

Australian/New Zealand Standard™

Occupational protective footwear

Part 2: Test methods (ISO 20344:2004, MOD)



AS/NZS 2210.2:2009

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee SF-003, Occupational Protective Footwear. It was approved on behalf of the Council of Standards Australia on 16 June 2009 and on behalf of the Council of Standards New Zealand on 26 June 2009.

This Standard was published on 21 August 2009.

The following are represented on Committee SF-003:

Association of Accredited Certification Bodies
Australasian Fire Authorities Council
Australian Chamber of Commerce and Industry
Australian Industry Group
Department of Defence (Australia)
Footwear Manufacturers Association of Australia
New Zealand Footwear Industry Association
New Zealand Leather & Shoe Research Association
Plastics and Chemicals Industries Association
Testing Interests (Australia)

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at www.standards.com.au or Standards New Zealand web site at www.standards.co.nz and looking up the relevant Standard in the on-line catalogue.

Alternatively, both organizations publish an annual printed Catalogue with full details of all current Standards. For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia or Standards New Zealand at the address shown on the back cover.

This Standard was issued in draft form for comment as DR 07197.

Australian/New Zealand Standard™

Occupational protective footwear

Part 2: Test methods (ISO 20344:2004, MOD)

Originated as part of AS Z2—1952 and AS Z3—1952.
Previous editions AS/NZS 2210.2:1994, AS/NZS 2210.2:2000 and AS/NZS 2210.6:2001.
Jointly revised, amalgamated and designated as AS/NZS 2210.2:2009.

COPYRIGHT

© Standards Australia/Standards New Zealand

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Jointly published by Standards Australia, GPO Box 476, Sydney, NSW 2001 and Standards New Zealand, Private Bag 2439, Wellington 6020

ISBN 0 7337 9212 X

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-003, Occupational Protective Footwear to supersede AS/NZS 2210.2:2000, *Occupational protective footwear, Part 2: Requirements and test methods* (in part) and AS/NZS 2210.2:1994, *Occupational protective footwear, Part 2: Specification*, as well as AS/NZS 2210.6:2001, *Occupational protective footwear, Part 6: Additional requirements and test methods*.

This Standard is an adoption with national modifications and has been reproduced from ISO 20344:2004, ISO 20344:2004/Cor.1:2005 and ISO 20344:2004/Amd.1:2007, *Personal protective equipment—Test methods for footwear* and has been varied as indicated in Appendix ZZ to take account of Australian/New Zealand conditions. The Corrigendum and Amendment have been added after the source text.

The objective of this Standard is to provide manufacturers and users with test methods for footwear intended for use in workplace applications.

The objective of this revision is to adopt the current edition of ISO 20344. In this edition, the Committee considered that methods for testing toecaps alone be excluded from this Standard, in line with ISO 20344:2004 requirements.

As this Standard is reproduced from an international standard, the following applies:

- (a) Its number appears on the cover and title page while the international standard number appears only on the cover.
- (b) In the source text ‘this European Standard’ should read ‘this Australian/New Zealand Standard’.
- (c) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
EN		AS/NZS	
388	Protective gloves against mechanical risks	2161	Occupational protective gloves
		2161.3	Part 3: Protection against mechanical risks
EN/ISO			
20345	Personal protective equipment— Safety footwear (ISO 20345:2004)	2210	Occupational protective footwear
		2210.3	Part 3: Specification for safety footwear
20346	Personal protective equipment— Protective footwear (ISO 20346:2004)	2210.4	Part 4: Specification for protective footwear
20347	Personal protective equipment— Occupational footwear (ISO 20347:2004)	2210.5	Part 5: Specification for occupational footwear

NOTE: Any international Standards not listed have not been adopted as Australian or Australian/New Zealand Standards.

Guidance for the selection, care and use of protective footwear is not covered by this Standard but is provided in AS/NZS 2210.1, *Occupational protective footwear, Part 1: Guide to selection, care and use*.

