Designation: ~~F510/F510M – 14~~ F510/F510M – 20

Standard Test Method for Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method[1]

This standard is issued under the fixed designation F510/F510M; 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[2] describes a laboratory procedure for determining the abrasion resistance of resilient flooring using an abrader with a grit feeder.[3]

1.2 The equipment used in this test method is a modification of the Taber abraser. The regular abrading wheels are replaced by leather clad brass wheels (rollers). As the specimen holder rotates, a grit-feeding device ~~feeds~~dispenses aluminum oxide grit onto the specimen before ~~it~~ the grit passes under the leather clad brass wheels. As the specimen rotates, the rub-wear action of the wheels and abrasive grit causes abrasion on the test piece. Using the vacuum system incorporated in the apparatus, the used grit and abraded material are removed after passing under both wheels.

1.3 This test method employs a rotary, rubbing action caused by loose abrasive grit and the two abrading wheels. One wheel rubs the specimen from the center outward and the other from the outside toward the center. The wheels traverse a complete circle and have an abrasive action on the rotating specimen at all angles. This action approaches the twisting action between shoe and floor that occurs when a person turns. The use of loose grit serves the function of an abradant and also aids in the rolling action characteristic of normal walking.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.5 *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.*

1.6 *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:*[4]

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

G195 Guide for Conducting Wear Tests Using a Rotary Platform Abraser

---

[1] This test method is under the jurisdiction of ASTM Committee F06 on Resilient Floor Coverings and is the direct responsibility of Subcommittee F06.20 on Test Methods.

Current edition approved ~~May 1, 2014~~May 1, 2020. Published ~~June 2014~~June 2020. Originally approved in 1978. Last previous edition approved in ~~2013~~2014 as F510~~–13.~~–14. DOI: ~~10.1520/F0510_F0510M-14.~~10.1520/F0510_F0510M-20.

[2] ~~This test method is described by W. E. Irwin in "Development of a Method to Measure Wear on Resilient Flooring," *Journal of Testing and Evaluation*, Vol 4, No. 1, January 1976, pp. 15–20.~~This test method is described by W. E. Irwin in "Development of a Method to Measure Wear on Resilient Flooring," *Journal of Testing and Evaluation*, Vol 4, No. 1, January 1976, pp. 15–20.

[3] ~~This grit feed method is frequently referred to as the "Frick Grit Feed Method" because it is based on work done by Otto F. V. Frick as described in "Studies of Wear on Flooring Materials," *Wear*, Vol 14, 1969, pp. 119–131.~~This grit feed method is frequently referred to as the "Frick Grit Feed Method" because it is based on work done by Otto F. V. Frick as described in "Studies of Wear on Flooring Materials," *Wear*, Vol 14, 1969, pp. 119-131.

[4] 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.

2.2 *ANSI Standard:*
B74.12 Checking the Size of Abrasive Grain for Grinding Wheels, Polishing, and General Industrial Uses[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *abrasion—of resilient floor coverings*, a form of wear, in which a gradual removing of a flooring surface is caused by the frictional action of relatively fine hard particles.

3.1.2 *resistance to abrasion—of resilient floor coverings*, the ability of a material to withstand mechanical actions of relatively fine hard particles, which by rubbing, scraping, and eroding remove material from a floor covering surface.

4. Significance and Use

4.1 When subjected to normal in-use traffic conditions, a flooring material is exposed to abrasion caused by the destructive action of fine hard particles. This situation occurs whenever loose debris, dirt and other particulate matter exists between traffic bodies (that is, shoes and a flooring surface). Under continuing exposure to an "abrasive action," a flooring material may suffer a thickness loss sufficient to reduce its service life.

4.2 Abrasion resistance measurements of resilient floor coverings can be complicated since the resistance to abrasion is affected by many factors. These may include the physical properties of the material in the floor covering surface, particularly its hardness and resilience; type and degree of added substances, such as fillers and pigments; surface characteristics of the specimen, such as type, depth, and amount of embossing. It can also be affected by conditions of the test, including the type and characteristics of the abradant and how it acts on the area of the specimen being abraded; pressure between the specimen and leather clad brass wheels; and vacuum suction.

4.3 This test method is designed to simulate one kind of abrasive action and abradant that a flooring may encounter in the field. However, results should not be used as an absolute index of ultimate life because, as noted, there are too many factors and interactions to consider. Also involved are the many different types of service locations. Therefore, the data from this test method are of value chiefly in the development of materials and should not be used without qualifications as a basis for commercial comparisons.

