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An American National Standard

Standard Test Method for Using a James Machine[1]

This standard is issued under the fixed designation F 489; 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.

ε[1] NOTE—Per Committee F13 Bylaws, editorially replaced term definitions with reference to Terminology F 1646 in January 2004.

1. Scope

1.1 This test method covers laboratory measurement of the dry static coefficient of friction of shoe sole and heel materials on controlled walking surfaces and under controlled conditions. It is recognized that certain contaminants and conditions may alter results.

NOTE 1—See Test Method D 2047 for information on measurement of the static coefficient of friction of floor surfaces for the James Machine.

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

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:* [2]

D 2047 Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine

F 1646 Terminology Relating to Safety and Traction for Footwear

3. Terminology

3.1 See Terminology F 1646 for the following terms used in this test method:

3.1.1 Coefficient of friction,

3.1.2 Friction, and

3.1.3 Slip.

4. Significance and Use

4.1 The James Machine is a laboratory instrument intended to measure the slip resistance characteristics of shoe sole and heel materials. However, the tendency to slip may be influenced by foreign materials or lubricants on the shoe materials or on the walking surfaces. Consequently, acceptable levels of slip resistance as determined by this test method may not predict an individual's resistance to slipping while walking or running on various surfaces.

5. Apparatus

5.1 *James Machine* (Fig. 1),[3] with three weights of 25 lb (11.4 kg) each, plus supporting members (80 lb (36.3 kg) total).

5.2 *Shoe*, faced with the specimen under test.

6. Walking Surfaces

6.1 A 12 by 12-in. (305 by 305-mm) square of surface shall be used for testing.

6.2 The surfaces to be used shall be OVCT tiles[4] or a surface agreed upon between laboratories.

6.3 The surfaces are prepared by thoroughly wiping with a 3 % ammoniacal solution using a clean cloth prior to conditioning.

7. Preparation of Shoe Sole and Heel Materials Samples

7.1 Sand the sample using a 60-grit silicon carbide abrasive paper[5] to remove finish or mold characteristics, or both.

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[1] This test method is under the jurisdiction of ASTM Committee F-13 on Safety and Traction for Footwear and is the direct responsibility of Subcommittee F13.10 on Traction.

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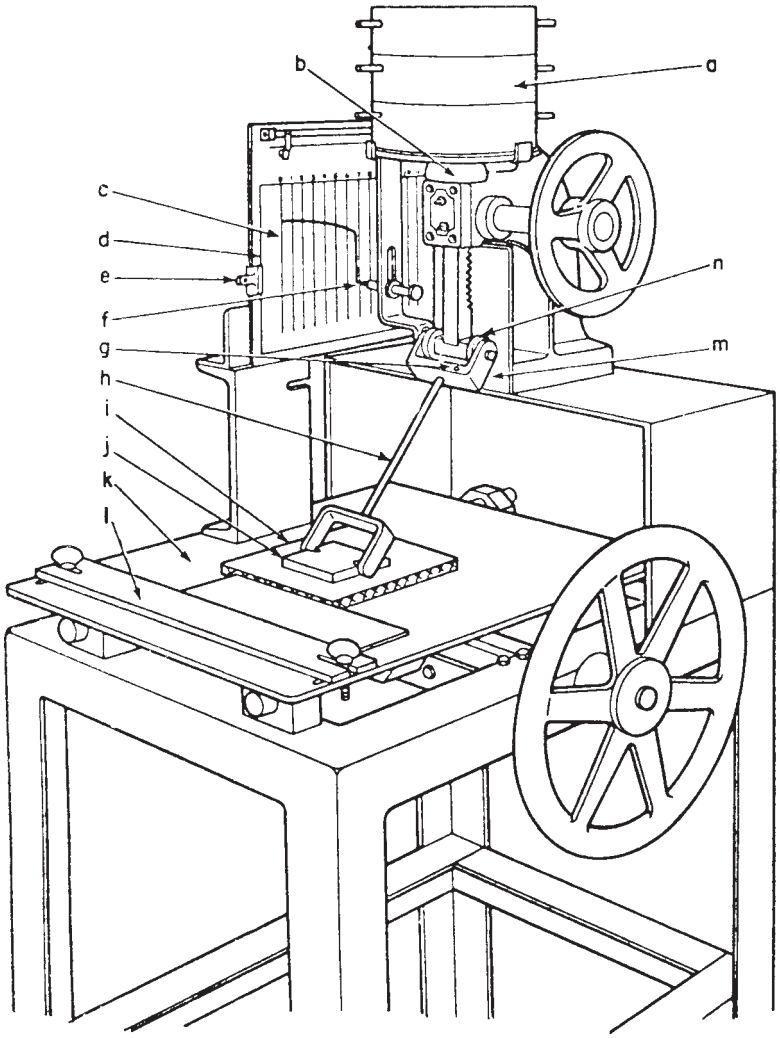
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] This machine was developed by S. V. James of the Underwriters Laboratories, Inc. The machine is available from Quadra, Inc., 1833 Oakdale Ave., Racine, WI 53405. Phone (414) 637-6525.

[4] OVCT is official vinyl composition tile and is available from the Chemical Specialties Manufacturers Assn., 1901 I St., N.W., Washington, DC 20006. These tiles may be used and reused for testing. Tiles should be discarded when they show excessive wear or when erratic results are obtained.

