INTERNATIONAL STANDARD

ISO 13287

Second edition
2012-10-15

Personal protective equipment — Footwear — Test method for slip resistance

Équipement de protection individuelle — Chaussures — Méthode d'essai pour la résistance au glissement

Reference number
ISO 13287:2012(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13287 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 161, *Foot and leg protectors*, in collaboration with ISO Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 3, *Foot protection*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 13287:2006), which has been restructured for ease of use, more precisely specified in many areas and technically revised. The main technical revisions are:

— Subclause 4.1.2 and Clause 6 allow the use of the footwear manufacturer's shoemaking last;

— Subclauses 4.5 and 8.9 and Annexes B and D introduce ceramic tile Eurotile 2 as a replacement for Eurotile 1 (Annex C);

— Subclause 6.2.4 changes a timing parameter in the test;

— Subclauses 7.1.6 and 7.2.4 limit the amount of use of footwear and floor specimens before requiring re-preparation;

— Annex E has been added, which amends and supersedes ISO 20344:2011, 5.11.2, including a technical change in E.4.6.

The Bibliography refers to an instructional video available to users of this International Standard.

Personal protective equipment — Footwear — Test method for slip resistance

1 Scope

This International Standard specifies a method of test for the slip resistance of PPE footwear. It is not applicable to special purpose footwear containing spikes, metal studs or similar.

NOTE For product development purposes, sole units or other soling components such as top pieces may be tested.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 4662, *Rubber, vulcanized or thermoplastic — Determination of rebound resilience*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
normal force
force applied to the surface through the footwear, perpendicular (90°) to the surface

NOTE The force includes the weight of the footwear, shoemaking last (4.1.1 or 4.1.2) or mechanical foot (4.1.3) and mounting.

3.2
frictional force
force parallel to the surface and against the direction of movement arising when footwear slides over a surface

3.3
coefficient of friction
CoF
ratio of the frictional force divided by the normal force

3.4
static contact time
time between initial contact of the footwear with the surface achieving a normal force of 50 N and the beginning of movement

3.5
measurement period
time interval during which the frictional force measurement is taken and during which the test conditions are satisfied

3.6
floor
material (flooring), without contaminant (lubricant), to be used as the test surface

3.7
surface
floor, with or without contaminant (lubricant), against which the footwear is tested

3.8
calibration test value
CTV
coefficient of friction between the Slider 96[1)] and the test surface

4 Apparatus and materials

4.1 One or more of the following foot forms to hold the item of footwear to be tested.

4.1.1 Standard shoemaking last, conforming to Clause A.1.

4.1.2 Manufacturer's shoemaking last used to make the footwear sample to be tested, if required.

4.1.3 Mechanical foot, conforming to the dimensions given in Clause A.2.

4.2 Mechanism for lowering the item of footwear onto the surface and applying the required normal force at the required time in accordance with Clause 6.

4.3 Device for measuring the normal force between the footwear and surface when setting up the test and during the measurement period to an accuracy of 2 % or better.

4.4 Steel floor, consisting of a stainless steel plate.

NOTE 1 For example, steel Number 1.4301, Type 2G (cold rolled, ground) conforming to EN 10088-2:2005.

Surface roughness shall be measured in the area where the slip measurements are actually made. Measurements shall be made at 10 locations within this area and in the direction parallel to the sliding movement. At each location, measurements shall be made with a sampling length of 0,8 mm, taking five sampling lengths per location (evaluation length 4,0 mm).

The average roughness, R_z, shall be measured in accordance with ISO 4287. The overall mean value from all 10 locations shall be for R_z between 1,6 µm and 2,5 µm.

When the roughness parameter does not conform to the above specifications, the steel shall be prepared using silicon carbide abrasive paper or cloth for polishing in a succession of reducing grit sizes. The polishing direction of each operation shall be perpendicular to the preceding operation with the final direction being in the test direction. The preparation shall continue until the roughness parameter falls within the above specifications.

NOTE 2 Grit sizes 100 to 600 can be suitable.

4.5 Pressed ceramic tile floor, as specified in either Annex C or Annex D. The tiles shall not be modified in any way, for example, by mechanical or chemical treatment.

4.6 Other floors, for example, wood, concrete, stone, polymeric flooring. The floor shall be characterized by determining the coefficient of friction in accordance with Annex E.

4.7 Mechanism for inducing movement between the footwear and the surface at a time and speed as specified in Clause 6.

---

1) Slider 96 (formerly known as Four S rubber) is the trade name of a product supplied by Rapra (www.rapra.net). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

4.8 Device for measuring the frictional force between the footwear and surface during the measurement period to an accuracy of 2 % or better.

4.9 Silicon carbide paper, 400 grit size, mounted on a rigid block with a flat face measuring 100 mm × 70 mm and mass (1 200 ± 120) g.

NOTE This can be achieved using steel to make a block 22 mm thick.

4.10 Rigid wedges having a (7,0 ± 0,5)° angle as a suitable means of setting the contact angle. The tip of the wedge shall be truncated so that it is no more than 0,5 mm in height as judged by a graduated eyepiece. The width of the wedge should be sufficient to ensure that the full width of the heel or forepart shall be fully supported by the wedge. For the heel test, the length shall be sufficient to support the full length of the heel but shall not make contact with the forepart [see Figure 1a)]. For the forepart test, the length of the wedge shall be sufficient to support the whole of the heel and forepart of the shoe [see Figure 1b)].

4.11 Glycerol aqueous solution with a viscosity of (0,2 ± 0,1) Pa·s. At 23 °C this corresponds to an aqueous solution containing a mass fraction of approximately 85,6 % to 92,8 % glycerol. For other temperatures, see Table 1 (values for temperatures in the range given in Table 1 may be interpolated). The solution shall be replaced 30 min after exposure to the ambient atmosphere unless it can be shown to still comply with Table 1.

