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Personal protective equipment — Test methods for footwear (ISO 20344:2011)

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National foreword

This British Standard is the UK implementation of EN ISO 20344:2011. It supersedes BS EN ISO 20344:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PH/1, Safety, protective and occupational footwear.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Personal protective equipment - Test methods for footwear (ISO
20344:2011)

Équipement de protection individuelle - Méthodes d'essai
pour les chaussures (ISO 20344:2011)

Persönliche Schutzausrüstung - Prüfverfahren für Schuhe
(ISO 20344:2011)

This European Standard was approved by CEN on 30 November 2011.

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Foreword

This document (EN ISO 20344:2011) has been prepared by Technical Committee CEN/TC 161 "Foot and leg protectors", the secretariat of which is held by BSI, in collaboration with Technical Committee ISO/TC 94 "Personal safety - Protective clothing and equipment".

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of an identical text or by endorsement, at the latest by June 2012, and conflicting national standards shall be withdrawn at the latest by June 2012.

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

This document supersedes EN ISO 20344:2004.

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.

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

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Annex ZA (informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 89/686/EEC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the EU Directive 89/686/EEC on PPE.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard, together with the relevant requirements given in the product standards, confers within the limits of the scope of those standards, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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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 $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \% \text{RH}$ 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.

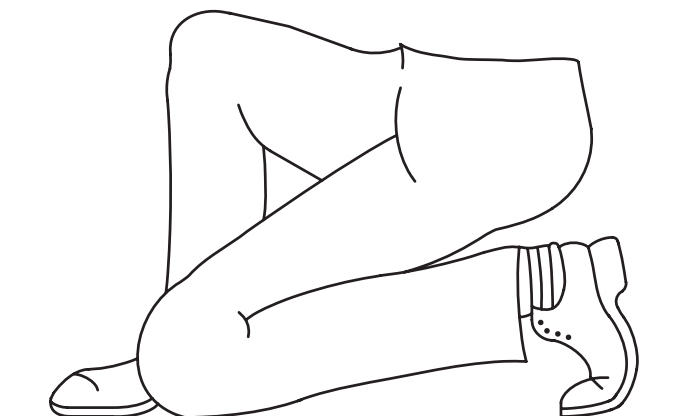


Figure 1 — Position to adopt during the kneel/crouch down test

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), $(27,5 \pm 2,5)$ 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.