FIG. 1 Taber Abraser with Grit Feeder

5. Apparatus

5.1 *Apparatus*[5], as shown in Fig. 1, shall consist of the following:

5.1.1 *Abraser,* as described in Guide G195~~.~~ with auxiliary weights marked 1000 g (see X1.1.6).

5.1.2 *S-39 ~~Leather-covered~~Leather-clad brass wheels,~~.~~* the brass hub shall be cylindrical shaped, have a diameter of ~~4.44 cm [1.75 in.], and the width shall be 1.27 cm [0.50~~44.4 mm [1.75 in.], a width of 12.7 mm [0.50 in.], and include an axial hole 16.0 mm [0.625 in.]; weight of the brass hub shall be 145 g [5.11 oz]. Width of the leather covering shall be ~~1.27 cm [0.50 in.], and the weight of the leather strip shall be 5 g [0.202 oz].~~ 12.7 mm [0.50 in.]. The minimum diameter of the leather covered brass wheel shall be 46 mm [1 13⁄16 in.].

5.1.3 *Vacuum unit,~~.~~* or equivalent, and an optional water trap as shown in Fig. 2. The purpose of the water trap is to protect the vacuum equipment motor, reduce the need to empty the vacuum bag frequently, and minimize readjustment of speed. The inlet pipe to the water trap should be far enough away from the water surface so that undue turbulence is avoided and water does not enter the exhaust line.

5.1.4 *Grit Feeding Device,~~.~~* that provides a regular flow of abrasive grit particles; consisting of a storage reservoir for the aluminum oxide grit, grit distribution nozzle, speed control for adjusting grit feed rate, and vacuum pick-up nozzle.

5.2 *S-41 Aluminum Oxide Grit*[5], 240 aluminum oxide grit, ~~ANSI B74.12~~ unless otherwise specified by the interested parties.

5.3 *S-38 Standardization Plates*[5], 100 mm [4.0 in.] square, ~~cast~~cell-cast acrylic sheet with a 7 mm [¼ in.] center hole.

5.4 *Sieve,* No. 80 [180 µm].

5.5 *Equipment,* for determining specific gravity.

5.6 *Analytical Balance,* for weighing specimens to a precision of 0.001 g.

5.7 *Die or Knife,* for cutting specimens to designated size.

5.8 *Oven,* to dry grit by heating at 82°C [180°F].

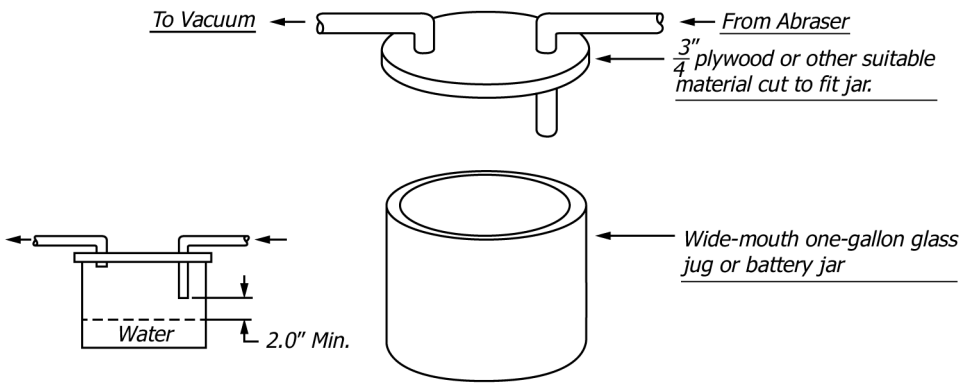
5.9 *Static ~~Eliminator Brush.~~ Eliminator.*

6. Test Specimens

6.1 *Specimen Thickness*—The standard material thickness that can be evaluated with the Taber abraser is ~~6.35~~6.5 mm [0.25 in.] or less. For materials thicker than ~~6.35~~6.5 mm [0.25 in.] but less than 12.7 mm [0.50 in.], an extension nut such as type S-21[5] or equivalent may be used.

6.2 *Specimen Size*—The width of the resulting wear path is 12.7 mm [0.50 in.] and is located 31.75 mm [1.25 in.] from the center of the specimen. For most rigid materials, a sample ~~approximately~~ 100 mm [4 in.] square is recommended. If the material is flexible and can be lifted by the vacuum ~~nozzle,~~ nozzle suction, a round specimen ~~approximately~~ 100 mm [4 in.] in diameter is suggested to permit the use of the specimen ~~table~~platform hold down ring. A 6.5 mm [0.25 in.] diameter hole is drilled through the ~~precise~~ center of the specimen to allow fastening to the specimen ~~holder.~~platform.