NOTE As a solution containing a mass fraction of approximately 90 % glycerol is hygroscopic in air with a relative humidity of more than 32 %, it is advisable to use solutions with a mass fraction of approximately 90,0 % to 92,5 % glycerol.

Table 1 — Approximate concentrations of glycerol in water for different temperatures and viscosities

Temperature °C	Concentration and refractive index of glycerol in water for					
	0,1 Pa·s		0,2 Pa·s		0,3 Pa·s	
	Mass fraction %	Refractive index	Mass fraction %	Refractive index	Mass fraction %	Refractive index
21,0	84,5	1,450 0	89,5	1,457 4	91,9	1,461 0
23,0	85,6	1,450 9	90,4	1,458 4	92,8	1,462 0
25,0	86,6	1,451 2	91,4	1,459 4	93,7	1,462 8

4.12 Detergent solution, containing a mass fraction of 0,5 % sodium lauryl sulfate (SLS) in demineralized water.

4.13 Ethanol solution, containing a mass fraction of (50 ± 5) % ethanol GPR (CAS 64-17-5), which may be prepared from industrial methylated spirits GPR containing minimum 90 % ethanol, in demineralized water.

5 Sampling and conditioning

5.1 Sampling

Unless otherwise specified, use a minimum of two samples of the same type of footwear of the same size.

NOTE The uncertainty of measurement may be assessed by one of the two following approaches:

— a statistical method, e.g. that given in ISO 5725-2;

— a mathematical method, e.g. that given in ENV 13005.

5.2 Conditioning

The test items shall be conditioned prior to the test at (23 ± 2) °C and (50 ± 5) % RH for a minimum of 48 h. If necessary, the sample may be removed from this standard atmosphere provided that its temperature is

maintained at (23 ± 2) °C, that testing starts within 30 min after removal from this standard atmosphere and that the testing is carried out at (23 ± 2) °C.

6 Test method

6.1 Principle

The item of footwear to be tested is put on a surface, subjected to a given normal force, and moved horizontally relative to the surface (or the surface is moved horizontally relative to the item of footwear). Both the frictional force and normal force are measured and the dynamic CoF is calculated.

6.2 Test modes and test conditions

6.2.1 The footwear shall be tested in one or more of the following modes (see Figure 1):

a) forward heel slip at angled contact;

b) backward slip on the forepart;

c) forward flat slip.

NOTE The heel test mode is considered the most important test mode in relation to reducing the risk of pedestrian slip.

6.2.2 For the heel and forepart test modes, the footwear shall be fitted onto a shoemaking last (4.1.1 or 4.1.2). The inside tangent of the shoemaking last, as defined by a straight line placed against the heel and joint swell on the inside of the shoemaking last (line A-B in Figure 2), shall be aligned parallel to the direction of sliding movement (see Figure 2).

In the heel test mode the footwear moves forward in the heel to toe direction. The contact angle between the bottom of the heel and the floor shall be (7,0 ± 0,5)° [see Figure 1a)], determined using a rigid wedge (4.10) placed on the floor. The shoemaking last, with the footwear mounted on it, shall be lowered onto the wedge under its own weight and adjusted until the footwear heel sits flat on the angled face of the wedge with 2 mm to 3 mm of the wedge extending beyond the rearmost contact point of the heel with the face of the wedge. The footwear forepart shall not contact the surface or the rigid wedge.

In the forepart test mode the footwear moves backwards in the toe to heel direction. The contact angle between the bottom of the shoe and the floor shall be (7,0 ± 0,5)° [(see Figure 1b)] determined using a rigid wedge (4.10) placed on the floor. The shoemaking last (4.1.1 or 4.1.2), with the footwear mounted on it, shall be lowered onto the wedge under its own weight and adjusted until the footwear bottom sits flat on the angled face of the wedge with 2mm to 3 mm of the wedge extending beyond the foremost contact point of the forepart with the face of the wedge.

For the flat test mode, the footwear shall be fitted onto the mechanical foot (4.1.3) or the manufacturer's shoemaking last (4.1.2). The mechanical foot shall be orientated such that the longitudinal axis of the mechanical foot is aligned parallel to the direction of sliding movement. The footwear shall be fitted onto the mechanical foot with the heel contact plate placed centrally in the heel seat with a small gap between the back edge and sides of the insole and with the forepart contact plate positioned approximately central to the forepart (see Figure 3). If using a manufacturer's shoemaking last (4.1.2) in place of the mechanical foot (4.1.3), then the last shall be aligned such that the footwear attains the same orientation of the outsole tread pattern relative to the direction of slip as would be achieved if using a mechanical foot (4.1.3).

6.2.3 The normal force (3.1) for footwear of European size 40 (UK size 6,5, Mondopoint 255) and above shall be (500 ± 25) N. For footwear of European size below 40 the normal force shall be (400 ± 20) N.

In the heel test mode, the line of action of the normal force shall be aligned approximately through the rear edge of the heel-floor contact area determined under the weight of the shoe, last and mounting [see Figure 1a)]. No additional force should be applied.

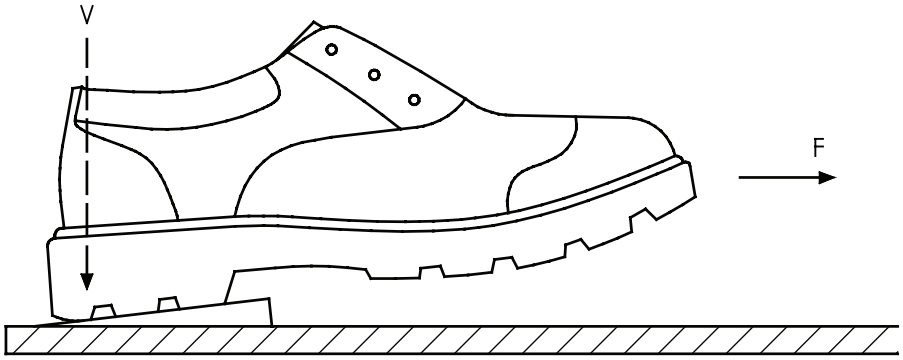
In the forepart test mode, the line of action of the normal force shall be aligned through a point approximately onethird of the length of the outsole measured back from the end of the toe [see Figure 1b)].