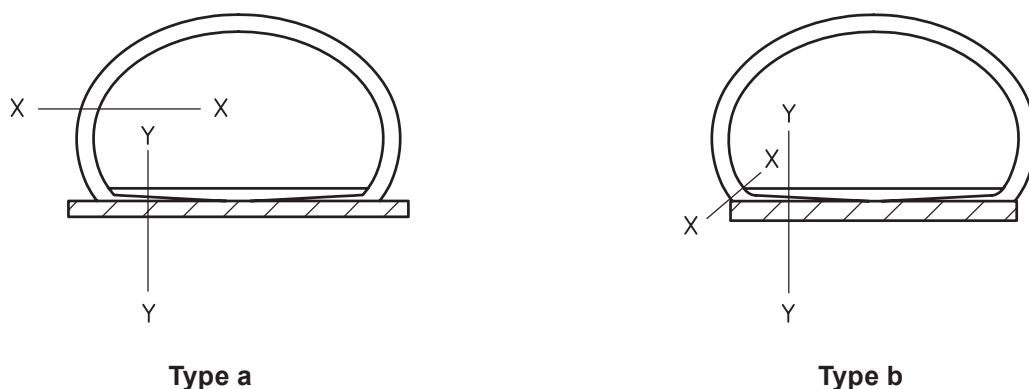
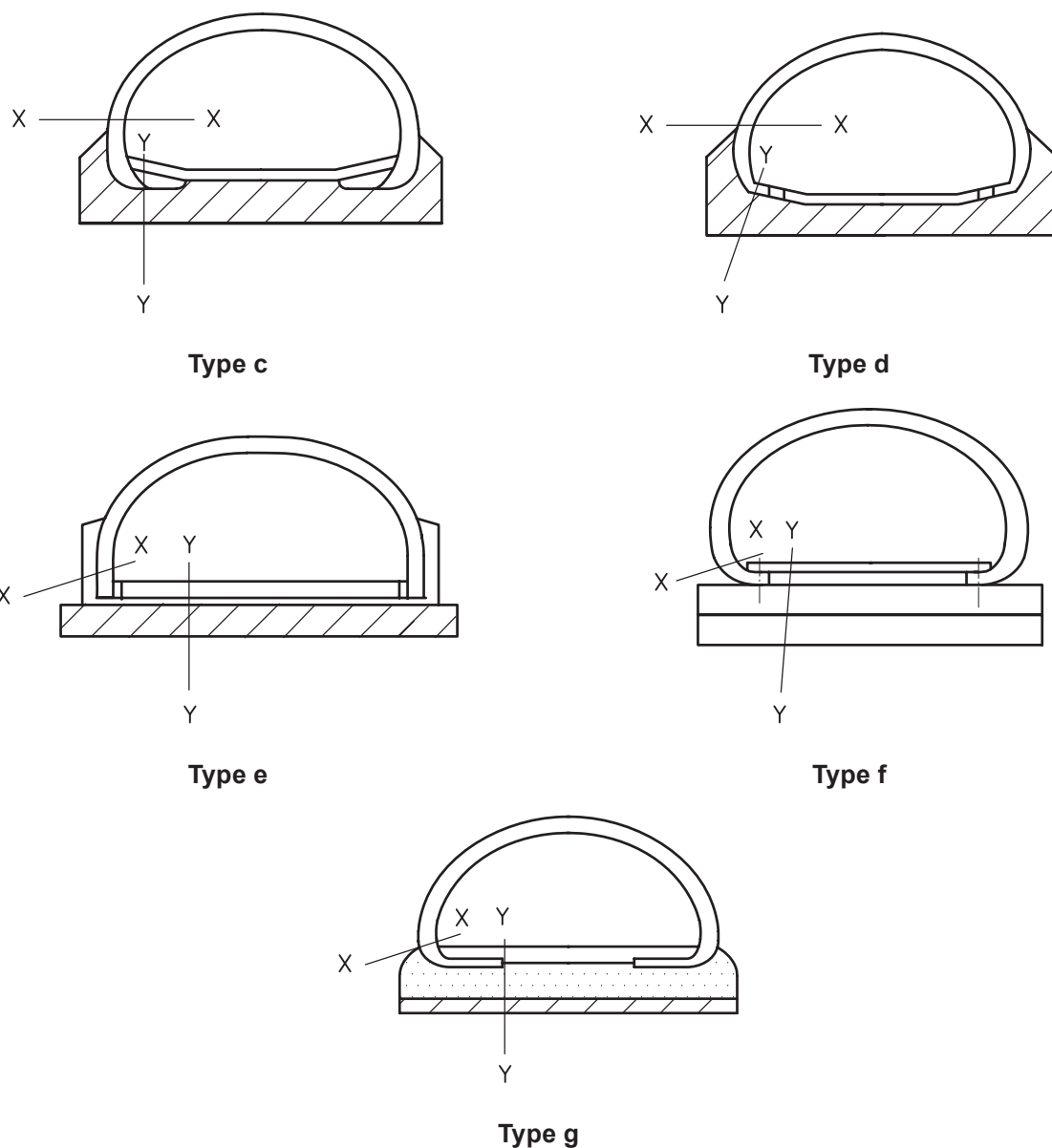


Figure 2 (continued)