6.3 The required number of specimens for each test shall be indicated in the material specification. If no number is given, four samples shall be taken from the material and one determination made on each. The average of the four or otherwise specified measurements shall be ~~taken~~reported as the abrasion loss for the material.



NOTE 1—A vacuum-tight seal between the cover and jar is not required.

FIG. 2 Water Trap

[5] 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 alternative 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.

7. Calibration and Standardization

7.1 Verify the calibration of the abrader as directed by the equipment manufacturer (see Appendix X1).

7.2 Adjust the abrader with the grit feeder for proper operation using ~~cast~~cell-cast acrylic sheet[5] such as S-38 standardization plates as the standard material. The equipment, when running properly, shall produce an average weight loss of 127.5 mg ± 10 mg for four specimens, and 127.5 mg ± 18 mg for an individual test ~~at~~of 2000 revolutions (Note 3). Operation of the equipment for calibration shall be as described in Section 9, except that specific gravity will not need to be determined.

NOTE 1—The average weight loss reported in 7.2 is based on S-41 aluminum oxide grit, and may not be applicable if other abrasive grits are used.

NOTE 2—~~Prior to use, the leather clad wheels must be broken in. To do this, subject the wheels to an initial test of 2000 cycles on an S-38 standardization plate with results to be discarded.~~To generate good test results, it is essential the grit feeding device is positioned such that the abrasive grit falls in the path of the wheels. The correct location of the feeder can be verified by turning off the vacuum and collecting grit for one revolution on a plate marked with concentric circles that match the location of the inner and outer diameter of the wear path.

NOTE 3—If the desired weight loss is not obtained, check ~~on~~ the following: grit feed rate, ~~path of the grit,~~ location where the grit is deposited, removal of the grit, condition of the leather on the wheels, free rotation of wheel bearings, specimen slippage, static charge effects, humidity control, faulty revolution counter, and weighing errors.

8. Conditioning

8.1 For those tests where conditioning is required, condition the specimens at 23 °C ± ~~2°C~~ 2 °C [73.4 °F ± ~~3.6°F]~~ 3.6 °F] and 50 % ± 5 % relative humidity for not less than 40 h prior to test.

8.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 °C ± ~~2°C~~ 2 °C [73.4 °F ± ~~3.6°F]~~ 3.6 °F] and 50 % ± 5 % relative humidity unless otherwise agreed upon by the interested parties.

9. Procedure

9.1 Determine the specific gravity of the material to be tested in accordance with standard analytical procedures, such as Method A-1 or A-2 in Test ~~Methods~~Method D792. If the specimen as received is not homogeneous but possesses a surface that differs from the body or core, determine the specific gravity of the surface alone. If abrasion is to be carried beyond the surface of the body, also determine the specific gravity of the latter and calculate and report the abrasion resistance of the two components separately.

9.2 Screen the S-41 aluminum oxide grit through a U.S. Standard Sieve No. 80 [180 µm] and dry for 1 h at ~~82°C [180°F].~~ 82 °C [180 °F]. Allow the grit to cool in a temperature and humidity controlled room prior to use.

9.3 Fill the grit reservoir with grit. Adjust the rate of feed to 35 g ± 5 g per 100 specimen revolutions. The feed rate ~~may~~shall be measured by holding a tared ~~petri dish~~ container under the nozzle of the grit feeder for 100 specimen revolutions and weighing the amount of grit delivered. The feed rate may be controlled by adjusting the grit feeder motor speed. The collected grit may be returned to the grit reservoir. It is suggested that the grit feed rate check be made after every third run.

9.4 When the specimens have been prepared and conditioned, ~~brush with the~~ wipe with a soft cloth that has been dampened with static eliminator and record the initial values for weight to the nearest 0.001 g. Handle samples with care to eliminate contact with moisture from the hands or other environmental contact.

9.5 Place the specimen face up over the rubber mat on the turntable platform. Secure the specimen using the clamp plate and nut. The hold down ring may be used with circular specimens, to ~~keep the specimen from lifting.~~ prevent the vacuum from lifting the specimen during testing.

9.6 Adjust the feeder nozzle so that it is no higher than 6.5 mm [0.25 in.] above the specimen and so that the stream of grit delivered will evenly cover the wear path generated by the wheels. This should be done prior to the start of the test.

