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An American National Standard

Standard Test Method for Using a Portable Articulated Strut Slip Tester (PAST)[1]

This standard is issued under the fixed designation F 1678; 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.

1. Scope

1.1 This test method covers the operational procedures for using a portable articulated strut slip tester (PAST) for determining the slip resistance of footwear sole, heel, or related materials (test feet) against planar walkway surfaces or walkway surrogates (test surfaces) in either the laboratory or field under dry conditions. This test method does not address all methodological issues (for example, test surface and test foot material selection and preparation, experimental design, or report preparation).

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:*

F 1646 Terminology Relating to Safety and Traction for Footwear[2]

3. Terminology

3.1 *Definitions*—For definitions of terms, refer to Terminology F 1646.

4. Significance and Use

4.1 The PAST[3] is a tribometer designed to determine the slip resistance of footwear materials, walkway surfaces, or surrogates under field or laboratory conditions so that their slip-resistant qualities may be evaluated.

4.2 The measurement made by this apparatus relates to slip resistance and the static coefficient of friction. Other factors can affect slip resistance. When this test method is used in field tests, relevant factors shall be described.

5. Apparatus

5.1 *Portable Articulated Strut Tribometer*—See Fig. 1.

5.2 *Main Components*:

5.2.1 *Frame*, aluminum, U-shaped (*a*).

5.2.2 *Carriage Rails*, two, steel, horizontal (*b*).

5.2.3 *Carriage*, aluminum (*c*).

5.2.4 *Weight*, cast steel (*d*).

5.2.5 *Articulated Strut*, aluminum, ladder shaped (*e*).

5.2.6 *Trigger*, steel (*f*).

5.2.7 *Trigger Adjustment Knob and Adjustment Lock Knob* (*g*).

5.2.8 *Trigger Stop* (*h*).

5.2.9 *Measuring Rod*, steel, cylindrical, graduated (*i*).

5.2.10 *Measuring Rod Index Mark*, brass (*j*).

5.2.11 *Test Foot Holder*, magnetic (*k*).

5.2.12 *Spring Collars* (*l*).

5.2.13 *Spacer*, 0.5 in. (13 mm) (not shown).

6. Test Foot and Test Surface

6.1 *Test Foot*:

6.1.1 The test foot[4] is prepared by fastening a sample, typically 3 by 3 in.^{2} (76.2 by 76.2 mm^2), of the test foot material, appropriate side exposed, using a suitable adhesive, such as double-stick tape.

6.1.2 The test foot is placed on the test foot holder, where it is held in place by magnetic attraction.

6.2 *Test Surface*—The floor surface specimens[5] shall not be less than 4 by 4 in. (10.16 by 10.16 cm) and should be surrounded by enough material of similar thickness or placed in a suitable fixture so that the tribometer feet will be at the same elevation as the top of the specimen. The test foot material shall fit within the area of the test surface.

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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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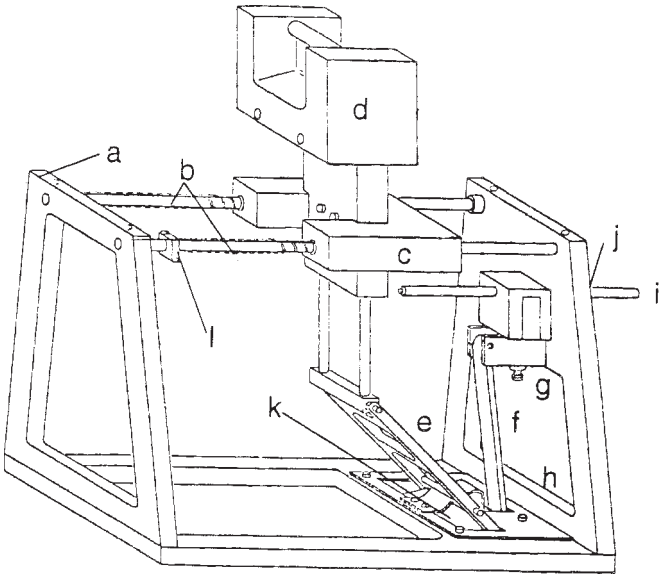
[2] *Annual Book of ASTM Standards*, Vol 15.07.