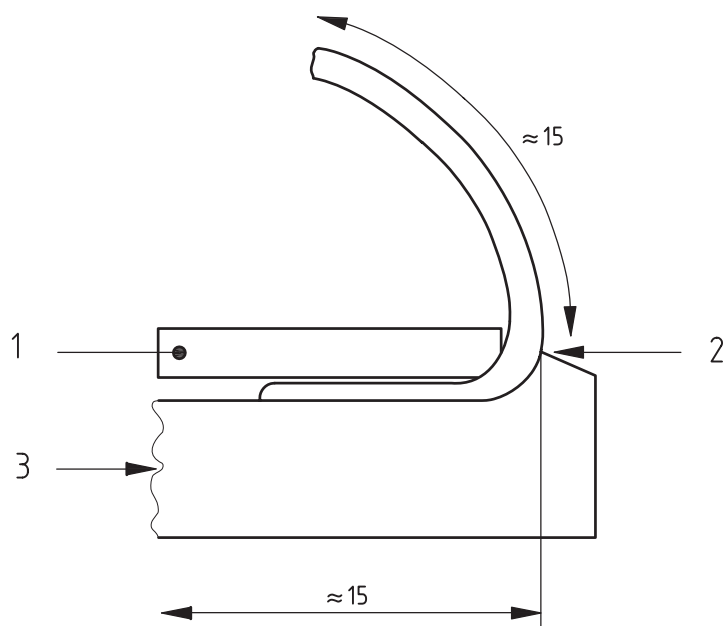


Key

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 dish sole
Type d	Strobel stitched, cemented dish sole 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

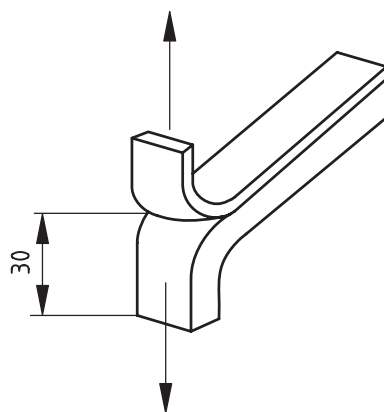
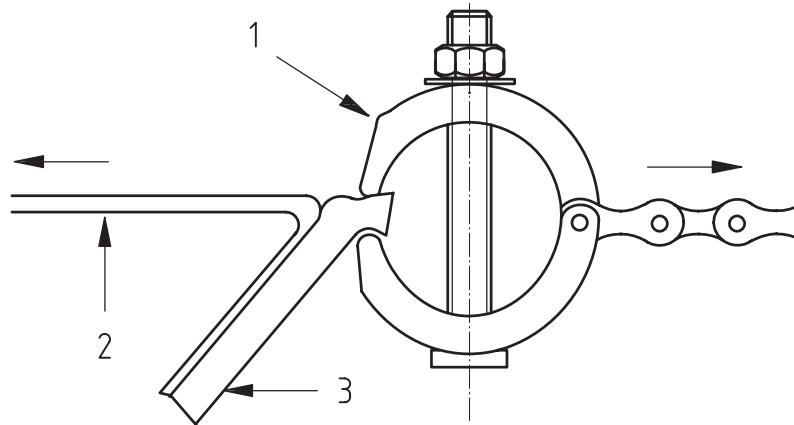


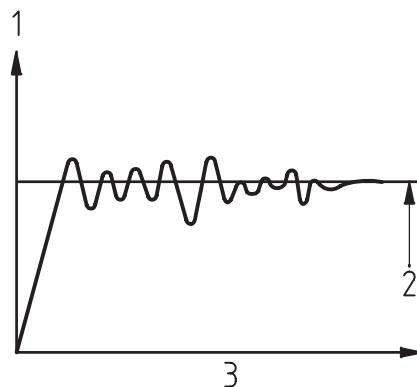
Figure 4 — Prepared test piece



Key

- 1 pincer jaw for sole edge
- 2 upper
- 3 sole

Figure 5 — Pincer jaw showing position of test piece



Key

- 1 peeling force, expressed in newtons
- 2 average
- 3 deformation

Figure 6 — Example of load/deformation graph

5.2.4 Measurement of bond strength

Before carrying out the test, measure the width of the test piece to the nearest mm at several points using a calibrated steel rule and calculate the average value to the nearest mm. Then measure the bond strength on a minimum length of 30 mm in one of the following ways.

- For sole/upper bond strength (construction type a): clamp the test piece into the jaws of the tensile machine, using a pincer jaw to grip the short edge of the sole (see Figure 5), and record the load/deformation graph (see Figure 6) at a jaw separation speed of (100 ± 20) mm/min.
- For sole/upper bond strength (construction types b, c, d and e) and sole interlayer bond strength (construction types f and g): clamp the separated ends of the test piece in the flat jaws and record the load/deformation graph (see Figure 6) at a jaw separation speed of (100 ± 20) mm/min.

5.2.5 Calculation and expression of results

Determine, from the load/deformation graph, the average peeling load in newtons and divide by the average width (calculated in 5.2.4) to give the bond strength in N/mm.

