INTERNATIONAL STANDARD

ISO 20344

Second edition
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Personal protective equipment — Test methods for footwear

Équipement de protection individuelle — Méthodes d'essais pour les chaussures

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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 20344 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 20344:2004), which has been technically revised. It also incorporates the Technical Corrigendum ISO 20344:2004/Cor.1:2005 and the Amendment ISO 20344:2004/Amd.1:2007.

The main differences between this edition and the 2004 edition are:

— Annex A, inclusion of a new procedure for plasticine calibration;

— Annex C, inclusion of a new table for footwear sizing;

— 4.1, Table 1, clarification of the method for sampling;

— 5.1, clarification on testing of ergonomic features;

— 5.4 and 5.5, inclusion of a reference to EN 12568:2010;

— 5.8.3, different test methods for anti-penetration insoles;

— 5.15.2, inclusion of a new test method for water resistance;

— 6.4.2 and 6.5.2, inclusion of test methods (due to the withdrawal of ISO 2023);

— 6.11, replacement of the method for determination of chromium VI by a reference to ISO 17075;

— withdrawal of 5.11, “Determination of the electrical insulation”.

Personal protective equipment — Test methods for footwear

1 Scope

This International Standard specifies methods for testing footwear designed as personal protective equipment.

2 Normative references

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

ISO 34-1:2010, *Rubber, vulcanised or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868:2003)*

ISO 1817:2011, *Rubber, vulcanised — Determination of the effect of liquids*

ISO 3290-1, *Rolling bearings — Balls — Dimensions and tolerances*

ISO 3376, *Leather — Physical and mechanical tests — Determination of tensile strength and percentage extension*

ISO 3377-2, *Leather — Physical and mechanical tests — Determination of tear load — Part 2: Double edge tear*

ISO 4045, *Leather — Determination of pH*

ISO 4643:1992, *Moulded plastic footwear — Lined or unlined poly (vinyl chloride) boots for general industrial use — Specification*

ISO 4649:2010, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

ISO 4674-1:2003, *Rubber- or plastics-coated fabrics — Determination of tear resistance — Part 1: Constant rate of tear methods*

ISO 5423:1992, *Moulded plastic footwear — Lined or unlined polyurethane boots for general industrial use — Specification*

ISO 13287, *Personal protective equipment — Footwear — Test method for slip resistance*

ISO 17075, *Leather — Chemical analysis — Determination of chromium VI*

ISO 20345:2011, *Personal protective equipment — Safety footwear*

ISO 20347, *Personal protective equipment — Occupational footwear*

ISO 23529:2010, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

EN 388:2003, *Protective gloves against mechanical risks*

EN 12568:2010, *Foot and leg protectors — Requirements and test methods for toecaps and penetration-resistant inserts*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20345 and ISO 20347 apply.

4 Sampling and conditioning

4.1 Sampling

The minimum number of samples to be tested in order to check compliance with the requirements specified in ISO 20345, ISO 20347 and any specific job-related footwear standards (e.g. ISO 17249, *Safety footwear with resistance to chain saw cutting*), together with the minimum number of test pieces taken from each sample, shall be in accordance with Table 1.

Wherever possible and necessary to ensure the essential safety requirements, test pieces shall be taken from the whole footwear. This paragraph is applicable to all of Table 1.

NOTE 1 If it is not possible to obtain a large enough test piece from the footwear, then a sample of the material from which the component has been manufactured may be used instead. This should be noted in the test report.

NOTE 2 Footwear sizes are defined in Annex C.

Where samples are required from each of three sizes, these shall comprise the smallest, middle and largest size of the footwear under test [indicated as (SML) in Table 1].

4.2 Conditioning

All test pieces shall be conditioned in a standard atmosphere of (23 ± 2) °C and (50 ± 5) % RH for a minimum of 48 h before testing, unless otherwise stated in the test method.

The maximum time which shall elapse between removal from the conditioning atmosphere and the start of testing shall not be greater than 10 min, unless otherwise stated in the test method.

4.3 Prerequisites on the testing procedure

When several test pieces are tested, at least the worst results per size shall to be reported.

