



# Standard Test Method for Measuring the Coefficient of Friction for Evaluation of Slip Performance of Footwear and Test Surfaces/Flooring Using a Whole Shoe Tester<sup>1</sup>

This standard is issued under the fixed designation F2913; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method<sup>2</sup> determines the dynamic coefficient of friction between footwear and floorings under reproducible laboratory conditions for evaluating relative slip performance. The method is applicable to all types of footwear, outsole units, heel top-pieces (top-lifts) and sheet soling materials, also to most types of indoor floorings, including matting and stair nosing, and surface contaminants on the flooring surface, including but not limited to liquid water, ice, oil and grease. The method may also be applied to surfaces such as block pavers, turf and gravel.

1.2 Special purpose footwear or fittings containing spikes, metal studs or similar may be tested on appropriate surfaces but the method does not fully take account of the risk of tripping due to footwear/ground interlock.

1.3 The values stated in the ASTM test method in metrics are to be regarded as the standard. The values in parentheses are for information.

1.4 *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:*<sup>3</sup>

**F1646 Terminology Relating to Safety and Traction for Footwear**

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee F13 on Pedestrian/Walkway Safety and Footwear and is the direct responsibility of Subcommittee F13.30 on Footwear.

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<sup>2</sup> This standard is derived from SATRA TM144, Friction {Slip Resistance} of Footwear and Floorings, copyright SATRA Technology Centre, Kettering Northamptonshire, NN16 8SD, United Kingdom.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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 *Other References:*

**BS EN ISO 4287 Geometrical product specification (GPS). Surface texture: Profile method. Terms, definitions and surface texture parameters<sup>4</sup>**

**EN 10088-2 Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes<sup>5</sup>**

## 3. Terminology

3.1 For general definitions of terms, refer to the Terminology **F1646**.

3.2 *Definitions:*

3.2.1 *slider*—a  $76 \pm 1$  mm circular test specimen cut from sheet material.

3.2.1.1 *Discussion*—Should a shape and or size of slider other than a 76 mm circular shape be used, it shall be documented within the test report (see **14.1.2.1**).

3.2.2 *slider 96*—a pre-described rectangular test specimen intended for use in calibration of the test surface (see **10.6.1**).

## 4. Summary of Test Method

4.1 The footwear item and underfoot surface are brought into contact, subjected to a specified vertical force for a short period of static contact then moved horizontally relative to one another at a constant speed. The horizontal frictional force is measured at a given time after movement starts and the dynamic coefficient of friction is calculated for the particular conditions of the test.

## 5. Significance and Use

5.1 This non-proprietary laboratory test method allows preliminarily for the reproducible testing of whole footwear and footwear-related soling materials for evaluating relative slip performance. Other ASTM test methods generally employ a standardized test foot primarily for evaluation of flooring materials.

<sup>4</sup> Available from British Standards Institution (BSI), 389 Chiswick High Rd., London W4 4AL, U.K., <http://www.bsigroup.com>.

<sup>5</sup> Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, <http://www.cen.eu>.



FIG. 1 Example of Footwear Mounted Using 7° Wedge to Set Proper Contact Angle

TABLE 1 Vertical Load to be Applied in Slip Test Run

Footwear Item	Full Load to be Applied (N)
Footwear and finished soles of size US size 7.5 men's and 8.5 women's, (Paris Points 40) (UK size 6.5) and above	500 ± 25
Footwear and finished soles of sizes below US size 7.5 men's and 8.5 women's (Paris Points 40) (UK size 6.5)	400 ± 20
Top-pieces and sole materials intended for men's footwear	500 ± 25
Top-pieces and sole materials intended for women's, children's and infant's footwear	400 ± 20

## 6. Apparatus

6.1 Slip tester capable of performing the required test.<sup>6,7</sup>

6.2 A means of conditioning the test specimens and standard reference materials, prior to the test, against which the specimens are to be tested, at  $23 \pm 2^\circ\text{C}$  and  $50 \pm 5\%$  RH relative humidity and carrying out the test at  $23 \pm 2^\circ\text{C}$ .

6.3 A means of securely mounting the footwear, outsoles or slider.

6.4 A flat rigid horizontal surface mount of minimum width 150 mm and minimum length 450 mm, to which the test underfoot surface, hereafter termed the test surface, shall be securely mounted.

NOTE 1—A device may be used to entrap lubricant within the footwear/surface contact area to ensure that the required depth of lubricant is maintained.

6.5 A means of holding the footwear, sole unit or slider clear of the test surface between test measurements without contact with any other surfaces.

6.6 A means of adjusting the angle between the footwear, sole unit or slider and the test surface so that the required contact angle can be achieved, and a means of adjusting the contact point horizontally with respect to the line of action of the vertical force when required.

6.7 A rigid wedge of minimum dimensions 80 mm wide by 120 mm long shall be used to set the contact angle of  $7.0 \pm 0.5^\circ$  between footwear, sole unit or slider and test surface when required. Fig. 1

6.8 A mechanism for lowering the footwear, sole unit or slider onto the test surface and applying a steadily increasing downward force, including the weight of the test specimen and its mounting, at a rate that enables the required full force—either  $400 \pm 20$  N or  $500 \pm 25$  N (see Table 1) to be achieved within 0.2 s of reaching 50 N.

