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An American National Standard

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

This standard is issued under the fixed designation F 1677; 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 inclinable articulated strut slip tester (PIAST) 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 the field under dry, wet, or contaminated conditions.

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]

F 1646 Terminology Relating to Safety and Traction for Footwear

3. Terminology

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

4. Significance and Use

4.1 The PIAST[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 measurements made by this apparatus relate to slip resistance. 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 Inclined Articulated Strut Tribometer*—See Fig. 1.

5.2 *Main Frame*—A ¾-in. (1.9-cm) thick aluminum plate having a piece of skid-resistant surfacing on the front end of it. Either operators foot can be placed in this area to help hold the tester in place during use.

5.3 *Handle*—A tubular assembly extending upward near the center of the main frame. This can be used to lift and carry the tester and also to hold the tester in place during use.

5.4 *Indicating Quadrant*—With the skid-resistant foot pad to the left when facing the tester, the indicating quadrant is on the front edge of the tester and is graduated in terms of slip resistance.

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[1] This test method is under the jurisdiction of ASTM Committee F13 on Pedestrian/Walkway Safety and 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] The portable inclined articulated strut slip tester (PIAST or Mark II) was developed by Dr. Robert Brungraber of Bucknell University, Lewisburg, PA. The Mark II 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.

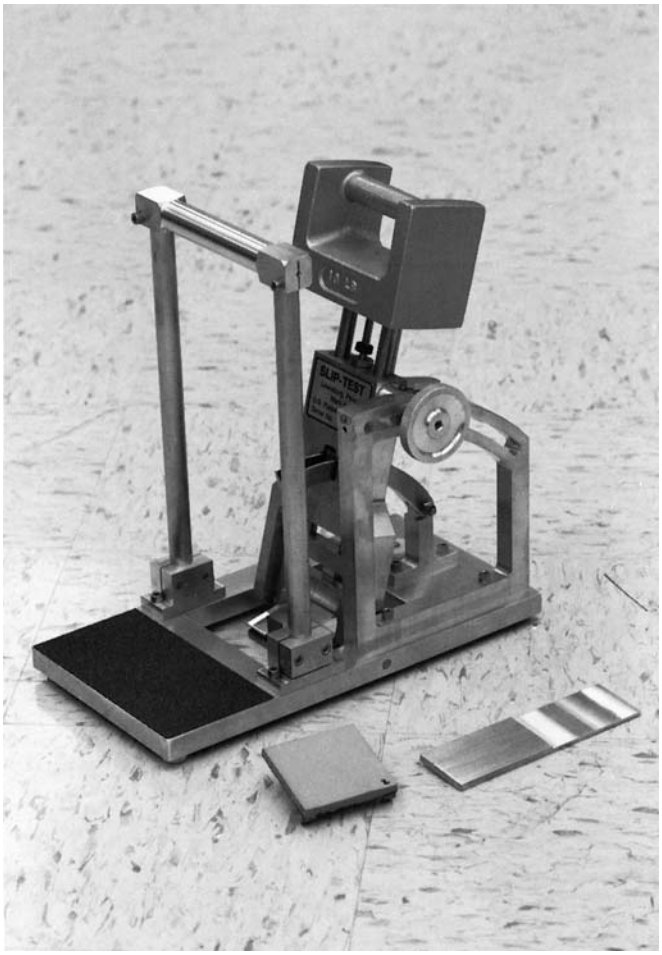

FIG. 1 Portable Inclineable Articulated Strut Slip Tester

5.5 *Rotating Support*—A 1¼-in. (3.18-cm) thick aluminum piece pivoted to the main frame by a pair of pins near the center of the main frame. This support is able to rotate from a vertical position to an angle from vertical of slightly more than 45°. The angled position of this support is controlled by either of two methods: (*1*) a knurled hand wheel that tightens against the indicating quadrant, and (*2*) a rubber pad that engages a control quadrant that has the cross section of a V belt pulley and is attached near the rear of the frame. The rubber pad is disengaged from the control quadrant, permitting free rotation of the rotating support by lifting the 10-lb (4.5-kg) weight to the end of its travel.

5.6 *Weight*—A 10-lb (4.5-kg) weight of cast iron, incorporating a handle that is used to operate the tester and that can also be used to lift and carry the tester. Extending from the bottom of this weight are three ½-in. (1.27-mm) round stainless steel rods. Two of these extend through the rotating support and control the relative motion of the weight and support. A third rod extends into the trigger mechanism.

5.7 *Trigger Mechanism*—An aluminum assembly located on the right-hand face of the rotating support. This can be operated by pinching with either hand and releases the weight so that it can move with respect to the rotating support.

5.8 *Articulated Strut*—A ladder-shaped aluminum piece pivoted at the bottom of the pair of stainless steel rods and also pivoted to the test foot holder on the bottom of the tester. This articulated strut indicates the occurrence of slip by permitting the test foot holder/clip assembly to slide forward.

5.9 *Test Foot Holder*—An assembly composed of aluminum or stainless steel, with a thin piece of stainless steel riveted loosely to it to permit a modest amount of lateral articulation of the test foot. The bottom of the test foot holder has magnetic tape attached to it. The magnetic tape serves to hold the test foot in place.