5.3 Determination of internal toecap length

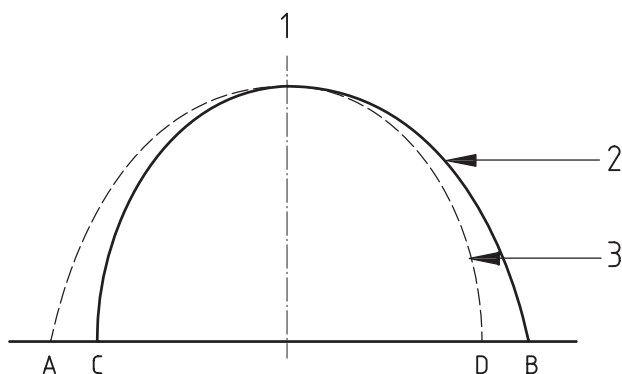
5.3.1 Preparation of test piece

Carefully extract the toecaps from an untested pair of footwear and remove all foreign materials adhering to them, or take a new pair of identical toecaps.

NOTE Preconditioning of the test piece is unnecessary.

5.3.2 Determination of the test axis

Position the left toecap with its rear edge in line with a base line and draw its outline. Repeat the exercise with the right toecap of the pair. Position the outlines in such a manner that the outlines at both the toe end of the toecaps and the base lines coincide (see Figure 7).



Key

- 1 test axis
- 2 right cap
- 3 left cap

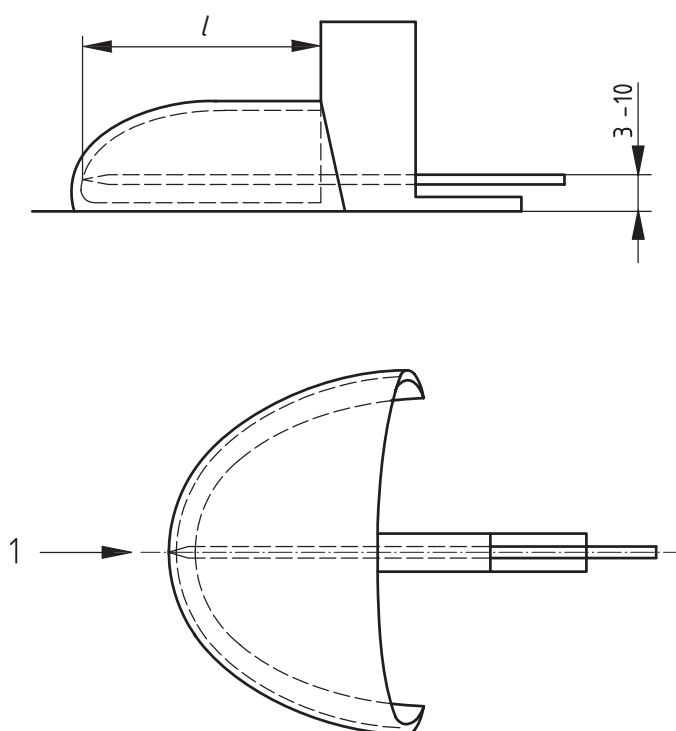
Figure 7 — Determination of the test axis

Mark the four points A, B, C and D where the outlines of the left and right toecaps intersect on the base line. Erect the perpendicular from the base line at the midpoint of A-B or C-D. This constitutes the test axis of the toecap.

5.3.3 Test procedure

Place the toecap, open side down, on a flat surface. Using an appropriate gauge, measure the internal length, l , along the test axis from the toe to the back edge at a distance between 3 mm and 10 mm above and parallel to the surface upon which the toecap rests (see Figure 8). l is the maximum length which can be measured.