In the flat mode, the mechanical foot (4.1.3) determines the line of action of the normal force [see Figure 1c)]. If the manufacturer's shoemaking last (4.1.2) is used, the line of action of the normal force shall be through the approximate mid-point of the length of the footwear.

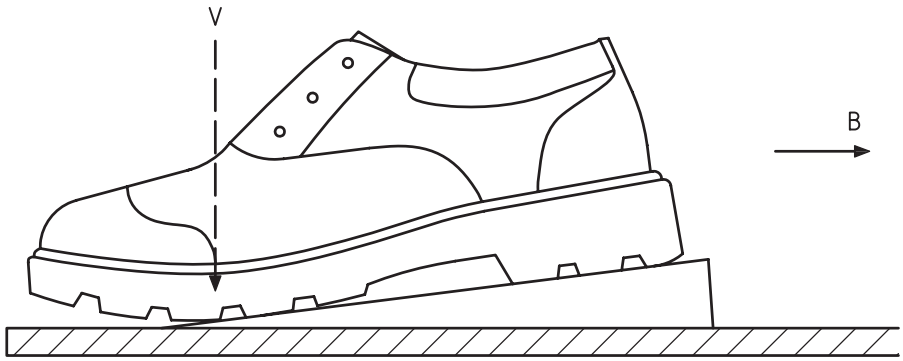
6.2.4 The static contact time shall be a maximum of 1,0 s from an initial contact force of 50 N to achieving full normal force and initiation of sliding movement. Sliding movement shall start within 0,3 s of achieving the full normal force (see Figure 4).

6.2.5 The sliding velocity during the measurement period shall be (0,3 ± 0,03) m/s.

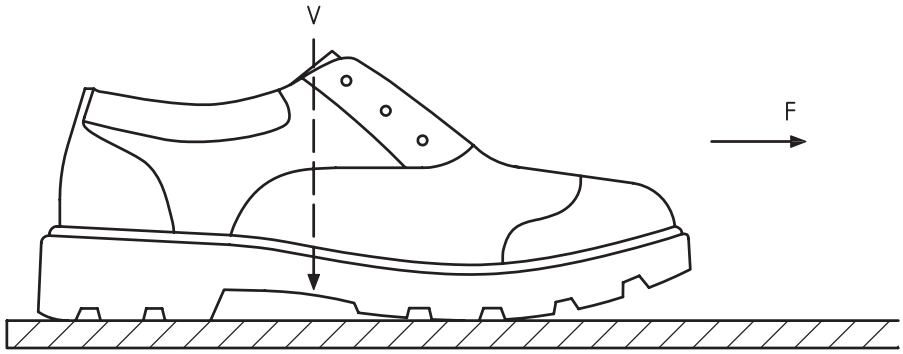
6.2.6 The mean frictional force shall be measured over the measurement period between (0,30 ± 0,02) s and (0,60 ± 0,02) s after the start of sliding movement, during which the full normal force (6.2.3) and sliding speed is maintained (see Figure 4).



a) Forward heel slip using standard or manufacturer's shoemaking last



b) Backward forepart slip using standard or manufacturer's shoemaking last



c) Forward flat slip using mechanical foot or manufacturer's shoemaking last

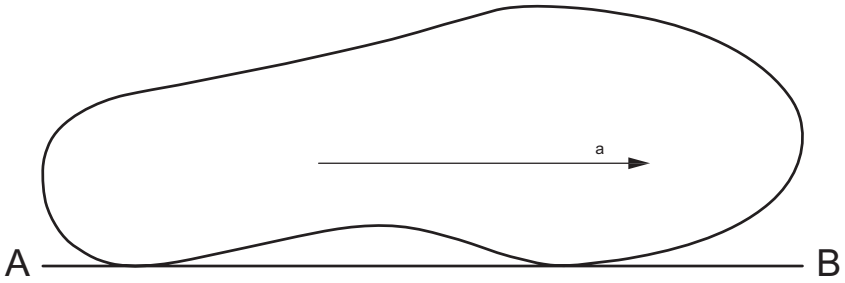
Key

V normal force

F forward movement of shoe relative to surface

B backward movement of shoe relative to surface

Figure 1 — Three test modes showing line of action of the normal force with respect to the sole-floor contact area