Footwear shall be tested as it is intended to be used, unless otherwise specified in the test method. For instance, if there is a removable insock, it shall be left in place to perform the tests.

The uncertainty of measurement for each test method described in this International Standard may be assessed. One of the two following approaches should be used:

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

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

Table 1 — Minimum number of samples and test pieces

	Property under test (B = basic requirement, A = additional requirement)		Test only on the final footwear	Subclause reference	Type and number of samples	Type and number of test pieces per sample
Whole footwear	Specific ergonomic features	B	yes	5.1	1 pair of shoes in 3 sizes	1 pair of shoes
	Upper/outsole and sole interlayer bond strength	B	yes	5.2	1 shoe from each of 3 sizes (SML)	1 test piece taken from the shoe
	Internal toecap length	B	yes	5.3	1 pair of shoes from each of 3 sizes (SML)	1 pair of toecaps
	Impact resistance	B	yes	5.4	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	Compression resistance	B	yes	5.5	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	Behaviour of toecaps and inserts (thermal and chemical)	B	no	5.6	See Tables 3 and 4	
	Leakproofness	B	yes	5.7	2 shoes from different sizes	1 shoe
	Dimensional conformity and penetration resistance of inserts	A	yes	5.8	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	Flex resistance of penetration-resistant insert	A	no	5.9	1 pair of insert from each of 3 sizes (SML)	1 pair of inserts
	Electrical resistance	A	yes	5.10	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	Slip resistance	B	yes	5.11	1 shoe from each of 3 sizes (SML)	1 shoe
	Insulation against heat	A	yes	5.12	2 shoes from different sizes	1 shoe
	Insulation against cold	A	yes	5.13	2 shoes from different sizes	1 shoe
	Energy absorption of seat region	A	yes	5.14	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	Water resistance	A	yes	5.15	3 pairs of shoes (minimum 2 different sizes)	1 pair of shoes
	Impact resistance metatarsal protective device	A	yes	5.16	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	Ankle protection	A	yes	5.17	1 shoe from each of 3 sizes (SML)	2 test pieces

Table 1 (*continued*)

	Property under test (B = basic requirement, A = additional requirement)		Test only on the final footwear	Subclause reference	Type and number of samples	Type and number of test pieces per sample
Upper lining and tongue	Thickness	B	yes	6.1	1 shoe from each of 3 sizes (SML)	1 test piece
	Height of the upper	B	yes	6.2	1 shoe from each of 3 sizes (SML)	1 shoe
	Tear strength	B	yes	6.3	shoes from each of 3 sizes (SML)	3 test pieces per size
	Tensile properties	B	yes	6.4	shoes from each of 3 sizes (SML)	3 test pieces per size
	Flexing resistance	B	yes	6.5	1 shoe from each of 3 sizes (SML)	1 test piece
	Water vapour permeability	B	yes	6.6	1 shoe from each of 3 sizes (SML)	1 test piece
	Water vapour absorption	B	yes	6.7	1 shoe from each of 3 sizes (SML)	1 test piece
	pH value	B	no	6.9	Each leather	2 test pieces
	Hydrolysis	B	yes	6.10	1 shoe from each of 3 sizes (SML)	1 test piece
	Chromium VI content	B	no	6.11	Each leather	2 test pieces
	Abrasion resistance of lining	B	no	6.12	shoes or materials	6 test pieces, wet 6 test pieces, dry
	Water penetration and water absorption	A	no	6.13	shoes or materials	3 test pieces
	Cut resistance	A	no	6.14	1 pair of shoes from each of 3 sizes (SML) or material	2 test pieces
Insole and Insock	Thickness of insole	B	no	7.1	1 shoe from each of 3 sizes or material	1 test piece
	pH value	B	no	6.9	Each leather	2 test pieces
	Water absorption and desorption	B	no	7.2	1 shoe from each of 3 sizes or material	1 test piece
	Abrasion resistance of insole	B	no	7.3	1 shoe from each of 3 sizes or material	1 test piece
	Chromium VI content	B	no	6.11	Each leather	2 test pieces
	Abrasion resistance of insock	B	no	6.12	Shoes or materials	6 test pieces, wet 6 test pieces, dry