[5] 60-grit silicon carbide abrasive paper is available from the 3M Corp., St. Paul, MN.



a—Weights
b—Cushion
c—Chart
d—Chart Board
e—Spring Clip
f—Recording Pencil
g—Set Screw
h—Strut
i—Walking Surface
j—Shoe and Specimen
k—Test Table
l—Retaining Bar
m—Back Plate
n—Ball Bearing Rollers

FIG. 1 The James Machine

7.2 Again sand the sample using 400A wet or dry silicon carbide abrasive paper.[6]

7.3 Brush the sanded sample to remove loose particles.

8. Test Specimens

8.1 Specimens, 3 by 3 in. (76 by 76 mm), prepared in accordance with 6.1 and 6.2, and 6.3 shall be applied to the shoe by use of double-faced tape[7] or a suitable adhesive.

8.2 The specimen shall be wiped with a clean, dry cloth to remove dust or foreign matter from the surface after conditioning.

9. Conditions for Testing

9.1 Run the specimens under the following conditions:

9.1.1 Both surfaces dry and conditioned 18 h at 73 ± 3.6°F (22.8 ± 2°C).

9.2 This procedure may also be used at other conditions, such as 36°F (2.2°C) dry.

10. Calibration

10.1 Obtain a calibration curve as follows:

10.1.1 Attach a low-friction ball bearing unit[8] to the shoe.

[6] 400A wet or dry Tri-M-Ite is available from the 3M Corp., St. Paul, MN.

[7] Suitable tape is available from the 3M Corp., St. Paul, MN.

[8] Suitable linear ball bearing units may be obtained from the Turnomat Division of Heil Grinding & Manufacturing Co., 455 Adirondack St., Rochester, NY 14606. Model BP-1000W is suitable and two units are needed.

10.1.2 Attach a nylon string and bridle to the shoe to act against the direction of movement and run over a fixed ball-bearing pulley, so as to permit the application of standard weights in 15-lb (6.8-kg) increments to a total of 75 lb (34 kg).

10.1.3 Run a James tester curve for each weight applied, and use the point of slip to construct a calibration curve.

10.1.4 For each weight applied to the string divided by the weight acting on the shoe (5.1) plotted against the value determined on the corresponding James curve yields one point on the calibration curve.

10.2 Check the calibration of the James Machine at 45 lb (20.3 kg) at frequent intervals and recalibrate as necessary.

11. Procedure

11.1 Thoroughly check the James Machine and correct any mechanical malfunctions to ensure reliable results.

11.2 Carefully level the machine in all directions using a machinist's level.

11.3 With the large hand wheel or automatic switch, move the test table to the right against the stop.

11.4 Insert the chart[9] on the chart board.

11.5 With the small hand wheel, raise the column, using a machinist's level, until the strut is perpendicular to the table. Make sure the rollers are in firm contact with the back plate, and adjust the set screw, if necessary.

11.6 Check the fit of the test shoe on the machine, being sure the weight bears equally.

11.7 Using the walking surface prepared in 6.3, conduct four tests. Rotate the walking surface 90° between each of the four tests so that a fresh surface is tested each time and so that directional effects, if any, are avoided.

11.8 Place the walking surface on the test table in firm contact with the retaining bar. Lightly dust the test specimen with a clean, dry cloth to make sure it is free of dust and any other extraneous matter.

11.9 Carefully place the shoe in the yoke and gently lower the shoe, yoke, and weight assembly into contact with the walking surface.

11.10 Release the recording pen, making sure it is on the zero line of the chart.

11.11 Move the test table forward uniformly at a rate of 1 in./s (25.4 mm/s) until the shoe slips and the vertical column drops. The movement should be started within 5 s after the contact in 11.9 has been made.

11.12 Record as the static coefficient of friction the point at which the horizontal curve, made on the chart by the recording pen, changes to a vertical line. If this point is not sharply defined at the top of the vertical line, it may be necessary to draw a standard curve with the machine, bracing the shoe to prevent slippage. Overlay this standard curve on the test curve, and record the point at which the test curve first deviates from the standard curve. Estimate the reading to the nearest 0.01.

12. Report

12.1 Report as the static coefficient of friction the arithmetic average of the four readings obtained.

12.2 Also report all readings obtained, conditions, dates, and order of tests conducted.

13. Precision and Bias[10]

13.1 The relationship, if any exists, of observed James Machine units to some true value of coefficient of friction of shoe sole and heel materials has not been concluded. As a result, the precision and bias of this test method in relation to a true coefficient of friction of shoe sole and heel materials have not been evaluated, and only repeatability and reproducibility are given for this test method.

13.2 In many situations, the variability among replicate tests is greater when measurements are made at different times than when they are made together, as part of a group by the same operator. Sometimes trends are apparent among results obtained consecutively. Furthermore, some materials undergo measurable changes within relatively short storage periods. For these reasons, the dates of testing as well as the order of tests carried out in a group shall, when possible, be treated as controlled systematic variables.

13.3 *Repeatability*—Results by the same operator should not be considered suspect unless they differ by more than 0.05 (± 0.025) static coefficient of friction.

13.4 *Reproducibility*—Duplicate determinations by this test method should not differ by more than 0.08 as determined by tests conducted by three laboratories.

13.5 *Bias*—Bias for this test method cannot be determined since there are no acceptable reference standards.

14. Alternative Test Methods

14.1 When possible, values for each material should be established by alternative test methods to determine if there is a variable bias between the proposed test method and the referee method at different levels of the static coefficient of friction.

15. Keywords

15.1 shoe heel; shoe soling; static coefficient of friction

[9] Suitable charts may be obtained from the Chemical Specialties Manufacturers Assn., 1901 Eye St., N.W., Washington, DC 20006. Under no circumstances use copies of these charts; use original printed charts only. Even the best copying machines will not duplicate exactly, and even slight differences in the distance between the coefficient of friction lines will give inaccurate results.

[10] Laboratory data on precision have been filed at ASTM Headquarters and are available upon request. Request RR:F13-1000.