5.10 *Test Foot Clip*—The test foot is 3 in.^{2} (7.62 cm^2) light gage mild steel. This clip is retained against the magnetic tape on the bottom of the test foot holder. The test foot material is affixed to the clip by means of double-stick tape or contact cement.

5.11 *Spring Steel Retainer*, made of light gage steel.

5.12 *Thickness Gage*—A special thickness gage used to check the height of the bottom of the test foot, in the set position, above the floor surface. The thin end of this gage is ⅛-in. (3.17-mm) thick. The thick end of this gage is ¼-in. (6.34-mm) thick.

5.13 *Spacers*—If height adjustments are required, spacers shall be inserted or removed between the tester bottom and the rubber feet.

5.14 *Rubber Feet*—Three rubber feet are connected by removable machine screws to the underside of the tester.

5.15 *Test Foot Material*—A specimen of sole, heel, or other material.

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. If needed, the spring steel retainer can be pushed onto the test foot's vertical extension to fasten the test foot positively to the test foot holder.

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.

7. Reagents and Materials

7.1 *Double-Stick Tape*.

8. Tribometer Operational Check

8.1 Place the tester on a flat and level surface.

[4] The most convenient test foot material shape is a 3 in.^{2}(7.62 cm^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 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.

8.2 Check visually that no parts of the tester are bent or broken. Check that the test foot pivots freely at the end of the articulated strut and that the strut pivots freely at its upper end.

8.3 Set and lock the tester at a reading of 0.015 (1.5 division from zero).

8.4 Very gently push the test foot and articulated strut slightly forward, and release it. If the tester is in proper alignment, so that it has complete freedom of movement, the articulated strut and test foot should return against the stop, regardless of how slowly or gently this step is performed. In the event of an alignment problem, return the tester to the manufacturer for repair.

8.5 Lift up on the handle of the tester so that the test foot assembly, with the clip attached, is held above the floor surface by the trigger.

8.6 The height of fall of the test foot shall be checked, which may require removing the rubber feet and inserting or removing spacers. The gap between the bottom of the test foot and the floor surface is satisfactory when the thin end of the thickness gage slides beneath the test foot and the thick end of the same gage will not slide under this assembly. No height adjustments are required if the gap is satisfactory. Insert spacers if the gap is too low. Remove the spacers if the gap is too high. To maintain the tester parallel to the floor surface, all rubber feet shall have either none or the same number of spacers.

9. Operational Procedure

9.1 Before performing any tests, install an appropriately prepared test foot.

9.2 Place the tester on a flat and horizontal surface.

9.3 Place the test foot onto the test foot holder. Ensure that the test foot and test foot holder are parallel with the surface being tested.

9.4 *Operational Considerations*:

9.4.1 For laboratory testing, secure the floor surface specimen to a substrate that is as stable as possible to reduce slipping and vibration. Use double-stick tape or other suitable means.

9.4.2 When testing ramp surfaces, use the tester in the uphill or crosshill direction.

9.4.3 When testing stairs, the three rubber feet on the bottom of the tester may be replaced with a continuous surface of the same thickness as the feet, extending over the entire area of the base. This same attachment can be used when testing carpet or other compliant walkway surfaces. Perform the test with the test foot slipping perpendicular to the tread in the same direction as one would walk up or down the stairs. Test stair nosings "upslope."

9.4.4 During wet testing, if needed, slide the spring retainer over the front extension of the clip to prevent the test foot from sticking to the test surface.

9.5 Check the test foot fall height before testing (see 8.6).

9.6 Place the tester so that the rubber feet are at the same elevation as the top of the floor surface specimen and the test foot is located over the top of the floor surface specimen. Release the knurled wheel, and lift the weight to the limit of its travel, permitting the rotating support to be moved to any desired spot along its arc. Select a scale position on the rotating support with a slip resistance value below the anticipated value of the surface being tested. Lock the knurled wheel in place to prevent the rotating frame from slipping.

9.7 Lift the weight so that the trigger is engaged, leaving the rotating support in the vertical position, locked by the knurled hand wheel. Let go of the weight so that the test foot holder is held suspended above the surface by the trigger.

9.8 Secure the tester frame to prevent any movement during the test by either placing the operator's foot on the tester base and a hand on the handle or by other means. Apply sufficient anchorage or force to prevent the tester from moving during its operation.

9.9 Perform testing by using the trigger to release the weight. Note visually whether the test foot slips when contacting the floor surface. This slip action will usually be quite sudden. In the event that the slip is slow, judgment must be exercised regarding whether a slip has occurred. A full slip occurs when the test foot moves forward and the motion is stopped by the structural frame of the device.

9.10 Without moving the tester, repeat the steps described in 9.7-9.9, starting at a slip resistance value below the anticipated value and increasing the angle on the indicating quadrant until the value at which slip just occurs has been determined. This may necessitate averaging of the largest value at which slip does not occur with the lowest value at which it does. The value so obtained shall be recorded.

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; PIAST; portable inclined articulated strut slip tester; shoe testing; slip resistance; slip tester; tribometer; walkway surfaces