Table 1 (*continued*)

	Property under test (B = basic requirement, A = additional requirement)		Test only on the final footwear	Subclause reference	Type and number of samples	Type and number of test pieces per sample
Outsole	Thickness	B	yes	8.1	1 shoe from each of 3 sizes (SML)	1 test piece
	Tear strength	B	yes	8.2	1 shoe from each of 3 sizes (SML)	1 test piece
	Abrasion resistance	B	yes	8.3	1 shoe from each of 3 sizes (SML)	1 test piece
	Flexing resistance	B	yes	8.4	1 shoe from each of 3 sizes (SML)	1 test piece
	Hydrolysis	B	yes	8.5	1 shoe from each of 3 sizes (SML)	1 test piece
	Resistance to fuel oil	B	yes	8.6	1 shoe from each of 3 sizes (SML)	2 test pieces
	Resistance to hot contact	A	yes	8.7	1 shoe from each of 3 sizes (SML)	1 test piece

5 Test methods for whole footwear

5.1 Specific ergonomic features

The specific ergonomic features of the footwear shall be assessed by examining the footwear using wear trials on three wearers with appropriate foot sizes.

During the trials the wearers, wearing each pair of the correctly fitting footwear, simulate typical tasks likely to be undertaken in general use.

These tasks are:

— walking normally for 5 min at a speed between 4 and 5 km/h;

— climbing (17 ± 3) stairs and descending (17 ± 3) stairs in 1 min maximum;

— kneeling/crouching down (see Figure 1).

After having completed all tasks, each wearer shall fill in the questionnaire given in Table 2.

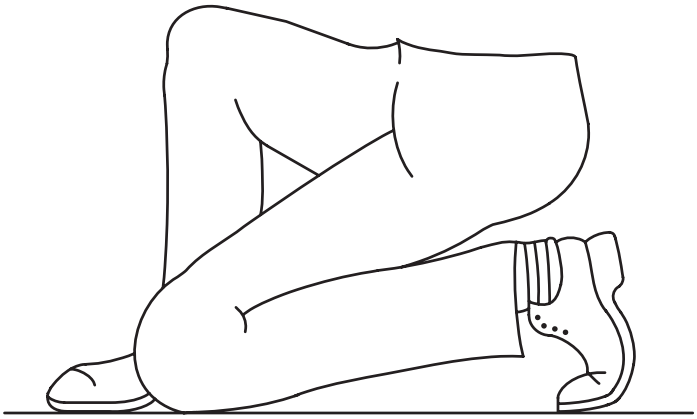


Figure 1 — Position to adopt during the kneel/crouch down test

Table 2 — Questionnaire for the assessment of ergonomic features

1	Is the inside surface of the footwear free from rough, sharp or hard areas that caused you irritation or injury (checked by hand)?	YES	NO
2	Is the footwear free of features that you consider make wearing the footwear hazardous?	YES	NO
3	Can the fastening be adequately adjusted (if necessary)?	YES	NO
4	Can the following activities be performed without problems?		
	4.1 Walking	YES	NO
	4.2 Climbing stairs	YES	NO
	4.3 Kneeling/crouching down	YES	NO

5.2 Determination of upper/outsole and sole interlayer bond strength

5.2.1 Principle

The force required to separate the upper from the outsole, or to separate adjacent layers of the outsole, or to cause tear failure of the upper or the sole is measured. The test is not applicable when the bond has been made by grindery (using e.g. nails or screws) or stitching.

NOTE In all cases the objective should be to test the bond strength nearest to the edge of the assembly.

5.2.2 Apparatus

5.2.2.1 Tensile machine, with a means of continuously recording load, with a jaw separation rate of (100 ± 20) mm/min and a force range of 0 N to 600 N. The machine shall be fitted with either pincers or flat jaws (depending on the construction of the test sample, see 5.2.4), (27,5 ± 2,5) mm wide, capable of firmly gripping the test pieces.