Dimensions in millimetres



Key

- 1 test axis
- l internal length

Figure 8 — Measurement of internal toecap length

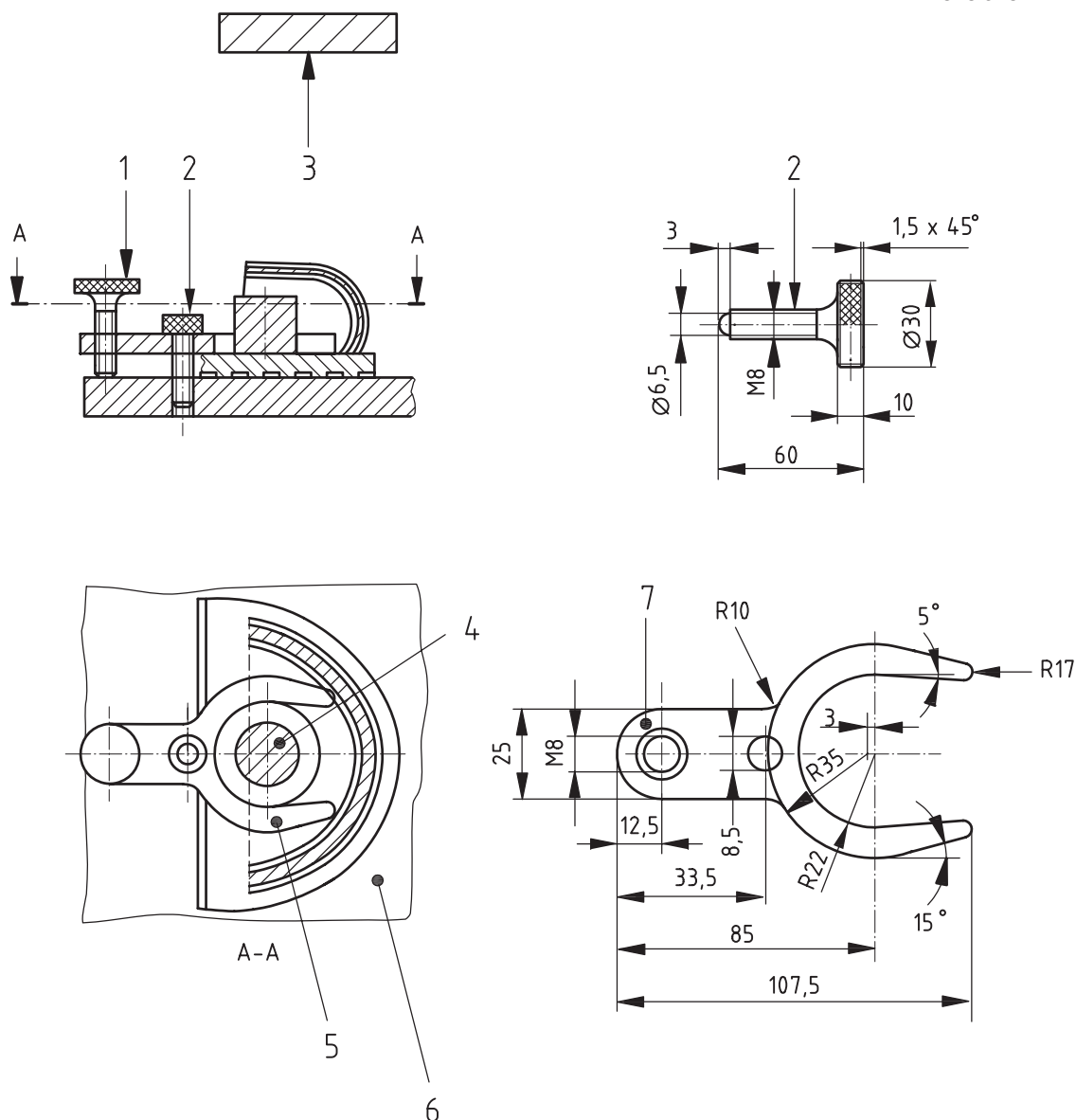
5.4 Determination of impact resistance

5.4.1 Apparatus

5.4.1.1 Impact apparatus, as described in EN 12568:2010, 5.2.2.1.1.

5.4.1.2 Clamping device, consisting of a smooth steel plate at least 19 mm thick and 150 mm × 150 mm, of minimum hardness 60 HRC, with a screw clamp for clamping the forepart of the insole/insock of the toe-end of the footwear under test to the plate in a way which will not restrict lateral expansion of the toecap during the impact test (see Figure 9).

Dimensions in millimetres



Key

- 1 adjusting screw
- 2 clamping screw
- 3 striker
- 4 modelling clay cylinder
- 5 stabilizing fork
- 6 base plate
- 7 thickness = 10 mm

NOTE The dimensions given in this figure are illustrative only. Smaller stabilizing forks of the same proportions may be used for smaller toecaps.

