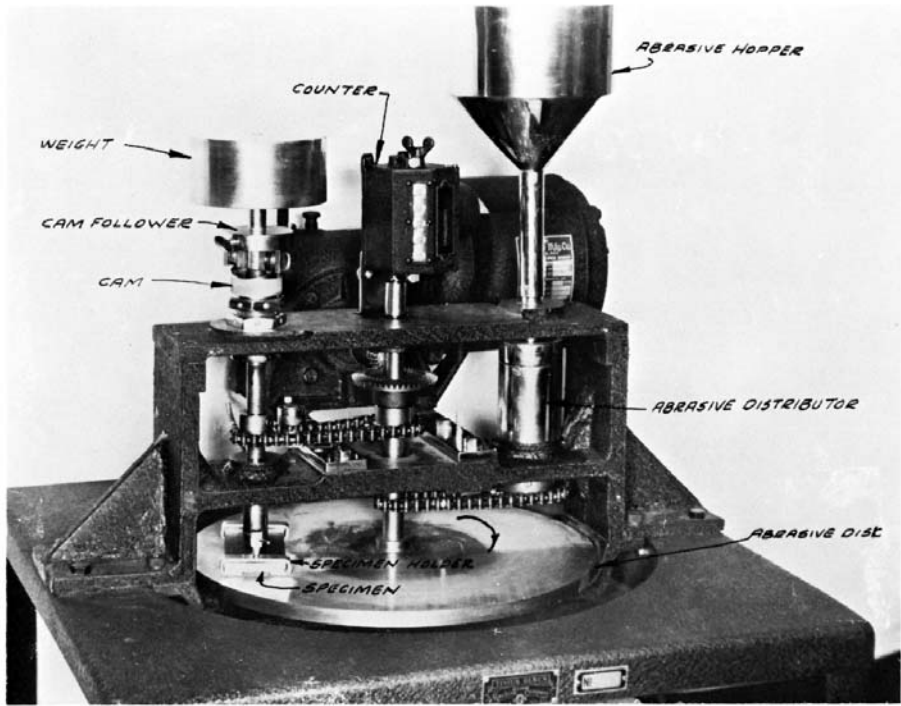
This edition includes the addition of an ISO equivalency statement.

² *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 08.02.

⁴ *Annual Book of ASTM Standards*, Vol 08.03.

⁵ *Annual Book of ASTM Standards*, Vol 14.02.



NOTE 1—Distance from center line of camshaft to center line of rotating disk shaft shall be 127 mm (5 in.).

FIG. 1 Loose Abrasive Abrading Machine

Classification System D 4000 lists the ASTM materials standards that currently exist.

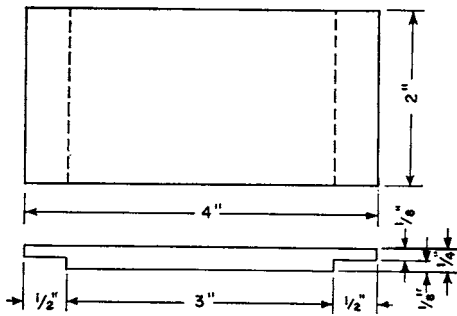


Table of Metric Equivalents

in.	1/8	1/4	1/2	2	3	4
mm	3.18	6.35	12.7	51	76	102

FIG. 2 Specimen Mounting Plates (Aluminum)

TEST METHOD A—LOOSE ABRASIVE⁶

5. Apparatus

5.1 The apparatus shown in Fig. 1⁷ shall consist of the following: a rotating disk, a specimen-mounting plate holder, a

cam arrangement for actuating the specimen holder, hopper and distributor for feeding fresh abrasive, hopper for collecting used abrasive, revolution counter, an added weight of 4.5 kg (10 lb), and suitable mechanism for driving the disk at 23½ r/min and the specimen holder at 32½ r/min.

5.2 Metal Plate, 63.5 by 88.9 by 1.6 mm (±0.05 mm) (2½ by 3½ by 1/16 in. (±0.002 in.)), for adjusting height of drop.

5.3 Specimen Mounting Plate, made of aluminum in accordance with Fig. 2, for mounting test specimens.

5.4 Analytical Balance, for weighing specimen to a precision of 0.001 g.

5.5 Aluminum Oxide Grit No. 80 TP⁸, or other abradant as specified.

5.6 Suitable Adhesive,⁹ for adhering test specimens to the specimen plate.

6. Test Specimens

6.1 The test specimen shall measure 50.8 ± 0.4 by 76.2 ± 0.4 mm (2 ± 1/64 by 3 ± 1/64 in.), and shall be mounted face up on the raised 50.8 by 76.2-mm (2 by 3-in.) portion of the specimen mounting plate by means of a suitable adhesive.

⁶ This test method is based on the development described by A. W. Cizek, Jr., D. H. Kallas, and N. Nestlen in "A New Machine for Measuring Wear Resistance of Walkway Materials," ASTM Bulletin, No. 132, Jan. 1945.

⁷ The Olsen Wearometer, manufactured by the Tinius Olsen Testing Machine Co., Willow Grove, PA, has been found satisfactory for this purpose.

⁸ No. 80 TP aluminum oxide grit is manufactured by the Carborundum Co., Niagara Falls, NY. Typical screen analysis on this grit has shown from a trace to 1.0 % retained on the No. 60 (250-µm) sieve, and 5 to 15 % passing the No. 100 (149-µm) sieve. Detailed requirements for these sieves are given in Specification E 11.