The terms ‘normative’ and ‘informative’ are used to define the application of the annex or appendix to which they apply. A normative annex or appendix is an integral part of a standard, whereas an informative annex or appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
1. Scope	1
2. Normative references	1
3. Terms and definitions	2
4. Sampling and conditioning.....	2
5. Test methods for whole footwear	4
5.1 Specific ergonomic features.....	4
5.2 Determination of upper/outsole and sole interlayer bond strength.....	5
5.3 Determination of internal toecap length.....	10
5.4 Determination of impact resistance.....	11
5.5 Determination of compression resistance.....	15
5.6 Determination of corrosion resistance.....	16
5.7 Determination of leakproofness.....	17
5.8 Determination of the dimensional conformity of inserts and the penetration resistance of the sole	17
5.9 Determination of the flex resistance of penetration-resistant inserts	20
5.10 Determination of electrical resistance.....	20
5.11 Determination of the electrical insulation	21
5.12 Determination of insulation against heat.....	21
5.13 Determination of insulation against cold.....	22
5.14 Determination of energy absorption of seat region.....	24
5.15 Determination of resistance to water for whole footwear	26
5.16 Determination of impact resistance of metatarsal protective device	33
5.17 Determination of the shock absorption capacity of ankle protection materials incorporated into the upper	37
6. Test methods for upper, lining and tongue	41
6.1 Determination of thickness of upper.....	41
6.2 Measurement of the height of the upper.....	41
6.3 Determination of tear strength of upper, lining and/or tongue.....	41
6.4 Determination of the tensile properties of upper material	42
6.5 Determination of upper flexing resistance.....	42
6.6 Determination of water vapour permeability	42
6.7 Determination of water vapour absorption.....	47
6.8 Determination of water vapour coefficient.....	49
6.9 Determination of pH value	49
6.10 Determination of resistance to hydrolysis of upper	49
6.11 Determination of chromium VI content	49
6.12 Determination of abrasion resistance of lining and insock	55
6.13 Determination of water penetration and water absorption for upper.....	56
6.14 Determination of resistance of upper to cutting	58

7. Test methods for insole and insock	58
7.1 Determination of insole thickness	58
7.2 Determination of water absorption and desorption of insole and insock	58
7.3 Determination of abrasion resistance of insole	61
8 Test methods for outsole	63
8.1 Determination of outsole thickness	63
8.2 Determination of tear strength of outsole	63
8.3 Determination of outsole abrasion resistance	64
8.4 Determination of flexing resistance of outsole	64
8.5 Determination of resistance to hydrolysis of outsole.....	69
8.6 Determination of resistance to fuel oil	69
8.7 Determination of resistance to hot contact	69
Bibliography.....	73

AUSTRALIAN/NEW ZEALAND STANDARD

Occupational protective footwear**Part 2:****Test methods (ISO 20344:2004, MOD)****1. Scope**

This 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.

EN 388:1994, Protective gloves against mechanical risks

EN 12568:1998, Foot and leg protectors — Requirements and test methods for toecaps and metal penetration resistant inserts

EN 50321:1999, Electrically insulating footwear for working on low voltage installations

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

EN ISO 3696, Water for analytical laboratory use — Specification and test methods (ISO 3696:1987)

EN ISO 3376:2002, Leather — Physical and mechanical tests - Determination of tensile strength and percentage extension (ISO 3376:2002)

EN ISO 3377-2, Leather - Physical and mechanical tests - Determination of tear load (ISO 3377-2: 2002)

EN ISO 4044, Leather — Preparation of chemical test samples (ISO 4044:1977)

EN ISO 4045, Leather — determination of pH (ISO 4045:1977)

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

EN ISO 17249:2004, Safety footwear with resistance to chain saw cutting (ISO 17249: 2004)

EN ISO 20345, Personal protective equipment - Safety footwear (ISO 20345:2004)

EN ISO 20346, Personal protective equipment - Protective footwear (ISO 20346:2004)

EN ISO 20347, Personal protective equipment - Occupational footwear (ISO 20347:2004)

ISO 34-1:1994, Rubber, vulcanised or thermoplastic — Determination of tear strength — Part 1 : Trouser, angle and crescent test pieces

ISO 1817:1999, Rubber, vulcanised — Determination of the effect of liquids

ISO 2023:1994, Rubber footwear - Lined industrial vulcanized rubber boots - Specification

ISO 3290, Rolling bearings — Balls — Dimensions and tolerances

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

ISO 4648:1991, Rubber, vulcanized or thermoplastic — Determination of dimensions of test pieces and products for test purposes

ISO 4649:2002, Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device

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

COPYRIGHT

3. Terms and definitions

For the purposes of this standard, the terms and definitions given in EN ISO 20345, EN ISO 20346 and EN ISO 20347 shall apply.