Figure 9 — Example of footwear clamp

The stabilizing fork, which is to be introduced into the front part of the footwear, shall be adjusted by means of the adjusting screw to rest on the insole, parallel to the base plate. The clamping screw (M8 thread) shall be tightened by applying a torque of $(3 \pm 1) \text{ N}\cdot\text{m}$.

5.4.1.3 Cylinders, of modelling clay of diameter (25 ± 2) mm and of height (20 ± 2) mm for footwear up to and including size 40 (French) and of height (25 ± 2) mm for footwear above size 40. The flat ends of the cylinder shall be covered with aluminium foil to prevent them sticking to either the test piece or the test equipment.

The modelling clay shall fulfil the requirement given in Annex A.

5.4.1.4 Dial gauge, with a hemispherical foot of $(3,0 \pm 0,2)$ mm radius and a hemispherical anvil of (15 ± 2) mm radius exerting a force not greater than 250 mN.

5.4.2 Procedure

5.4.2.1 Determination of the test axis (see Figure 10)

Locate the testing axis by placing the footwear on a horizontal surface and against a vertical plane so that it touches the edge of the sole at points A and B on the inner side of the footwear. Construct two further vertical planes at right angles to the first vertical plane so that they meet the sole at points X and Y, the toe point and heel point respectively. Draw a line through X and Y. This constitutes the test axis for the forepart of the footwear.