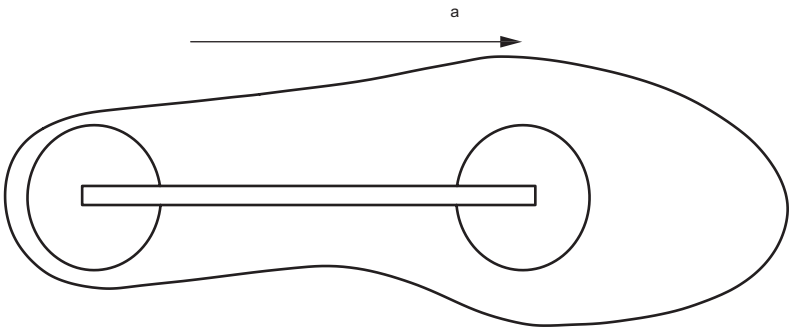


Key

A-B inside tangent

[a] direction of sliding movement

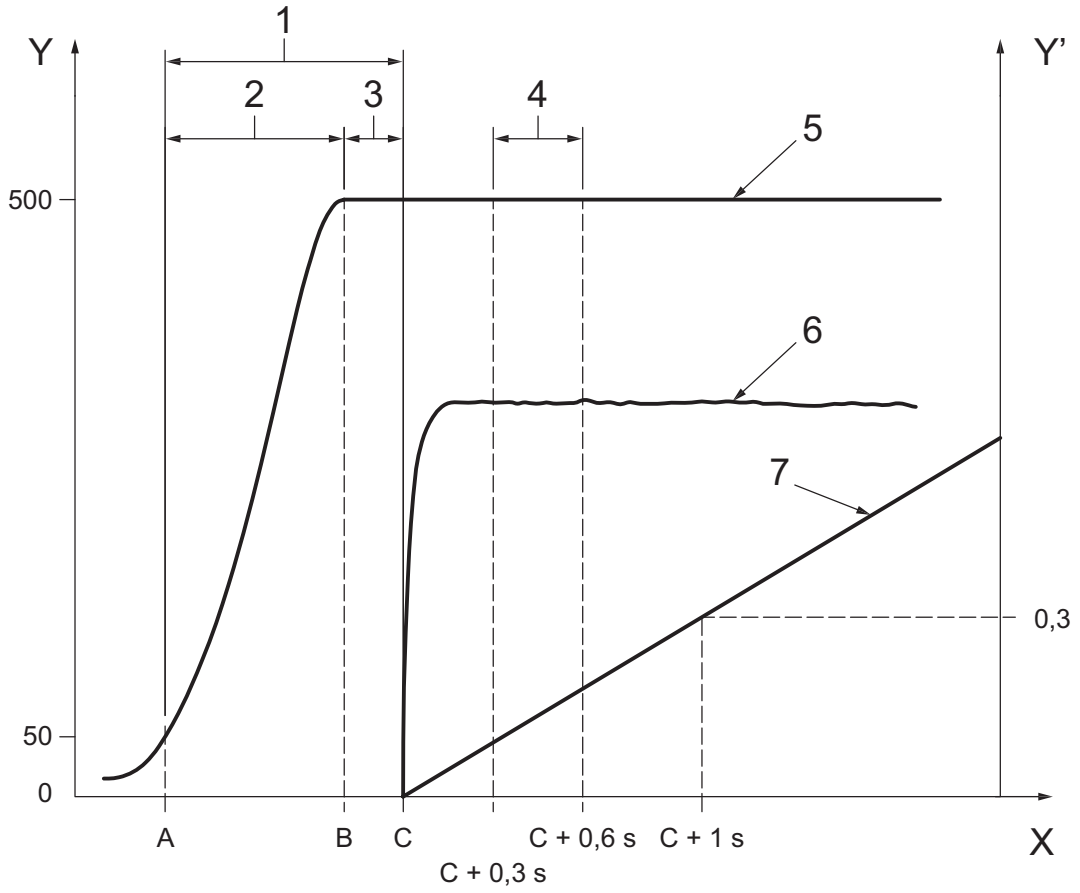
Figure 2 — Inside tangent of the standard or manufacturer's shoemaking last parallel to the direction of movement



Key

[a] direction of sliding movement

Figure 3 — Longitudinal axis of the mechanical foot parallel to the direction of movement



Key

X time (s)
Y force (N)
Y′ displacement (m)
A time at initial contact when normal force is 50 N
B time at which full normal force (e.g. 500 N) is reached
C time at start of movement
1 static contact time between points A and C: ≤ 1,0 s
2 time elapsed between points A and B: ≤ 1,0 s
3 time elapsed between points B and C: ≤ 0,3 s
4 measurement period between (C + 0,3 s) and (C + 0,6 s)
5 normal force
6 frictional force
7 displacement (sliding velocity during measurement period shall be 0,3 m/s)

Figure 4 — Illustrative test trace at 500 N normal force

7 Preparation of footwear and floor

7.1 Footwear

7.1.1 If there is a removable insock, it shall be taken out.

7.1.2 The upper of the footwear may be cut in order to facilitate its mounting on the last (4.1.1 or 4.1.2) or mechanical foot (4.1.3).

NOTE A sole unit or top piece may be tested by fixing to the bottom of a shoemaking last (4.1.1 or 4.1.2) or other suitable device, although the results may not be as reliable as testing whole shoes.

7.1.3 Wash the sole (all parts that will be in contact with the surface during the test, including the heel and forepart) with an ethanol solution (4.13) and a clean medium stiff brush. Rinse with demineralized water. Dry using clean, dry compressed air and then at ambient temperature.

7.1.4 Preparation of the sole: if the footwear is to be mounted on a shoemaking last (4.1.1 or 4.1.2) for testing, then the following abrasion shall be carried out with the footwear mounted on the appropriate last. If the footwear is to be mounted on a mechanical foot (4.1.3) for testing, the abrasion may be carried out without mounting the footwear on any device.

Prepare the sole (all parts that will be in contact with the surface during the test, including the heel and forepart) of the footwear by lightly abrading it with silicon carbide paper wrapped around a rigid block (4.9). No significant additional pressure shall be applied other than by the weight of the block (see Figure 5). Use linear or circular abrasion but with the final abrasion being linear and in the direction parallel to the direction of sliding movement in the test. Only superficial abrasion shall be applied that does not significantly change the tread pattern or the surface texture of the sole, and that produces a final visually uniform appearance. Any debris shall be removed using clean dry compressed air.