~~9.7 It is essential that the grit feeding device is positioned correctly such that the abrasive grit falls in the path of the wheels. The correct location of the feeder can be checked by collecting grit for one revolution on a calibration plate containing concentric circles of various radii. The location of the grit pattern can then be compared with the wear path recorded on a poly(methyl methacrylate) (PMMA) or other transparent plate.~~

9.7 Place the 1000-g ~~weights provided with the apparatus~~ auxiliary weights on each of the abraser arms. Fasten the ~~leather-covered~~ leather-clad brass wheels to each arm and lower to the specimen surface. ~~The leather rollers should~~ Prior to use, new leather-clad wheels shall be preconditioned by subjecting them to an initial test of 2000 cycles on an S-38 standardization plate, with results to be discarded. The leather-clad brass wheels shall be replaced when ~~one third of the original thickness of the leather clad is~~the diameter falls below 46 mm [1 13⁄16 ~~reached.~~in.]. This will occur in approximately 45 000 specimen revolutions.

NOTE 4—~~Accessory~~Auxiliary weight references are per arm (not combined), and include the mass of the pivoted ~~arm.~~arm but not the mass of the leather-clad brass wheel.

9.8 Position the grit removal vacuum nozzle and adjust the settings so that all grit will be removed after passing under the wheels.

NOTE 5—To ensure proper removal of grit and debris generated during the test, regularly examine the condition of the vacuum pick-up nozzle and abrader vacuum hose for holes or other types of damage. Replace if necessary.

9.9 Adjust the counter to zero and start the machine.

9.10 When the prescribed number of specimen revolutions have been reached, stop the machine, remove the specimen, clean with a filtered dry air blast, brush with the static eliminator, and reweigh.

10. Calculation and Report

10.1 Report the resistance to abrasion for the number of revolutions employed using one or more of the following equations:

$$\text{Volume loss, cm}^3 = \frac{W_1 - W_2}{S} \quad (1)$$

where:

W_1 = initial weight, g,
W_2 = weight after abrasion g, and
S = density of the material being abraded, g/cm^3.

or:

$$\text{Volume loss, mm}^3\text{/100 revolutions} = \frac{\text{cm}^3 \times 1000}{\text{total revolutions}} \times 100 \quad (2)$$

10.2 The average loss in thickness can be calculated by dividing the loss in volume by the abraded area of the specimen.

11. Precision and Bias[6]

NOTE 6—For further information on the use of statistical methods, refer to the appendix.

11.1 *Precision:*

11.1.1 The repeatability for smooth surfaces is 10 % for this test.[2]

11.1.2 The reproducibility for smooth surfaces is 20 % for this test.[2]

11.1.3 The repeatability and reproducibility for embossed surfaces has not been established.

11.2 *Bias*—This procedure for measuring resistance to abrasion of resilient floor covering using an abrader with a grit feed has no bias because the value of abrasion resistance can only be defined in terms of a test method.

12. Keywords

12.1 abrasion resistance; aluminum oxide; grit feed; resilient flooring; Taber abraser

APPENDIXES

X1. CALIBRATION VERIFICATION

X1.1 To facilitate the verification of calibration of the Taber abraser, a kit is available[5] that provides a fast reliable system check. This kit is not meant as a substitute for regular instrument calibration. Procedures in the kit allow the user to verify:

X1.1.1 *Wheel Alignment and Tracking*—The wheels should be spaced equally on both sides from the wheel-mounting flange to the center of the specimen holder. 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. Wheel internal faces shall be 52.4 mm ± 1.0 mm [2.063 in. ± 0.004 in.] apart and the hypothetical line through the two spindles shall be 19.05 mm ± 0.3 mm [0.750 in. ± 0.002 in.] away from the central axis of the turntable. The distance from the inside of the wheel mounting flange to the center of the specimen holder shall be 38.9 mm ± 0.5 mm [1 17⁄32 in. ± 0.002 in.] (Fig. X1.1).

X1.1.2 *Wheel Bearings Condition*—The Taber abraser wheel bearings should be able to rotate freely about their horizontal spindles and not stick when the wheels are caused to spin rapidly by a quick driving motion of the forefinger.

X1.1.3 *Vacuum Suction Force*—Air pressure in the suction device must not be lower than 137 millibar [55 in. of water column], as measured by a suction gage.

NOTE X1.1—Vacuum suction force may be influenced by the condition of the collection bag and ~~filter, which should be replaced on a regular basis.~~ filter; empty or replace as required. Any connection or seal leaks will also influence suction force.

[6] The method of calculating the coefficient of variation may be found in *MNL 7,Manual on Presentation of Data and Control Chart ~~Analysis,~~Analysis,*, American Society for Testing and Materials, 1990.