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Personal protective equipment — Test methods for footwear

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

ICS: 13.340.50

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 94 *Personal safety – Personal protective equipment*, Subcommittee SC 3, *Footwear*.

This second edition cancels and replaces the first edition (ISO 20344:2011), which has been technically revised.

The main changes compared to the previous edition are as follows:

— for each test same organisation (1 principle 2 test equipment's 3 sampling and conditioning 4 test method 5 test report)

— Systematic inclusion of a clause test report in all the test methods

— Several tests are not described anymore in this standard but in the standard, reference is made to specific standards (ISO 22649, ISO 11640, ISO 17707, etc...)

— 2. All reference standards are dated

— 2. New standards are taken into account (ISO17075 part 1and 2, ISO 22568 part 1 to 4);

— 4.2 Conditioning pass from 48 H to 24 H

— 5.14 slip resistance, New test condition

— 5.10 non-metallic perforation insert reference to the new ISO 22568.

— 5.4 new drawing for impact test

— 5.18.4New detection of water resistance

— 5.19.4New detection of water resistance

— 5.21.2 clarification in the position of the ankle protection

— 5.24 new tests for scuff caps, seam strength, dimension of ankle protection, cleats height in the waist area,

— 6.2.3 Determination of the area for non-water permeable material

— Annex A is deleted;

— new annex A with new drawings of footwear degradations

— Annex B new system of sizing in accordance with ISO TC137 recommendations

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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 documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 34-1:2015, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

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

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

ISO 3290-1:2014, *Rolling bearings — Balls — Part 1: Steel balls*

ISO 3376:2019, *Leather — Physical and mechanical tests — Determination of tensile strength and percentage extension*

ISO 3377-2:2016, *Leather — Physical and mechanical tests — Determination of tear load — Part 2: Double edge tear*

ISO 4045:2018, *Leather — Chemical tests — Determination of pH and difference figure*

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

ISO 4649:2017, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

ISO 4674-1:2016, *Rubber- or plastics-coated fabrics — Determination of tear resistance — Part 1: Constant rate of tear methods*

ISO 5402-1:2017, *Leather — Determination of flex resistance — Part 1: Flexometer method*

ISO 5403-1:2011, *Leather — Determination of water resistance of flexible leather — Part 1: Repeated linear compression (penetrometer)*

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

ISO 6487+A1:2017, *Road vehicles – Measurement techniques in impact tests - instrumentation*

ISO 7500-1:2018, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 6487+A1:2017, *Road vehicles – Measurement techniques in impact tests - instrumentation*

ISO 11640:2018, *Leather — Tests for colour fastness — Colour fastness to cycles of to-and-fro rubbing*

ISO 12947-1:1998+Cor. 1:2002, *Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 1 Martindale abrasion testing apparatus*

ISO 13287:2019, *Personal protective equipment — Footwear — Test method for slip resistance*

ISO 14268:2012, *Leather — Physical and mechanical tests — Determination of water vapour permeability*

ISO 17697:2016, *Footwear — Test methods for uppers, lining and insocks — Seam strength*

ISO 17707:2005, *Footwear — Test methods for outsoles — Flex resistance*

ISO 17075-1:2017, *Leather — Chemical determination of chromium(VI) content in leather — Part 1: Colorimetric method*

ISO 17075-2:2017, *Leather — Chemical determination of chromium(VI) content in leather — Part 2: Chromatographic method*

ISO 20345:2021, *Personal protective equipment — Safety footwear*

ISO 20346:2021, *Personal protective equipment —Protective footwear*

ISO 20347:2021, *Personal protective equipment — Occupational footwear*

ISO 22568-1:2019, *Foot and leg protectors — Requirements and test methods for footwear components — Part 1: Metallic toecaps*

ISO 22568-2:2019, *Foot and leg protectors — Requirements and test methods for footwear component — Part 2: Non-metallic toecaps*

ISO 22568-3, *Foot and leg protectors — Requirements and test methods for footwear components — Part 3: Metallic perforation resistant inserts*

ISO 22568-4:2019, *Foot and leg protectors — Requirements and test methods for footwear components — Part 4: Non-metallic perforation resistant inserts*

ISO 22649:2016, *Footwear — Test methods for insoles and insocks — Water absorption and desorption*

ISO 23529:2016, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

ISO 23388:2018, *Protective gloves against mechanical risks*

EN 15090:2012, *Footwear for firefighters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20345:2021, ISO 20346:2021 and ISO 20347:2021 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 General testing parameters

4.1 Sampling

The minimum number of samples to be tested, 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.

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]. Where Table 1 does not specify (SML) any three sizes of footwear may be used.

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 B.

4.2 Conditioning before and during the test

All test pieces shall be conditioned in a standard atmosphere of (23 ± 2) °C and (50 ± 5) % RH for a minimum of 24 h before testing, unless otherwise stated in the test method.

If the test requires a defined condition (temperature (23 ± 2) °C and/or (50 ± 5) % RH), it is mentioned in the test method. Where the testing in conditioned atmosphere is not required, 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 tolerances are not specified in this document (text or figures), a maximum tolerance of ±10 % shall be applied.