4. Sampling and conditioning

The minimum numbers of samples to be tested in order to check compliance with the requirements specified in EN ISO 20345, EN ISO 20346, EN ISO 20347 and any specific job related footwear standards (e.g. EN ISO 17249 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.

Table 1 — Minimum number of samples and test specimens or test pieces and their origin

Property under test		Clause reference	Number of samples	Number of test pieces from each sample	Test only on the final footwear	
B : basic requirement A : additional requirement						
5. Whole footwear	Specific ergonomic features	B	5.1	3 pairs from 3 different sizes	1 pair	yes
	Upper/outsole and sole interlayer bond strength	B	5.2	1 from each of 3 sizes	1	yes
	Internal toecap length	B	5.3	1 pair from each of 3 sizes	1 pair	yes
	Impact resistance	B	5.4	1 pair from each of 3 sizes	1 pair	yes
	Compression resistance	B	5.5	1 pair from each of 3 sizes	1 pair	yes
	Corrosion resistance of metallic toecaps or penetration-resistant metallic inserts	B	5.6	2 from different sizes	1	No for classification I Yes for classification II
	Leakproofness	B	5.7	2 from different sizes	1	yes
	Dimensional conformity and penetration resistance of inserts	A	5.8	1 pair from each of 3 sizes	1 pair	yes
	Flex resistance of penetration-resistant insert	A	5.9	1 pair from each of 3 sizes	1 pair	no
	Electrical resistance	A	5.10	1 pair from each of 3 sizes	1 pair	yes
	Electrical insulation	A	5.11	1 pair from each of 3 sizes	1 pair	yes
	Insulation against heat	A	5.12	2 from different sizes	1	yes
	Insulation against cold	A	5.13	2 from different sizes	1	yes
	Energy absorption of seat region	A	5.14	1 pair from each of 3 sizes	1 pair	yes
	Water resistance	A	5.15	3 pairs (minimum 2 different sizes)	1 pair	yes
	Impact resistance metatarsal protective device	A	5.16	1 pair from each of 3 sizes	1 pair	yes
	Ankle protection	A	5.17	1 pair from each of 3 sizes	1 pair	yes

Table 1 (continued)— Minimum number of samples and test specimens or test pieces and their origin

Property under test		Clause reference	Number of samples	Number of test pieces from each sample	Test only on the final footwear	
B : basic requirement						
6. Upper Lining And Tongue	Thickness	B	6.1	1 from each of 3 sizes	3	yes
	Height of the upper	B	6.2	1 from each of 3 sizes	3	yes
	Tear strength	B	6.3	1 from each of 3 sizes	3	yes
	Tensile properties	B	6.4	1 from each of 3 sizes	3	yes
	Flexing resistance	B	6.5	1 from each of 3 sizes	1	yes
	Water vapour permeability	B	6.6	1 from each of 3 sizes	1	yes
	Water vapour absorption	B	6.7	1 from each of 3 sizes	1	yes
	Water vapour coefficient	B	6.8	1 from each of 3 sizes	1	yes
	pH value	B	6.9	1	2	no
	Hydrolysis	B	6.10	1 from each of 3 sizes	1	yes
	Chromium VI content	B	6.11	1	2	no
	Abrasion resistance of lining	B	6.12	3	4	no
	Water penetration and water absorption	A	6.13	3	1	no
	Cut resistance	A	6.14	3	4	yes
7. Insole and Insock	Thickness of insole	B	7.1	3 ^a	1	no
	pH value	B	6.9	1	2	no
	Water absorption and desorption	B	7.2	3 ^a	1	no
	Abrasion resistance of insole	B	7.3	3 ^a	1	no
	Chromium VI content	B	6.11	1	2	no
	Abrasion resistance of insock	B	6.12	3	4	no
8. Outsole	Thickness	B	8.1	1 from each of 3 sizes	1	yes
	Tear strength	B	8.2	1 from each of 3 sizes	1	yes
	Abrasion resistance	B	8.3	1 from each of 3 sizes	1	yes
	Flexing resistance	B	8.4	1 from each of 3 sizes	1	yes
	Hydrolysis	B	8.5	1 from each of 3 sizes	1	yes
	Resistance to fuel oil	B	8.6	1 from each of 3 sizes	1	yes
	Resistance to hot contact	A	8.7	1 from each of 3 sizes	1	yes

^a if the samples are taken from the footwear use 3 different sizes

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

NOTE 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 and this should be noted in the test report.