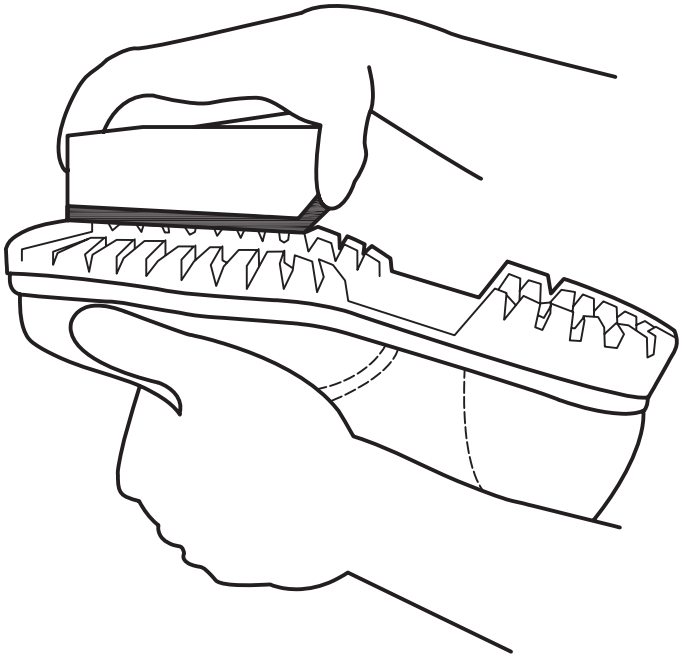


Figure 5 — Preparation of the sole

7.1.5 Avoid subsequent contamination of the sole other than by the test surface.

7.1.6 Each part of the sole (heel and/or forepart) shall be washed (7.1.3) and re-prepared (7.1.4) after every 30 single tests on that part of the sole (a single test being as defined in 8.8).

7.1.7 Condition the item of footwear in accordance with 5.2 prior to the first test. The item of footwear will not need to be re-conditioned between tests (e.g. different test modes or different surfaces) providing it is not removed from the standard temperature.

7.2 Floor

7.2.1 If the test floor comprises more than one piece of flooring, each piece shall be prepared as follows, ensuring that the edges are closely mated with no significant gap or unevenness across the joint(s).

7.2.2 Wash the floor with an ethanol solution (4.13), scrubbing gently with a clean medium stiff brush. Rinse with demineralized water. Dry using clean, dry compressed air and then at ambient temperature.

7.2.3 Avoid subsequent contamination of the floor other than by the lubricant and footwear.

7.2.4 The floor shall be re-cleaned (7.2.2) after every 30 single tests (a single test being as defined in 8.8).

7.2.5 Condition the floor in accordance with 5.2 prior to the first test. The floor will not need to be re-conditioned between tests (e.g. different test modes or different surfaces) providing it is not removed from the standard temperature.

8 Procedure

8.1 Prepare the item of footwear in accordance with 7.1.

8.2 Unless it has already been done, mount the item of footwear securely on the shoemaking last (4.1.1 or 4.1.2) or mechanical foot (4.1.3) as required, depending on the test mode to be used (6.2) and attach it to the testing machine. Select the largest size shoemaking last (4.1.1 or 4.1.2) that will ensure a tight fit without distorting the footwear sole; this is usually the last marked the same size as the footwear or one size smaller. If slippage is found to occur between the last or mechanical foot and the footwear during testing, prevent it by appropriate means, e.g. by placing some paper or cloth in the tip of the footwear and/or applying two-sided adhesive tape or abrasive paper to the underside of the last or mechanical foot.

8.3 Prepare the floor in accordance with 7.2.

8.4 Mount the floor securely on the test machine.

NOTE It is desirable that the footwear-floor contact area should not pass over a joint during the measurement period particularly in the heel test mode.

8.5 Mount the footwear on the test machine in the test mode required and in accordance with 6.2.1 to 6.2.3.

8.6 Apply the lubricant (4.11 or 4.12), if required, to the floor (4.4, 4.5 or 4.6) by pouring, or by other suitable means that avoids foaming of the liquid, such that it forms a continuous layer of at least 1 mm thickness (corresponding to at least 10 ml/100 cm^2) covering the whole floor-footwear contact area. Before each test ensure that the layer conforms to this requirement.

NOTE A trough or similar device can be used to entrap lubricant within the footwear/floor contact area to ensure that the required minimum depth of lubricant is reached.

8.7 Select the normal force in accordance with 6.2.3.

8.8 Activate the test sequence as follows: lower the item of footwear onto the surface ensuring that the footwear is fully supported by the surface, apply the normal force and initiate the sliding movement between the footwear and surface. Record the frictional force with the force measuring device (4.8) in accordance with the conditions given in 6.2.4 and 6.2.5. Determine the mean frictional force during the measurement period and calculate the mean CoF for that measurement (CoF_1) (6.2.6).

8.9 Repeat 8.8 four times to obtain five consecutive measurements (CoF_1 to CoF_5). Calculate the arithmetic mean of the CoF (CoF_m).

For all floors except Eurotile 2 (Annex D), the value of CoF_m shall be reported as the CoF. When using floor Eurotile 2 then the CoF shall be calculated as specified in Annex D.

However, if the five consecutive results (CoF_1 to CoF_5) show a systematic increase or decrease of more than 0,03 or 10 %, whichever the greater, of the initial reading (CoF_1), discard these results and repeat the test.

If the results continue to show a systematic increase or decrease, cease testing and report the lowest CoF recorded in the first set of five measurements (CoF_1 to CoF_5) and whether the CoF was increasing or decreasing.

8.10 If further tests using the same item of footwear and surface are to be made, for example in different test modes (6.2.1), remove excess lubricant from the floor using a clean paper towel and adjust the contact mode, taking care not to contaminate the footwear or surface, and repeat 8.6 to 8.9.

8.11 Other items of footwear may be tested on the same surface. However, the test floor shall be re-cleaned in accordance with 7.2.4.

8.12 If the same item of footwear is to be tested with different lubricants, remove the footwear from the test machine and wash the sole in accordance with 7.1.3. However, demineralized water may be used in place of ethanol, before continuing.

