INTERNATIONAL STANDARD

ISO 13287

First edition
2006-02-15

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 13287:2006(E)

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Published in Switzerland

Foreword

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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 (as EN 13287:2004) and was adopted, under a special "fast-track procedure", by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 3, *Foot protection*, in parallel with its approval by the ISO member bodies. ISO 13287 replaces ISO/TR 11220:1993, which was withdrawn in 2003.

For the purposes of this International Standard, the CEN annex regarding the fulfilment of European Council Directives has been removed.

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Foreword

This document (EN 13287:2004) has been prepared by Technical Committee CEN/TC 161 “Foot and leg protectors”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2004 and conflicting national standards shall be withdrawn at the latest by September 2004.

This document supersedes ENV 13287:2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

Annexes A and B are normative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies a method of test for the slip resistance of conventionally soled safety, protective and occupational footwear. It is not applicable to special purpose footwear containing spikes, metal studs or similar.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN ISO 20344, *Personal protective equipment – Test methods for footwear (ISO 20344:2003).*

EN ISO 4287, *Geometrical product specifications (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters (ISO 4287:1997).*

3 Terms and definitions

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

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

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 first contact of the footwear with the surface at 50 N normal force and 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
surface
floor, with or without contaminant (lubricant), against which the footwear is tested

3.7
test cycle
consists of 5 measurements of footwear in one mode according to 8.2

4 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). The frictional force is measured and the dynamic coefficient of friction is calculated.

The uncertainty of measurement for coefficient of friction in this standard shall be assessed according to annex B.

5 Reagents

5.1 Glycerol, aqueous solution with a viscosity of (0,2 ± 0,1) Pa·s {(200 ± 100) cP}. At 20 °C this corresponds to an aqueous solution containing a mass fraction of approximately 84,0 % to 91,4 % glycerol. For other temperatures see Table 1 (values for temperatures in the range given in the table may be interpolated).

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 89,0 % to 91,5 % glycerol and to renew the solution layer on the testing surface frequently during prolonged testing sessions if the relative humidity of the surrounding air exceeds 32 %. The concentration of the glycerol needs to be checked regularly, e.g. by measuring the refractive index.

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 (100 cP)		0,2 Pa·s (200 cP)		0,3 Pa·s (300 cP)	
	Mass fraction %	Refractive index	Mass fraction %	Refractive index	Mass fraction %	Refractive index
17,5	82,7	1,4481	87,8	1,4555	90,2	1,4595
20,0	84,0	1,4494	89,0	1,4568	91,4	1,4606
22,5	85,3	1,4508	90,2	1,4581	92,6	1,4618
25,0	86,6	1,4512	91,4	1,4594	93,7	1,4628

5.2 Detergent solution, containing a mass fraction of 0,5 % sodium lauryl sulphate in demineralized water.

5.3 Ethanol solution, containing a mass fraction of (50 ± 5) % ethanol in water.

6 Apparatus

6.1

a) Shoemaking last , conforming to A.1 to hold the item of footwear.

b) Artificial foot, conforming to dimensions given in A.2 to hold the item of footwear.

6.2 Mechanism, for lowering the item of footwear onto the surface and applying the required normal force at the required time according to clause 8.

6.3 Device, for measuring the normal force exerted on the item of footwear.

6.4 Steel floor, consisting of a stainless steel plate, such as steel Number 1.4301, Type 2G (cold rolled, ground) conforming to EN 10088-2: 1995. [1)]

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 according to EN ISO 4287. The overall mean value from all 10 locations shall be for R_z between 1,6 µm and 2,5µm.

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 Grit sizes 100 to 600 can be suitable.

6.5 Pressed ceramic tile floor, of roughness R_z, measured according to 6.4, having an overall mean value of R_z from all 10 locations of between 14µm and 18µm. [2)]

6.6 Mechanism, for inducing movement between the footwear and the surface at a time and speed according to clause 8.

6.7 Frictional force measuring device, connected to either footwear or surface.

6.8 Silicon carbide paper, 400 grit size, mounted on a rigid block with a flat face 100 mm × 70 mm and mass (1200 ± 120) g.

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

7 Sampling

When testing in accordance with EN ISO 20344 test at least one item of footwear of each of the smallest, middle and largest sizes in the manufacturer's size range.

For other applications a minimum of three samples of the same type of footwear should be tested unless otherwise specified.

8 Test conditions

8.1 The test items shall be conditioned prior to the test at (23 ± 2) °C and (50 ± 5)% rh in accordance with EN ISO 20344 and the test shall be performed within 30 min after removal from that standard atmosphere. The climatic conditions during the test shall be a temperature of (23 ± 2) °C.

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1) Details of a source of suitable steel can be obtained from the Secretariat of CEN/TC 161.

2) Details of a source of suitable ceramic tiles can be obtained from the Secretariat of CEN/TC 161.

8.2 The footwear shall be tested in at least one of three modes (see Figure 1):

a) Forward heel slip at angled contact;

b) Backward slip on the forepart;

c) Forward flat slip.

8.3 For the heel and forepart test modes the footwear shall be fitted onto the shoemaking last (6.1). The inside tangent of the shoemaking last shall be aligned parallel to the direction of movement.

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 1).

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)º (see Figure 1).

For the flat test mode the footwear shall be fitted onto the artificial foot (6.1).

NOTE A rigid wedge having a (7,0 ± 0,5)º angle and of minimum dimensions 80 mm wide by 120 mm long can provide a suitable means of setting the contact angle. The shoemaking last holding the footwear is lowered onto the wedge under its own weight and adjusted until the footwear heel sits flat on the angled face of the wedge.

8.4 The normal force for footwear of Paris points size 40 (English size 6,5) and above shall be (500 ± 25) N. For footwear of Paris points 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 within the heel-floor contact area.

In the forepart test mode the line of action of the normal force shall be aligned through the approximate centre of the forepart-floor contact area.

In the flat mode, the artificial foot (6.1) determines the line of action of the normal force.

8.5 The static contact time shall be a maximum 1,0 s from an initial contact force of 50 N to achieving full normal force and initiation of sliding movement. Sliding movement should start within 0,5 s of achieving the full normal force (see Figure 2).

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

8.7 The mean frictional force shall be measured between 0,30 s and 0,60 s after the start of sliding movement when both the full normal force (8.4) and sliding speed (8.6) have been achieved (see Figure 2). The result of the measurement is the mean value during the measurement period.

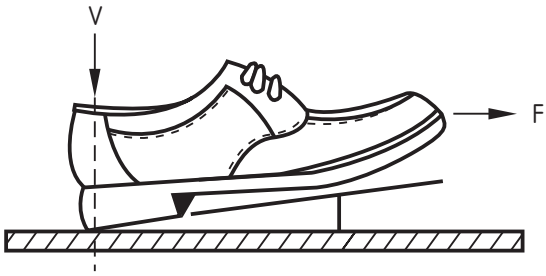

Figure 1a – Forward heel slip

Figure 1b – Backward forepart slip

Figure 1c – Forward flat slip

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