Where samples are required from each of three sizes, these shall comprise the largest, the smallest and a middle size of the footwear under test.

All test pieces shall be conditioned in a standard atmosphere of $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5)\%$ r.h. 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.

Each individual test piece shall satisfy the specified requirement, unless otherwise stated in the test method.

The uncertainty of measurement for each test method described in the present standard shall be assessed. One of the two following approaches shall be used:

- a statistical method, e.g. that given in ISO 5725-2;
- a mathematical method, e.g. that given in ENV 13005.

5. Test methods for whole footwear

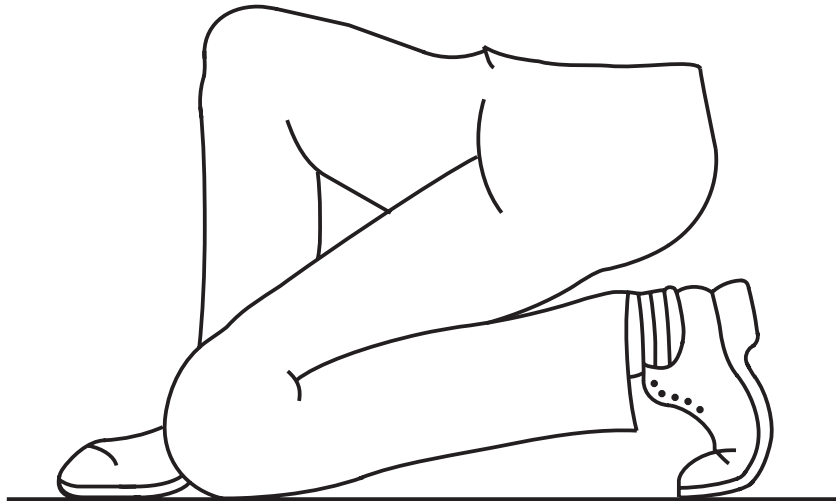
5.1 Specific ergonomic features

The specific ergonomic features of the footwear shall be assessed by examining the footwear using wear trials on 3 wearers with appropriate foot sizes.

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

These tasks are :

- walk normally for 5 min at a speed of approx. 6 km/h.
- climb and descend (17 ± 3) stairs for 1 min
- kneel / crouch down, see figure 1



Note : This degree of shoe flexion will not be achieved for all types of footwear (for example footwear with a steel midsole)

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

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

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?	YES	NO
2	Are there no pinch points caused by the toecap or the edge covering of the toecap ?	YES	NO
3.	Is the footwear free of features that you consider to make wearing the footwear hazardous ?	YES	NO
4.	Can the fastening be adequately adjusted ? (if necessary)	YES	NO
5.	Can the following activities be performed without problems :		
	walking	YES	NO
	Climbing stairs	YES	NO
	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.

NOTE In all cases the objective should be to test the bond strength nearest to the edge of the assembly. The test need not be carried out when the bond has been made by grindery (using, for example, nails or screws) or stitching.

5.2.2 Apparatus

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 (see figure 2)

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.

5.2.3.2 Sole/upper bond strength: construction types b, c, d and e (see figure 2)

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).