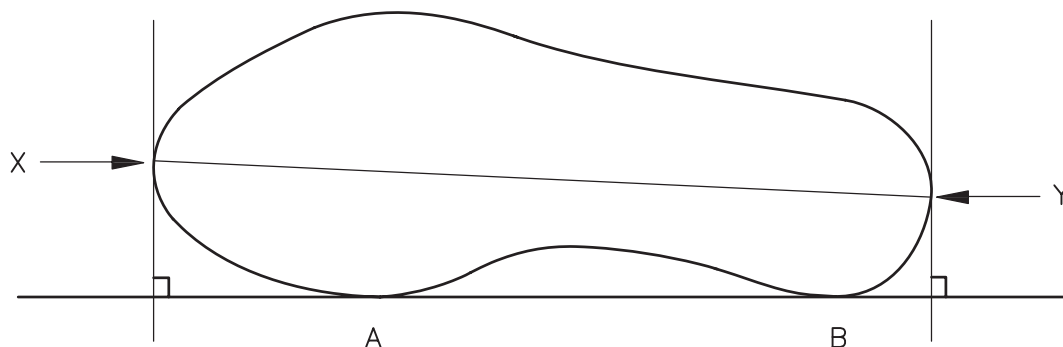


Figure 10 — Test axis for footwear

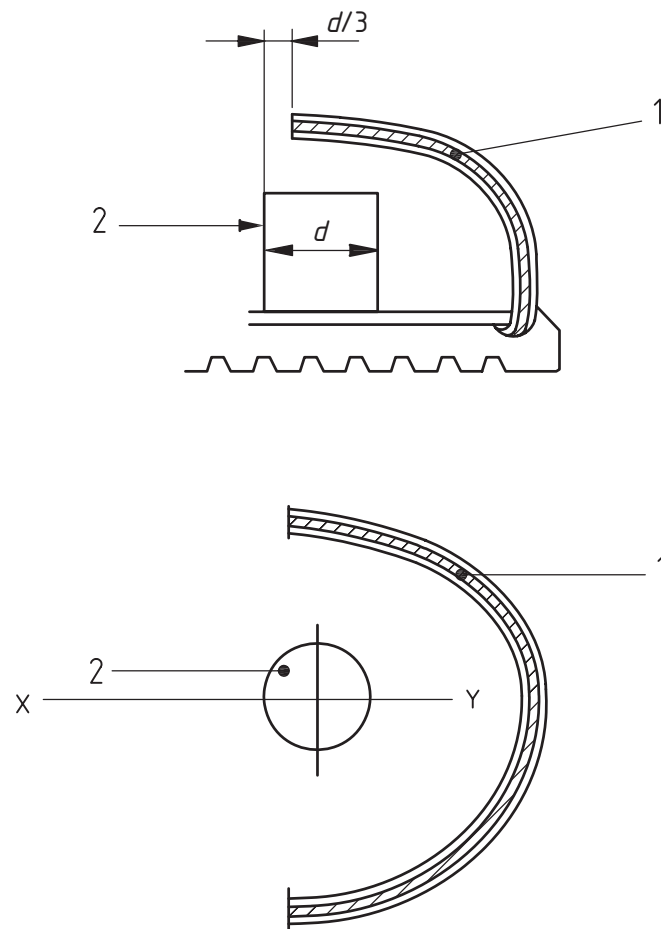
5.4.2.2 Preparation of the test piece

Prepare the forepart of the footwear by cutting off the toe end 30 mm behind the rear edge of the toecap. Then remove the complete upper assembly flush with the rear edge of the toecap. Do not remove the upper and lining in the toecap area. If the footwear has been supplied with a removable insock, carry out the test with it in place.

NOTE Preconditioning of the test piece is unnecessary.

5.4.2.3 Test procedure

Position a cylinder (5.4.1.3) on one of its ends inside the test piece as shown in Figure 11.



Key

- 1 toecap
- 2 modelling clay cylinder
- Text axis XY

Figure 11 — Position of cylinder for the impact or compression test of footwear

Position the test piece in the impact apparatus (5.4.1.1) so that when the striker hits it, the striker shall project over the back and the front of the toecap. Adjust the clamping device (5.4.1.2).

Allow the striker to drop on to the test axis from the appropriate height to give an impact energy of (200 ± 4) J for safety footwear.

With the measuring device (5.4.1.4), measure the lowest height to which the cylinder has been compressed to the nearest 0,5 mm. This value is the clearance at the moment of impact.

5.5 Determination of compression resistance

5.5.1 Apparatus

5.5.1.1 Compression testing machine, as described in EN 12568:2010, 5.1.3.1.1.

5.5.1.2 Cylinders, as described in 5.4.1.3.

5.5.1.3 Dial gauge, as described in 5.4.1.4.

5.5.1.4 Clamping device, as described in 5.4.1.2.

5.5.2 Procedure

5.5.2.1 Determination of the test axis

Determine the test axis as described in 5.4.2.1.

5.5.2.2 Preparation of the test piece

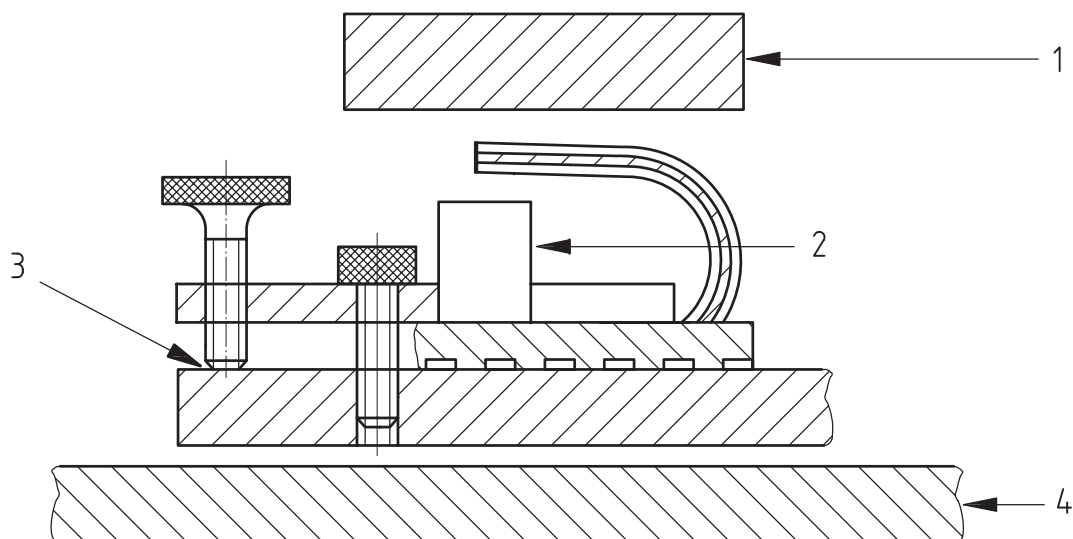
Prepare the test piece as described in 5.4.2.2.