NOTE Care should be taken when interpreting the results of tests on surfaces having a significant surface profile. In such cases, it is desirable to report the maximum and minimum CoF values recorded during the measurement period (6.2.6) in each test (8.8).

9 Test report

The test report shall contain the following information:

a) identification or description of the footwear item(s) tested, including marked footwear size and foot (left or right);

b) identification of the mounting method used (standard or manufacturer's shoemaking last, including the last reference, or mechanical foot) for each test mode;

c) the CoF as in 8.9 for each item of footwear, specifying the test combination chosen (floor, e.g. Eurotile 1, Eurotile 2, steel or other, and lubricant) and test mode;

d) identification or description of any other surface or lubricant used, including, where practicable, the calibration test value (CTV) measured in accordance with Annex E;

e) reference to this International Standard, i.e. ISO 13287:2012;

f) date of test;

g) any deviation from the method given in this International Standard.

Annex A
(normative)

Standard shoemaking last and mechanical foot for testing footwear

A.1 Standard shoemaking last

Plastic standard shoemaking last, type M3601[2)].

A.2 Mechanical foot[3)]

An example of a suitable mechanical foot is shown in Figure A.1. The dimensions “a” and “b” shown in Figure A.1 depend on the footwear size being tested and shall be as follows:

European (Mondopoint)	Diameter of the contact plates (a) mm	Distance of the centres of the contact plates from the centre axis (b) mm
below 36 (below 225)	40	60
36 to 39 (225 to 245)	40	70
40 to 44 (255 to 280)	55	80
above 44 (above 280)	55	90

2) For details of a suitable supplier of the shoemaking last please visit http://isotc.iso.org/livelink/livelink?func=ll&objId=8867539&objAction=browse&sort=name.

3) For details of suitable suppliers of the mechanical foot please visit http://isotc.iso.org/livelink/livelink?func=ll&objId=8867539&objAction=browse&sort=name.

Dimensions in millimetres

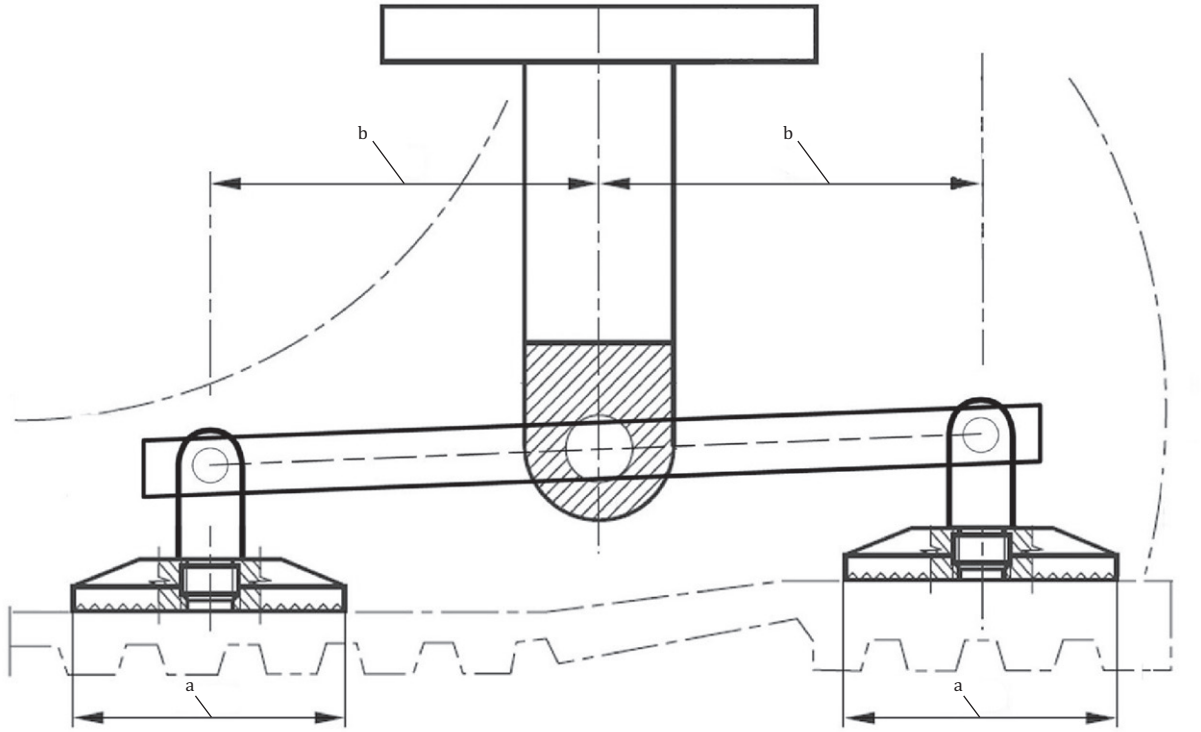


Figure A.1 — Example of a suitable mechanical foot

Annex B
(informative)

Background information relating to Eurotile 1 and Eurotile 2

Eurotile 1 was the original ceramic tile identified and specified for use in this International Standard prior to the publication of this second edition of ISO 13287. Due to the cessation of manufacture and supply of Eurotile 1, an alternative ceramic tile, Eurotile 2 (also known as OFIR tile) was identified as a suitable replacement subject to the adoption of an “adjustment factor” (Annex D) applied to test results in order to ensure close agreement with comparable results generated on Eurotile 1.

Eurotile 2 was evaluated as a potential replacement for Eurotile 1 as it was also a flooring tile being considered by CEN/TC 339, *Slip resistance of pedestrian surfaces — Methods of evaluation*, as a suitable reference surface for use in flooring slip resistance standards under development. If adopted by both the footwear and flooring industries, Eurotile 2 would serve as a useful cross reference flooring between footwear and flooring slip resistance standards.