[3] The portable articulated strut slip tester (PAST) was developed by Dr. Robert Brungraber of Bucknell University, Lewisburg, PA. The PAST is covered by a patent held by Slip-Test and is available from P.O. Box 387, Spring Lake, NJ 07762. It has been found suitable for this use. Interested parties are invited to submit information regarding the identification of acceptable alternatives to this patented item to the Committee on Standards, ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

[4] The most convenient test foot material shape is a 3 in.^{2} (76.2 mm^2), but if a different shape is desired it must be symmetrical with respect to the center line in the direction of testing and have some material at the front and rear edges of the test foot clip. This allows testing at various contact pressures.

[5] Floor surface materials of sizes smaller than 4 by 4 in. (100 by 100 mm) may be combined in a matrix to create a surface area at least 4 by 4 in. (100 by 100 mm) in size.



not shown = spacer, 0.5 in. (13 mm)
a = *frame*, aluminum, U-shaped
b = *carriage rails*, two, steel, horizontal
c = *carriage*, aluminum
d = *weight*, cast steel
e = *articulated strut*, aluminum, ladder shaped
f = *trigger*, steel
g = *trigger adjustment knob and adjustment lock knob*
h = *trigger stop*
i = *measuring rod*, steel, cylindrical, graduated
j = *measuring rod index mark*, brass
k = *test foot holder*, magnetic
l = *spring collars*

FIG. 1 Portable Articulated Strut Slip Tester

7. Reagents and Materials

7.1 *Double-Stick Tape*.

7.2 *Ivory Dishwashing Liquid Soap.*

7.3 *Medical Grade Silicone Elastomer*[6] *Test Foot*, 1½ by 3¼ in. (38 by 76 by 6 mm).

7.4 *Sheet of Plate Glass*, 8 by 8 by ¼ in. (203 by 203 by 6 mm).

8. Tribometer Calibration

8.1 A zero reading is performed by operating the tester with a medical grade silicone elastomer test foot on a sheet of plate glass in the presence of soapy water. The soapy water is made by adding enough water to a small pool of Ivory liquid dishwasher soap to just remove the greasy feeling of the soap. The average of six determinations of the slip resistance reading (called x_0) under these circumstances should agree with the zero reading supplied with the instrument within a range of ± 0.06 units.

9. Operational Procedure

9.1 Remove the tester from its case carefully, inspecting it for any loose or damaged parts.

9.2 Using a clean cloth or paper napkin, thoroughly wipe all parts of the vertical and horizontal carriage rails.

9.3 Select a test foot having a suitable facing material, and attach it to the bottom of the test foot holder, making certain that the vertical extension extends up through the hole in the base plate and lies behind the trigger. Also be certain that the foot is pushed back with respect to the test foot holder as far as it will go, so that the vertical extension is thoroughly engaged in the single notch at the front of the test foot holder.

9.4 Remove the measuring rod from the frame clips, and wipe it thoroughly with a clean cloth or paper napkin. Insert its magnetic end through the index mark tube (*j*), pushing the rod back until the magnet engages the head of the adjustable carbon steel bolt attached to the carriage. While inserting the rod, be certain that the trigger assembly is released thoroughly by pushing the test foot as far toward the rear of the tester as it will go. It may be necessary to back off the trigger adjustment knob if the rod fails to slide in easily. This is accomplished by first releasing the trigger locknut.

9.5 Adjust the trigger by first putting the tester on a level surface, with the test foot to the rear of its possible travel and with the carriage fully forward. Then adjust the trigger so that the 0.05-in. (1.3-mm) thick spacer, supplied with the tester, can be placed easily between the trigger and the vertical extension on the front of the test foot.