When several test pieces are tested, at least the worst results shall be reported unless specified in the test method. A result shall be reported for each tested size.

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 remain in place to perform the tests.

For each of the required measurements performed in accordance with this standard, a corresponding estimate of the uncertainty of measurement should be evaluated. One of the following approaches shall be used:

— a statistical method, e.g. as given in ISO 5725-2 [2];

— a mathematical method, e.g. as given in ISO/IEC Guide 98-1 [3];

— uncertainty and conformity assessment as given in ISO/IEC Guide 98-4 [4]

— JCGM 100:2008[5]

4.4 Test report

For each test method, the test report shall contain the following information.

— Name and address of the testing laboratory

— Date of issue of the test report

— Reference to this standard and the number of the used clause

— The reference of the sample;

— The results as defined in each test method

— Any deviation from the test method.

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
	toecap dimensions	B	yes	5.3	1 pair of shoes or toecap 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	B	no	5.6	See Tables 4 and 5	
	Leakproofness	B	yes	5.7	2 shoes from different sizes	1 shoe
	Dimensional conformity and perforation resistance of inserts	A	yes	5.8	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	perforation-resistance of footwear including metallic insert	A	yes	5.9	1 pair of insert from each of 3 sizes (SML)	1 pair of inserts
	perforation-resistance of footwear including non-metallic insert	A	yes	5.10	1 pair of insert from each of 3 sizes (SML)	1 pair of inserts
	Behaviour inserts	B	no	5.11	See Tables 6 and 7	
	Flexion resistance of insert	A	no	5.12	1 pair of insert from each of 3 sizes (SML)	1 pair of inserts
	Electrical resistance	A	yes	5.13	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	Slip resistance	B	yes	5.14	1 shoe from each of 3 sizes (SML)	1 shoe
	Insulation against heat	A	yes	5.15	2 shoes from different sizes	1 shoe
	Insulation against cold	A	yes	5.16	2 shoes from different sizes	1 shoe
	Energy absorption of seat region	A	yes	5.17	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	Water resistance (Trough test)	A	yes	5.18	2 pairs of shoes (minimum 2 different sizes)	1 pair of shoes
	Dynamic footwear water penetration test	A	yes	5.19	2 pairs of shoes (minimum 2 different sizes)	1 pair of shoes
	Impact resistance metatarsal protective device	A	yes	5.20	1 pair of shoes from each of 3 sizes (SML)	1 pair of shoes
	Dimension of the ankle protection	B	yes	5.21	1 pair of shoes in 3 sizes	2 test pieces (inner & outer side) taken from the shoe
	Ankle protection	A	yes	5.22	1 shoe from each of 3 sizes (SML)	2 test pieces
	Cut resistance	A	no	5.23	2 samples (perpendicular) from the material	2 test pieces
	Scuff cap	A	no	5.24	1 sample	1 test piece
	Seam strength	B	yes	5.25	1 shoe from each of 3 sizes	1 test piece taken from the shoe
Upper lining and tongue	Thickness	B	no	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

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	Tear strength	B	yes	6.3	shoes from each of 3 sizes	3 test pieces per size
	Tensile properties	B	yes	6.4	shoes from each of 3 sizes leather 3 samples from the material)	3 test pieces per size
	Flexing resistance	B	yes	6.5	1 shoe from each of 3 sizes	1 test piece
	Water vapour permeability	B	yes	6.6	1 shoe from each of 3 sizes	1 test piece
	Water vapour absorption	B	yes	6.7	1 shoe from each of 3 sizes	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	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	4 test pieces, wet 4 test pieces, dry
	Water penetration and water absorption	A	no	6.13	shoes or materials	3 test pieces
Insole and Insock	Thickness of insole	B	no	7.1	1 shoe from each of 3 sizes or 3 samples cuttings of material	1 test piece
	pH value	B	no	6.9	Each leather	1 test piece
	Water absorption and desorption	B	no	7.2	1 shoe from each of 3 sizes or 3 samples cuttings of material	1 test piece
	Abrasion resistance of insole	B	no	7.3	1 shoe from each of 3 sizes or 3 samples cuttings of material	1 test piece
	Chromium VI content	B	no	6.11	Each leather	1 test piece
	Abrasion resistance of insock	B	no	6.12	Shoes or materials	4 test pieces, wet 4 test pieces, dry
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	1 test piece
	Abrasion resistance	B	Yes **(*)**	8.3	1 shoe from each of 3 sizes	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	1 test piece
	Resistance to fuel oil	B	Yes **(*)**	8.6	1 shoe from each of 3 sizes	2 test pieces
	Resistance to hot contact	A	Yes **(*)**	8.7	1 shoe from each of 3 sizes	1 test piece
(*) when the outsole is a pre-moulded component (injected footwear or cemented footwear) the test can be done on the component directly and not on the footwear						

5 Test methods for whole footwear

5.1 Specific ergonomic features

5.1.1 Sampling and conditioning

Applicable conditioning see 4.2.