6.9 A means of sliding the test surface relative to the footwear, sole unit or slider at a speed of  $0.3 \pm 0.03$  m/s commencing within 0.2 s after a vertical load of 50 N is achieved. Sliding shall not start until full vertical force is achieved, see Fig. 2. The footwear test specimen may be constrained while the test floor is moved relative to it, or vice versa.

6.10 A means of measuring time with a resolution of 0.01 s (graph should have tick marks every 0.01 s) or better.

6.11 A means of measuring:

6.11.1 The continuous vertical force exerted on the test specimen, with an accuracy of 2 % or better.

6.11.2 The continuous horizontal frictional force, with an accuracy of 2 % or better, exerted on the test specimen measured in the plane of the surface of the test surface.

6.11.3 The displacement of the moving item, test surface or footwear, sole unit or slider, to the nearest 1 mm.

6.12 The apparatus comprising elements 6.2 – 6.10 shall be sufficiently rugged to prevent vibration.

## 7. Hazards

7.1 Care should be used when working with mechanical equipment. Attention to be given to preventing a pinch hazard while in operation.

## 8. Sampling and Test Specimens

8.1 For footwear items (footwear, sole units or slider), see 10.10.

NOTE 2—The term slider refers to sample of soling material generally cut from a larger sample so to fit the apparatus. Such as a piece of soling material or heel toplift, which is sold in sheets and cut to size as needed for use in footwear.

8.2 For test surfaces, see 10.3 and 10.4; for contaminants/lubricants, see 10.5.

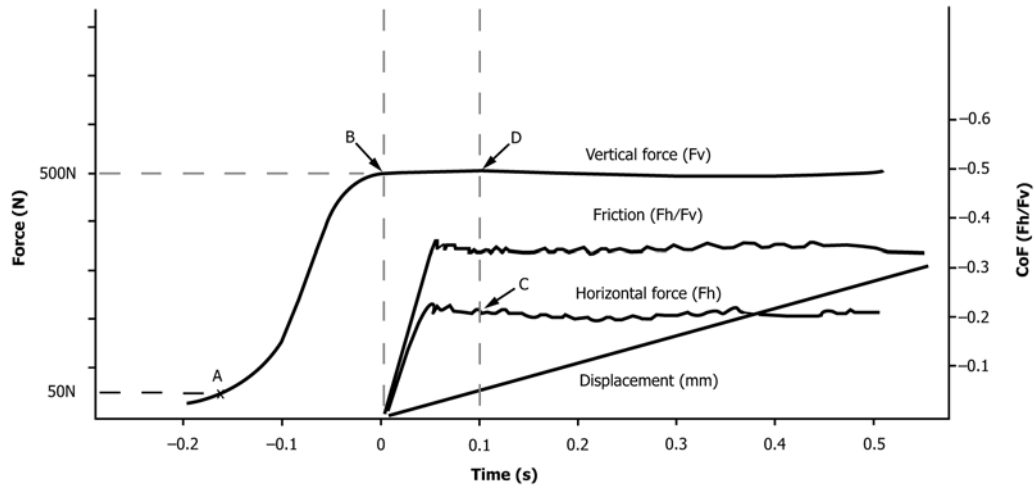
NOTE 3—Either the footwear item or the test surface may be the subject of the test. Appropriate flooring items and footwear items respectively are selected as the reference materials against which the test item is to be tested.

## 9. Preparation of Apparatus, Test Specimens and Test Surfaces

9.1 Prepare and condition standard reference materials (test surfaces and/or test sliders) according to 10.7.

<sup>6</sup> The sole source of supply of the slip tester (STM603) known to the committee at this time is SATRA Technology Centre, Kettering, Northamptonshire, NN16 8SD, United Kingdom.

<sup>7</sup> If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,<sup>1</sup> which you may attend.



- Key:
- A – 50 N reached
  - B – Full force achieved and relative movement started within 0.2 s after 'A'
  - C – Snapshot value of horizontal force taken at  $(0.1 \pm 0.01)$  s after the start of sliding movement
  - D – Snapshot value of vertical force taken at  $(0.1 \pm 0.01)$  s after the start of sliding movement

**FIG. 2 Test Chart Showing Sequence of Events in a Typical Test Run**



**FIG. 3 Example of Test Apparatus**

9.2 Prepare and condition footwear, outsole or slider materials according to 10.10.

9.3 Fit and secure the prepared test surface onto the rigid surface mount. If more than one test surface specimen is required to achieve a test track of at least 40 mm, position the joint(s) outside the area traversed during the test run.

9.4 Securely fit the prepared footwear, sole unit or slider to an appropriate mounting.

9.5 Lower the footwear, sole unit or slider into contact with the test surface under its own weight. Adjust the alignment and angle of the footwear, sole unit or slider to conform to one of the test modes defined in 12.6.1.

9.6 Fully tighten all mounting adjustments and lift the footwear test specimen away from the test surface.

9.7 Apply contaminant if required (see 10.5).