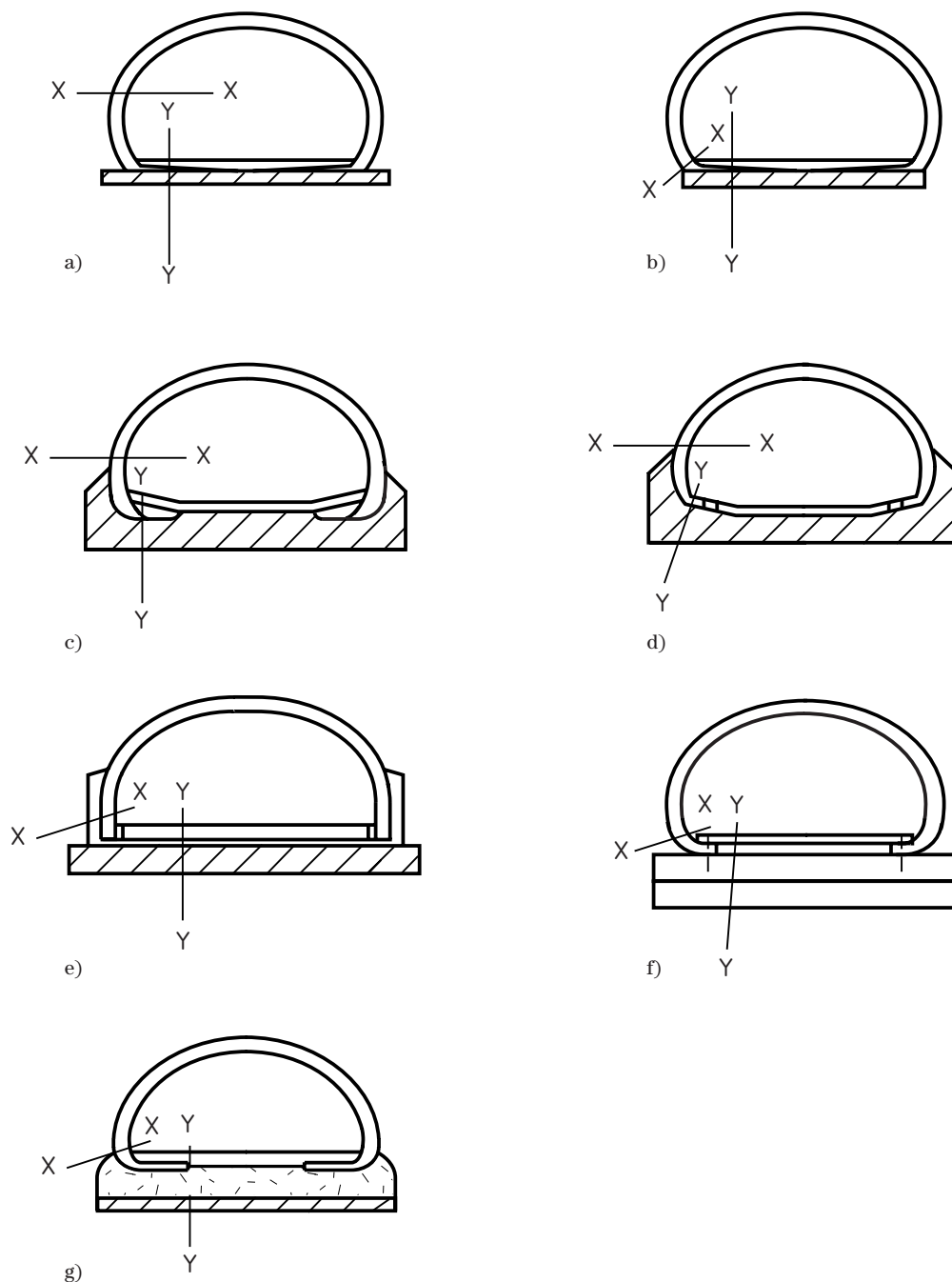
NOTE It is considered that a construction is c or d when the distance from X-X to the upper face of the insole is at least 8 mm.

5.2.3.3 Interlayer bond strength: construction types f and g (see figure 2)

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

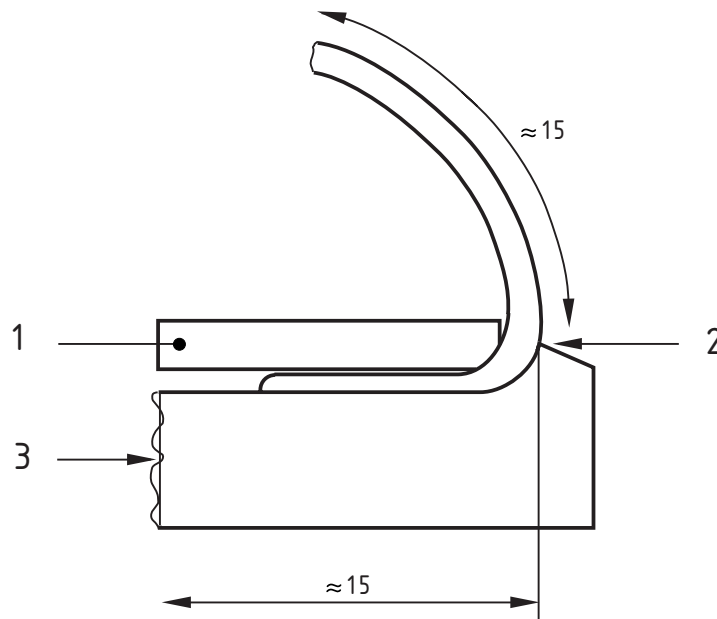
Remove the upper by cutting along the feather line at X-X. Remove the insole if present. Cut a strip parallel to and including the sole edge at Y-Y to produce a test piece about 15 mm wide and at least 50 mm long.