9.6 Set the trigger stop so that there is at least a 0.05-in. (1.3-mm) gap between the stop and the front of the trigger, with the trigger again at the front of its travel. This gap should not be greater than 0.125 in. (3.2 mm). At no time during these adjustments should the trigger be pushed hard enough to bend it. The 0.05-in. (1.3-mm), or larger, gap between the trigger and the stop permits some elastic bending of the trigger during operation of the tester, but the trigger should be free of bending stress while being adjusted.

9.7 With the carriage fully forward and the magnet on the measuring rod engaged with the attraction screw in the carriage, check the zero reading. If the zero line on the measuring rod does not lie opposite the notches in the index mark tube, bring them into alignment by releasing the thumb nut on the attraction screw in the carriage and adjusting it as needed. Before attempting to adjust the zero position of the rod, first check the indicator tube to ensure that it is secured tightly in front of the tester and is so positioned that the measuring rod may be read easily from the top of the tester.

9.8 Check the free movement of the measuring rod by holding the test foot in its rearward position and moving the carriage, by hand, throughout its travel. The rod must travel freely, without breaking the magnetic attachment to the attraction bolt in the carriage. Check the rod for straightness if the rod does not move freely. If the rod has been bent, it may be possible to straighten it carefully; if not, it must be replaced. During this operation, the test foot can be held in its rearward position either by hand or by adjusting the trigger stop temporarily such that all movement of the trigger is prevented.

9.9 With the tester on a level surface and the test foot again held in its rearward position, adjust the carriage rail spring control collar(s) so that the carriage will move freely throughout its entire travel. That is, the collar should be adjusted such

[6] 6382RTV Silicone Elastomer, available from Factor II, P.O. Box 1339, Lakeside, AZ 85929, Phone: (602) 537-8387, has been found suitable for this purpose.

that the carriage, while dragging the measuring rod, will just move to the end of its travel (the weight fully descended) without causing an excessive bump at the end of the travel.

9.10 With the tester fully adjusted and the proper test foot in place, conduct a test by picking up the tester by the handle, placing it on the area of the floor or test surface to be evaluated, and releasing the handle. Read the value of the resulting PAST number from the measuring rod at the index mark.

9.11 Convert the PAST number to an equivalent value of static coefficient of friction by means of the calibration chart or curve that is supplied with the tester, or by using the following formula:

$$\mu_s = k \frac{(x - x_0)}{\sqrt{100 - (x - x_0)^2}} \quad (1)$$

where:

k = an instrument-specific constant furnished by the manufacturer; $0.9 \leq k \leq 1$,

x = the tribometer reading, taken from the measuring rod, and

x_0 = the tribometer's" zero point," determined in 8.1.

9.12 When picking up the tester, take care to ensure that the clutch is released, permitting free movement of the measuring rod before the rod is forced forward to its initial position. This can be accomplished most easily by inducing a slightly rearward force on the handle during the initial part of the picking up operation. This ensures that the test foot is lifted free of the floor or bathing surface, thereby permitting it to return to its initial position, releasing the trigger and clutch, before the measuring rod is pushed by the carriage back to its initial position.

9.13 By repeating the procedure described in 9.10, additional readings can be taken at the same or newly selected spots on the test surface. When taking repeat tests at the same spot, hold the tester in place with one hand, and operate it with the other. In this case, exercise special care to be sure to apply a rearward bias to the handle when first lifting it to ensure that the measuring rod is free to be returned to its starting position.

9.14 Tests should not be conducted "downhill" on a slope.

10. Precision and Bias

10.1 The precision and bias of the tester is being determined.

11. Keywords

11.1 articulated strut; articulated strut tester; floor testing; footwear; heel material; PAST; portable articulated strut slip tester; shoe testing; slip resistance; slip tester; static coefficient of friction; tribometer; walkway surfaces