5.2.3 Preparation of test pieces

5.2.3.1 Sole/upper bond strength: construction type a

Take a test piece from either the inner or the outer joint region.

Make cuts at X-X and Y-Y at right angles to the edge of the sole, insole or outsole to produce a test piece about 25 mm wide. The length of the upper and sole shall be about 15 mm measured from the feather line (see Figure 3). Remove the insole.

NOTE See Figure 2.

5.2.3.2 Sole/upper bond strength: construction types b, c, d and e

Take a test piece from either the inner or outer joint region.

Cut the upper and sole at X-X and Y-Y to produce a test piece with a width of about 10 mm and a length of not less than 50 mm. Remove the insole.

Separate the upper from the sole for a length of about 10 mm by inserting a hot knife in the adhesive layer (see Figure 4).

It is considered that a construction is c or d when the distance from X-X to the upper face of the insole is at least 8 mm.

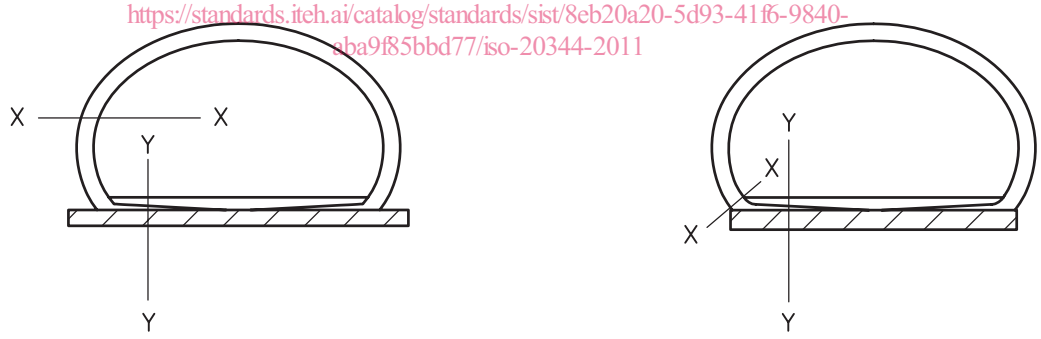
NOTE See Figure 2.

5.2.3.3 Interlayer bond strength: construction types f and g

Take a test piece from either the inner or the outer joint region.

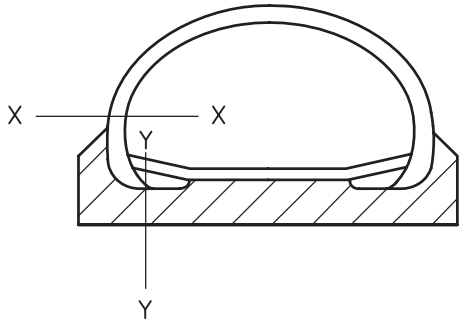
Remove the upper by cutting along the feather line at X-X. Remove the insole if present. Cut a strip parallel to and including the sole edge at Y-Y to produce a test piece about 15 mm wide and at least 50 mm long. Separate the sole layers for a length of about 10 mm by inserting a hot knife into the adhesive layer (see Figure 4).

NOTE See Figure 2.

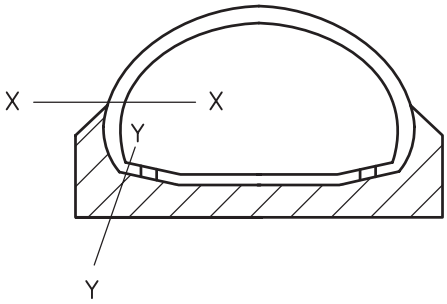


Type a **Type b**

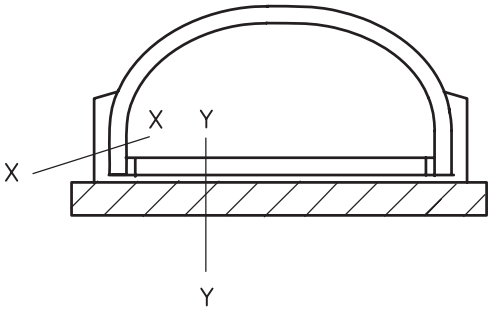
Figure 2 (*continued*)