Separate the sole layers for a length of about 10 mm by inserting a hot knife into the adhesive layer (see figure 4).



- 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



- 1 Insole (removed) Dimensions are in mm
 2 Feather line
 3 Outsole

Figure 3 - Cross section of test piece

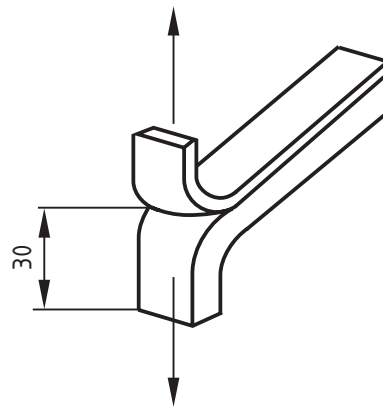
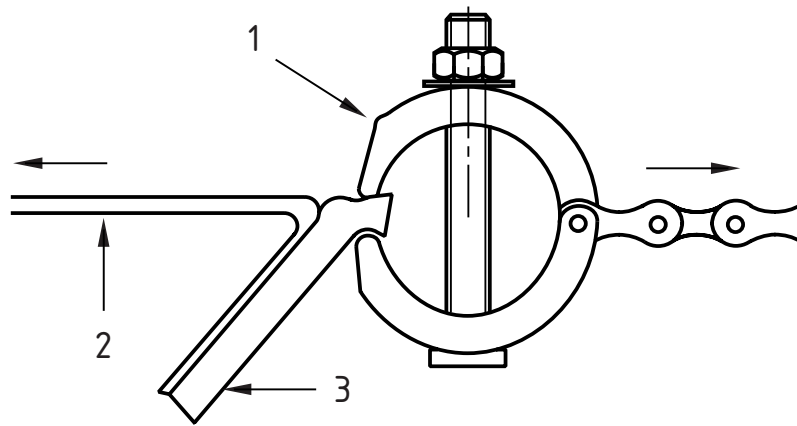


Figure 4 - Prepared test piece

5.2.4 Measurement of bond strength

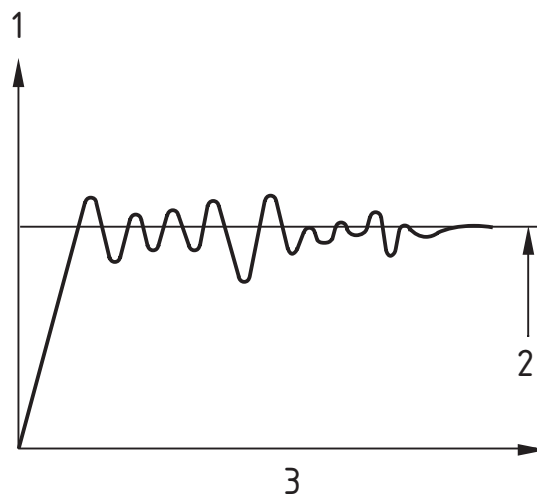
Before carrying out the test, measure the width of the test piece to the nearest mm at several points using a calibrated steel rule and calculate the average value to the nearest mm. Then measure the bond strength on a minimum length of 30 mm in one of the following ways:

- 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 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.



- 1 Pincer jaw for sole edge
- 2 Upper
- 3 Sole

Figure 5 — Pincer jaw showing position of test piece



- 1 Peeling force in Newtons
- 2 Average
- 3 Deformation

Figure 6 — Example of load/deformation graph

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.