For this International Standard, comparative tests were conducted on both tiles using a wide range of PPE footwear samples in several European laboratories. Eurotile 1 and Eurotile 2 were found to give a high degree of correlation in CoF results in both the forward heel and flat test modes (backward forepart tests were not conducted) but with a degree of dependence on the footwear soling material type.

Eurotile 2 was found to give greater differentiation between material types than Eurotile 1, giving relatively higher results for rubber compounds compared with other materials such as polyurethane and PVC blends. Consequently, in determining the value of the “adjustment factor” (AF), in Annex D it was deemed appropriate to take the lowest common denominator in order that the AF was sufficient to ensure, as far as possible, that Eurotile 2 results were at least comparable with Eurotile 1 results for all material types.

Annex C
(normative)

Specification of Eurotile 1

C.1 General

Eurotile 1 is no longer commercially available but remaining stocks may be used until 2013-12-31. After that date, only Eurotile 2 shall be used.

Only pressed ceramic Eurotile 1 tiles giving CTVs by the method specified in Annex E, in the range 0,18 to 0,22, shall be used for testing footwear. Tiles giving values outside this range shall be discarded.

The CTV shall be re-determined at least once per day prior to testing footwear and no less frequently than after every 30 single tests (a single test being as defined in 8.8).

NOTE This means, for example, that the CTV would have to be re-determined after testing three shoes of different sizes of a given style, in two test modes, such as heel and flat, and five measurements made for each

C.2 Calculation of footwear test results when using Eurotile 1

When using Eurotile 1 for footwear testing, the reported footwear test value shall be the measured coefficient of friction, CoF, where CoF = CoF_m.

CoF_m is as defined in 8.9.

Annex D
(normative)

Specification of Eurotile 2 (OFIR)

D.1 General

Only pressed ceramic Eurotile 2[4)] tiles giving CTV by the method specified in Annex E, in the range 0,20 to 0,26, shall be used for testing footwear. Tiles giving values outside this range shall be discarded.

The CTV shall be re-determined at least once per day prior to testing footwear and no less frequently than after every 30 single tests (a single test being as defined in 8.8).

NOTE This means, for example, that the CTV would have to be re-determined after testing three shoes of different sizes of a given style, in two test modes, such as heel and flat, and five measurements made for each.

D.2 Calculation of footwear test results when using Eurotile 2

When using Eurotile 2 for footwear testing, the reported footwear test result shall be the coefficient of friction, CoF, where CoF = CoF_m – AF.

— CoF_m is as defined in 8.9.

— AF is an adjustment factor as follows:

1) 0,07 for flat test mode;

2) 0,03 for the heel test mode.

4) For details of suitable suppliers of Eurotile 2 (which is currently referred to as the OFIR tile) please visit http://isotc.iso.org/livelink/livelink?func=ll&objId=8867539&objAction=browse&sort=name.

Annex E
(normative)

Calibration procedure for Eurotile tiles and other test surfaces

E.1 General

Before performing a test on ceramic tiles (4.5) or on other hard surfaces (4.6), the tile or other surface shall be characterized in accordance with the following procedure.

Only ceramic tiles (4.5) giving test results in the range specified in Annex C or Annex D shall be accepted as within calibration for testing footwear. Tiles giving results outside the specified range shall be rejected.

E.2 Apparatus and materials (additional to those in Clause 4)

E.2.1 Specimen Slider 96 of calibrated hardness (96 ± 2) IRHD measured value at (23 ± 2) °C and specified resilience in accordance with ISO 4662 of (24 ± 2) % at 23 °C. Required specimen Slider 96 (specimen S96) size: 25,4 mm wide, at least 50 mm long and 5 mm to 7 mm thick. The walls shall be vertical and the edges square.

Storage of specimen S96:

— storage temperature should be below 25 °C and preferably below 15 °C;

— moist conditions should be avoided and conditions should be such that condensation does not occur;

— it should be protected from light, particularly direct sunlight and strong artificial light;

— it should be protected from circulating air by wrapping or storing in airtight containers (paper and polythene are both suitable, however, plasticized PVC film is not to be used).

It is recommended that samples of specimen S96 are discarded 12 months after issue.

NOTE Specimen S96 should be supplied with a certificate stating the date the sample should be discarded.

E.2.2 Means of cutting specimen S96. Specimen S96 (E.2.1) is supplied pre-moulded in a suitable size and form. However, if larger sheets of specimen S96 are obtained, then a means is required of cutting a rectangular specimen such that it has vertical walls, square edges, is (25,4 ± 1,0) mm wide and at least 50 mm long. A means of trimming specimens parallel to the 25,4 mm edge while retaining a vertical wall and square edge may also be required (see E.3.6).

NOTE Cutting by some methods such as shoemaking press knives may produce concave walls.

E.2.3 Rigid, rectangular backing plate, with dimensions at least as wide as the specimen cut with the device and at least 50 mm long.

E.2.4 Means of securely attaching specimen S96 (E.2.1) to the backing plate (E.2.3). Suitable adhesives include epoxy resins, cyanoacrylate or solvent-based contact adhesive. The face to be bonded should be lightly abraded with abrasive paper (E.2.6) then dried in clean, dry compressed air or by wiping with a suitable solvent such as ethanol and allowing to dry in air before bonding.

NOTE Double-sided tape may be suitable when a low level of CoF is expected, for example when testing on ceramic tile (4.5) with detergent solution (4.12).

E.2.5 Means of attaching the specimen S96 backing plate (E.2.3) to the test apparatus at the required contact angle.

NOTE A rectangular metal box of dimensions 180 mm x 90 mm x 90 mm can be used to replace the shoemaking last (4.1.1, 4.1.2, 4.1.3) and the backing plate (E.2.3) attached to it.