NOTE Preconditioning of the test piece is unnecessary.

5.5.3 Test procedure

Position a cylinder (5.5.1.2) on one of its ends inside the test piece as shown in Figure 11. Place the test piece in the clamping device (5.5.1.4) and adjust.

Position the clamping device and test piece between the plates of the compression machine (5.5.1.1) and compress the test piece until the load of $(15 \pm 0,1)$ kN for safety footwear (see Figure 12) has been reached.



Key

- 1 upper plate
- 2 modelling clay cylinder
- 3 clamping device
- 4 lower plate

Figure 12 — Apparatus for compression resistance

Reduce the load, remove the cylinder and, with the measuring device (5.5.1.3), measure the lowest height to which the cylinder has been compressed to the nearest 0,5 mm. This value is the compression clearance.

5.6 Behaviour of toecaps and inserts (thermal and chemical)

5.6.1 Test method for metallic toecaps and metallic inserts in class II footwear

5.6.1.1 Preparation of the test piece

See Tables 3 and 4.

NOTE Preconditioning of the test piece is unnecessary.

5.6.1.2 Test solution

Use a mass fraction of 1 % aqueous solution of sodium chloride.

5.6.1.3 Procedure

Pour sufficient test solution into a test piece to fill it up in order to be sure that the toecap/insert is under the level of the solution. Cover the top of the footwear with e.g. a polyethylene cover, to minimise evaporation.

Leave for 7 days and then discard the test solution.

Remove the toecap/insert from the footwear and examine for any evidence of corrosion. When present, measure the longest distance across each area of corrosion and note the number of such areas.

5.6.2 Behaviour of toecaps (thermal and chemical)

Toecaps shall be tested in accordance with Table 3.

Table 3 — Minimum number of samples and test pieces and test methods for toecaps

Footwear	Type and number of sample	Type and number of test pieces per sample	Test only on the final footwear	Test method
Class I metal toecap	1 toecap in 2 sizes	1 toecap	No, only new toecaps can be tested	EN 12568:2010, 5.3
Class II metal toecap	1 shoe in 2 sizes	1 shoe	Yes	ISO 20344:2011, 5.6.1
Class I and II non-metal toecap	5 pairs of toecaps	1 pair of toecap for each of the 5 treatments	No, only new toecaps can be tested	EN 12568:2010, 5.4

5.6.3 Behaviour of inserts (thermal and chemical)

Inserts shall be tested in accordance with Table 4.

Table 4 — Minimum number of samples and test pieces and test methods for inserts

Footwear	Type and number of sample	Type and number of test pieces per sample	Test only on the final footwear	Test method
Class I metal insert	1 insert in 2 sizes	2 test pieces	No, only new inserts can be tested	EN 12568:2010, 7.3
Class II metal insert	1 shoe in 2 sizes	1 shoe	Yes	EN ISO 20344:2011, 5.6.1
Class I and II non-metal insert	1 insert for each of the 5 treatments	1 insert for each of the 5 treatments (2 penetration tests on each test piece)	No, only new inserts can be tested	EN 12568:2010, 7.4

5.7 Determination of leakproofness

5.7.1 Apparatus

5.7.1.1 Waterbath.

5.7.1.2 Supply of compressed air.

5.7.2 Preparation of the test piece

Take the entire item of footwear as the test piece.

5.7.3 Procedure

Carry out the test at a temperature of $(23 \pm 2) ^\circ\text{C}$.

Seal the top edge of the test piece, e.g. with a rubber collar through which compressed air may be fed via appropriate connections. Immerse the test piece in a waterbath up to the edge and apply a constant internal pressure of (30 ± 5) kPa for 30 s. Observe the test piece throughout the test and determine whether there is a continued formation of air bubbles, indicating leakage of air.

5.8 Determination of the dimensional conformity of inserts and the penetration resistance of the sole

5.8.1 Dimensional conformity of inserts

Measure L , the length of the inside of the bottom of the footwear. Draw as in Figure 13 the shaded areas 1 and 2.

Section the footwear and measure the distances X and Y (see Figure 13) being the distances between the edge of the insert and the line left by the feather edge of the last, to the nearest 0,5 mm.