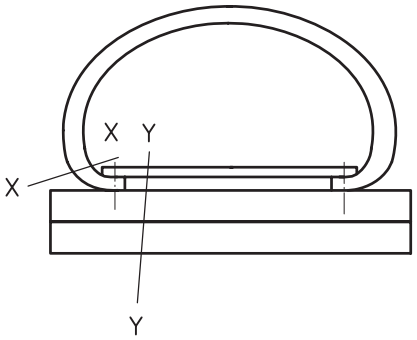
Type c



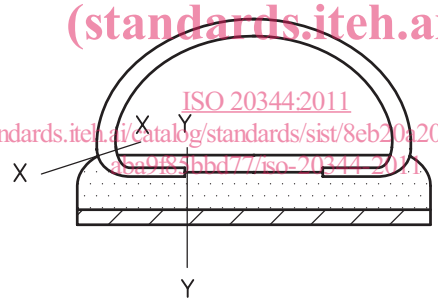
Type d



Type e



Type f



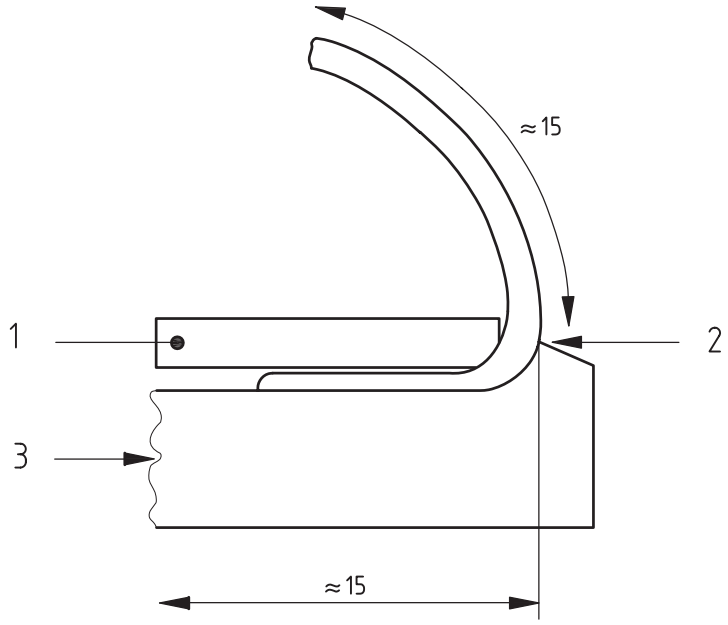
Type g

Key

Type a	conventional lasting, cemented or moulded outsole having an extended range
Type b	conventional lasting, close trimmed outsole
Type c	conventional lasting, direct injected or vulcanised outsole or cemented dished outsole
Type d	Strobel stitched, cemented dished outsole or direct injected or vulcanised outsole
Type e	conventional lasting or Strobel stitched with rubber mudguard and cemented outsole
Type f	machine sewn or welted where the outsole is bonded to the throughsole
Type g	multilayered sole, e.g. moulded-on sole, a moulded unit or a built unit

Figure 2 — Types of construction showing position for preparation of the test piece for bond strength

Dimensions in millimetres



Key

1 insole (removed)
2 feather line
3 outsole

Figure 3 — Cross section of test piece

Dimensions in millimetres

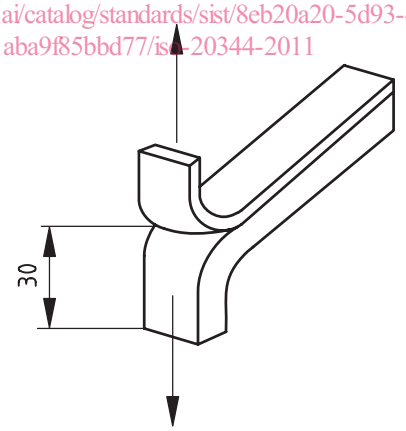


Figure 4 — Prepared test piece