E.2.6 Silicon carbide paper, 400 grit size, mounted on a flat rigid surface.

E.3 Preparation of test slider and tile or other surface

E.3.1 If necessary, cut to size a sample of specimen S96 (E.2.1) using the device (E.2.2) and clean using distilled water, then dry in air.

NOTE If other contamination, such as by oil, has occurred, discard and use a new sample of specimen S96.

E.3.2 Attach the specimen S96 (E.3.1) to the backing plate (E.2.3) using adhesive (E.2.4).

E.3.3 Holding the specimen S96 by the backing plate (E.2.3) and applying a light, evenly distributed pressure, abrade the surface of the rubber against the abrasive paper (E.2.6) until a visually even level of abrasion is achieved and the surface is parallel with the backing plate. For this procedure, alternately use a backward and forward linear movement in a direction parallel to the long side of the specimen S96, and a side-to-side movement in a perpendicular direction, with the final direction of abrasion being parallel to the long side.

E.3.4 Remove any debris from the surface of specimen S96 using clean, dry compressed air.

E.3.5 Clean the ceramic tile (4.5) in accordance with 7.2.2. Other surfaces (4.6) should be cleaned using appropriate cleaning agents.

E.3.6 The condition of the specimen S96 shall be restored at intervals as repeated use will cause edges to become rounded or a concave chamfer may develop across the tested edge. Either use the abrasion method described above to restore the slider to the correct condition and/or cut away the affected end section of material, providing at least 50 mm length remains and the new cut edge is vertical and flat.

Both ends and surfaces of specimen S96 may be used, provided that the end used is in the correct condition.

When the thickness of specimen S96 has been reduced to 5 mm by repeated use, it shall be replaced.

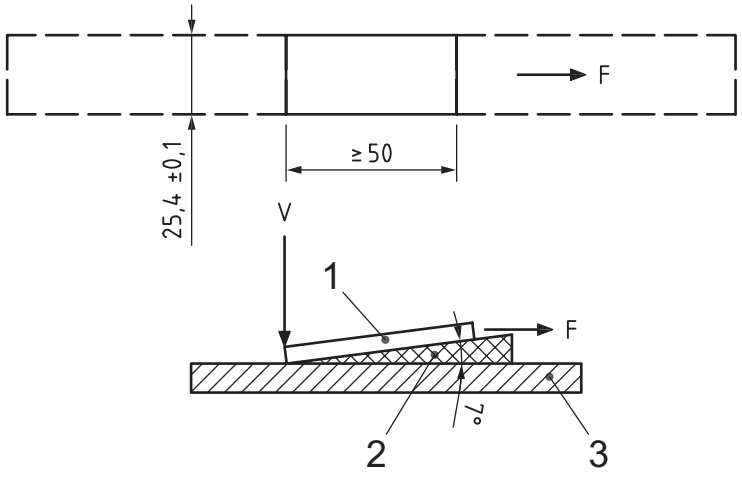
E.4 Calibration test procedure

E.4.1 Condition the test floor (4.5 or 4.6) and specimen S96 (E.2.4) for at least 3 h at the test atmosphere.

E.4.2 Attach the backing plate (E.2.3) with specimen S96 attached to the test machine so that the 25,4 mm edge is perpendicular to the direction of sliding movement and the line of action of the normal force passes through the specimen S96/floor contact area.

E.4.3 Using the shorter rigid wedge (4.10), set the face of specimen S96 at a contact angle of (7 ± 0,5)° to the test surface (4.5 or 4.6, Figure E.1). The backing plate, with specimen 96 attached, shall be lowered onto the wedge under its own weight and adjusted until specimen 96 sits flat on the angled face of the wedge with 2 mm to 3 mm of the wedge extending beyond the rearmost contact point of specimen 96 with the face of the wedge.

Dimensions in millimetres



Key

V normal force
F forward movement of specimen S96 relative to the surface
1 specimen S96
2 rigid wedge
3 test surface

Figure E.1 — Orientation and contact angle of specimen S96

E.4.4 Mount the test surface (4.5 or 4.6) and lubricate with detergent solution (4.12).

NOTE Other floors and lubricants may be used in order to provide additional information.

E.4.5 Apply the test conditions specified in Clause 6 for the forward heel slip mode, applying a 500 N normal force.

E.4.6 Carry out the test procedure as specified in 8.1 to 8.8. Then:

— for Eurotile 1 (4.5 and Annex C), report the result (CoF_1) as the CTV;

— for Eurotile 2 (4.5 and Annex D) and other hard surfaces (4.6), make two further consecutive measurements (CoF_2 and CoF_3) and report the third measurement (CoF_3) as the CTV [there should be no treatments applied between the three consecutive test measurements except for replenishing the lubricant (4.12) if required to maintain the correct coverage (8.3)].

E.4.7 For Eurotile 1 and 2, if the CTV is outside the specified range (Annex C or D), reject the tile.

E.4.8 For Eurotile 1 and 2, if the CTV is within the specified range (Annex C or D), accept the tile and record the CTV value obtained.

E.4.9 For other surfaces (4.6), unless specifications are given elsewhere, record the CTV value obtained.

E.4.10 Clean (E.3.1) and dry specimen S96 and the test floor before returning to storage.

Bibliography

[1] ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

[2] ISO 20344:2011, *Personal protective equipment — Test methods for footwear*

[3] EN 10088-2:2005, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

[4] ENV 13005, *Guide to the expression of uncertainty in measurement*

[5] Instructional video on carrying out tests in accordance with ISO 13287[5)]

5) For details of a suitable supplier of the instructional video please visit http://isotc.iso.org/livelink/livelink?func=ll&objId=8867539&objAction=browse&sort=name.

ICS 13.340.50

Price based on 20 pages