⁹ Adhesive 3M, Type 1711 or 2141, manufactured by the Minnesota Mining & Mfg. Co., has been found satisfactory for this purpose.



Good adhesion can be obtained by holding the mounted specimen for 24 h under a 2.3-kg (5-lb) weight in the conditioning room.

6.2 The required number of specimens for each test shall be indicated in the material specifications. In the event the material specifications omit this requirement, the material shall be sampled in triplicate, and duplicate measurements shall be made on each specimen. The average of the six measurements shall be taken as the abrasion loss for the material.

7. Conditioning

7.1 *Conditioning*—Condition the test specimens at $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and $50 \pm 5\%$ relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D 618, for those tests where conditioning is required. In cases of disagreement, the tolerances shall be $\pm 1^\circ\text{C}$ ($\pm 1.8^\circ\text{F}$) and $\pm 2\%$ relative humidity.

7.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and $50 \pm 5\%$ relative humidity, unless otherwise specified in the test methods or in this test method. In cases of disagreements, the tolerances shall be $\pm 1^\circ\text{C}$ ($\pm 1.8^\circ\text{F}$) and $\pm 2\%$ relative humidity.

8. Procedure

8.1 Determine the density of the material to be tested in accordance with standard analytical procedures.

NOTE 2—If the specimen as received is not homogeneous, but possesses a surface that differs from the body or core, determine the density of the surface alone. If abrasion is to be carried beyond this surface into the body, then determine also the density of the latter and calculate and report the abrasion resistance of the two components separately.

8.2 Fill the abrasive container with the grit and adjust the rate of feed¹⁰ to $44 \pm 2\text{g/min}$.

8.3 Weigh the mounted test specimen to the nearest 0.01 g, and attach to the specimen plate holder by means of the end clamp provided.

8.4 Place the weight on the specimen shaft, brush off grit under the specimen, place the 1.6-mm ($1/16$ -in.) spacer under the specimen with the larger dimension on the surface of the rotating disk, and adjust the cam follower to this maximum lift. Remove the spacer.

8.5 Set the counter for 1000 revolutions, and run the machine.

8.6 When the machine has stopped, check to see that the revolution counter has returned to zero, remove the mounted specimen, clean with a filtered air blast, and reweigh.

8.7 Inspect the abraded specimen for imbedded grit, unevenness on the abraded surface, peeling off of adhesive, chipped corners or edges, or any irregularities affecting loss of weight weighings.

8.8 For continuing runs, reattach the specimen mounting plate to the specimen plate holder, readjust to a 1.6-mm ($1/16$ -in.) lift as described in 8.4, and repeat the steps given in 8.5, 8.6, and 8.7.

9. Calculation

9.1 Calculate the resistance to abrasion or the abrasion loss as the loss in volume at 1000 revolutions, as follows:

$$\text{Volume loss, cm}^3 = (W_1 - W_2)/D$$

where:

W_1 = initial weight, g,

W_2 = weight after abrasion, g, and

D = density of the material being abraded.

10. Report

10.1 Report the following information:

10.1.1 The resistance to abrasion or the abrasion loss in volume at 1000 revolutions, as calculated in 9.1,

10.1.2 The average volume loss in cubic centimeters at 1000 revolutions for the three specimens tested in duplicate,

10.1.3 The 95 % confidence limits, and

10.1.4 The name and grade of abrasive grit employed in making the test.

NOTE 3—It should be noted that abrasion loss can be expressed in other ways, using the data given above. For instance, the average loss in thickness of the abraded test specimen can be calculated by dividing the loss in volume by the area of the abraded specimen.

11. Precision and Bias

11.1 *Precision*:

11.1.1 The coefficient of variation¹¹ for the six measurements performed on a single machine shall not exceed 7 %. The data from which this information was generated are no longer available.

11.1.2 A meaningful precision statement cannot be developed at this time because of the small number of laboratories using this test method.

11.1.3 *Bias*—There are no recognized standards on which to base an estimate of bias for this test method.

TEST METHOD B—BONDED ABRASIVE ON CLOTH OR PAPER (ABRASIVE TAPE)¹²

12. Apparatus

12.1 The apparatus shown in Fig. 3,¹³ with a schematic arrangement as shown in Fig. 4, shall consist of the following:

12.1.1 A continuous link belt with flat metal carrier plates upon which test specimens and zinc calibration standards may be mounted, and a constant-speed mechanism to provide a rate of travel of 2 m (80 in.)/min for the specimens.

¹¹ See *Manual on Quality Control of Materials, ASTM STP 15-C*, ASTM, 1951, for the method of calculating the coefficient of variation.

¹² This test method is based upon the development described by F. M. Gavan, S. W. Eby, Jr., and C. C. Schrader In "A New Sandpaper Abrasion Tester," *ASTM Bulletin*, No. 143, Dec. 1946.

¹³ A machine meeting the requirements of this test method is available from Custom Scientific Instruments, Inc., P.O. Box A, Whippany, N.J. 07981.

¹⁰ Feed rate may be measured by holding a tared Petri dish under the abrasive distributor for 1 min, while the machine is running, and weighing the amount of grit delivered. Feed rate may be adjusted by repositioning the abrasive feed impeller shaft upon which the abrasive hopper is mounted, either upward or downward. Fresh grit should always be used, and no attempt made to reclaim or run used grit.