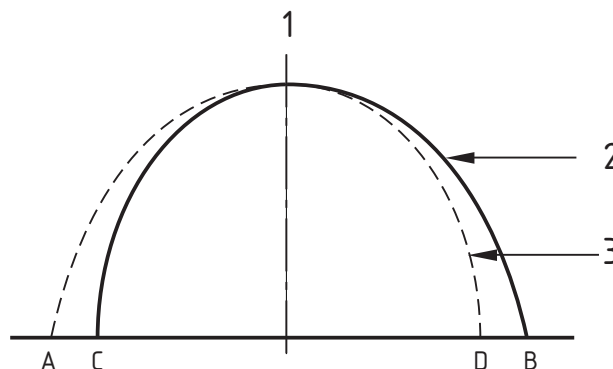
5.3.2 Determination of the test axis

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).

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 mid point of A-B or C-D. This constitutes the test axis of the toecap.

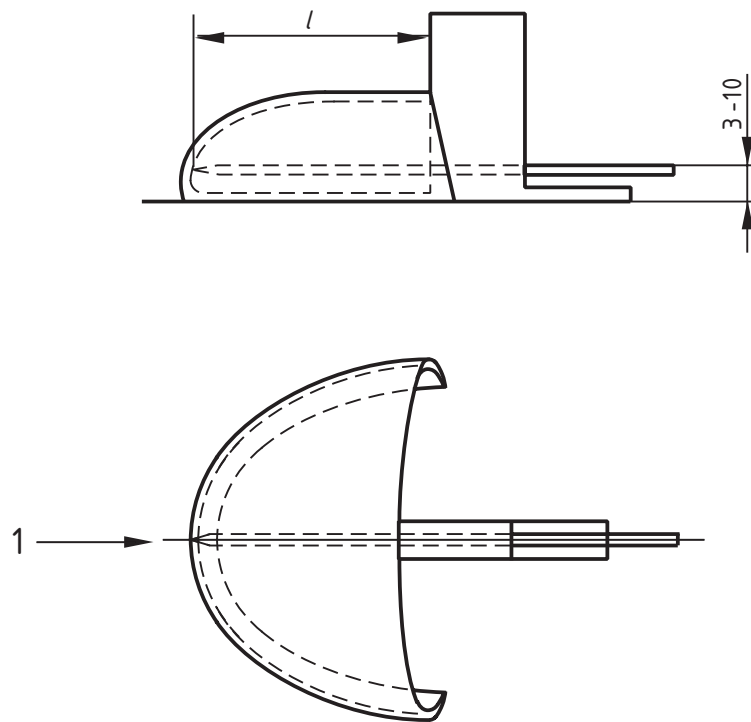
5.3.3 Test procedure

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.



- 1 Test axis
- 2 Right cap
- 3 Left cap

Figure 7 — Determination of test axis



1 Test axis
 l = internal length

Dimensions are in mm

Figure 8 — Measurement of internal toecap length

5.4 Determination of impact resistance

5.4.1 Apparatus

5.4.1.1 Impact apparatus, incorporating a steel striker of mass $20 \text{ kg} \pm 0,2 \text{ kg}$ adapted to fall freely on vertical guides from a predetermined height to give the required impact energy. Provision should be made for a mechanism to catch the striker after the first impact so that the test specimen is struck only once.

The striker (see figure 9) shall consist of a wedge at least 60 mm long, the faces of which subtend an angle of $(90 \pm 1)^\circ$. The apex where the faces meet shall be rounded to a $(3 \pm 0,1) \text{ mm}$ radius. During the test the apex shall be parallel within $\pm 17'$ to the surface of the clamping device.

The base of the apparatus shall have a mass of at least 600 kg and a metal block of dimensions of at least 400 mm x 400 mm x 40 mm deep shall be bolted to it.

The apparatus shall be free standing on a flat and level floor which is sufficiently massive and rigid to support the test equipment.

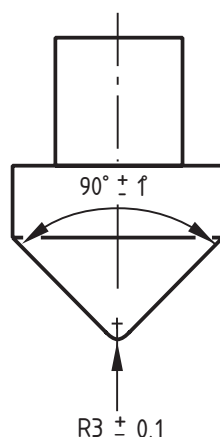


Figure 9 — Impact striker

5.4.1.2 Clamping device, consisting of a smooth steel plate at least 19 mm thick and 150 mm x 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 10). 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 ± 1) Nm.

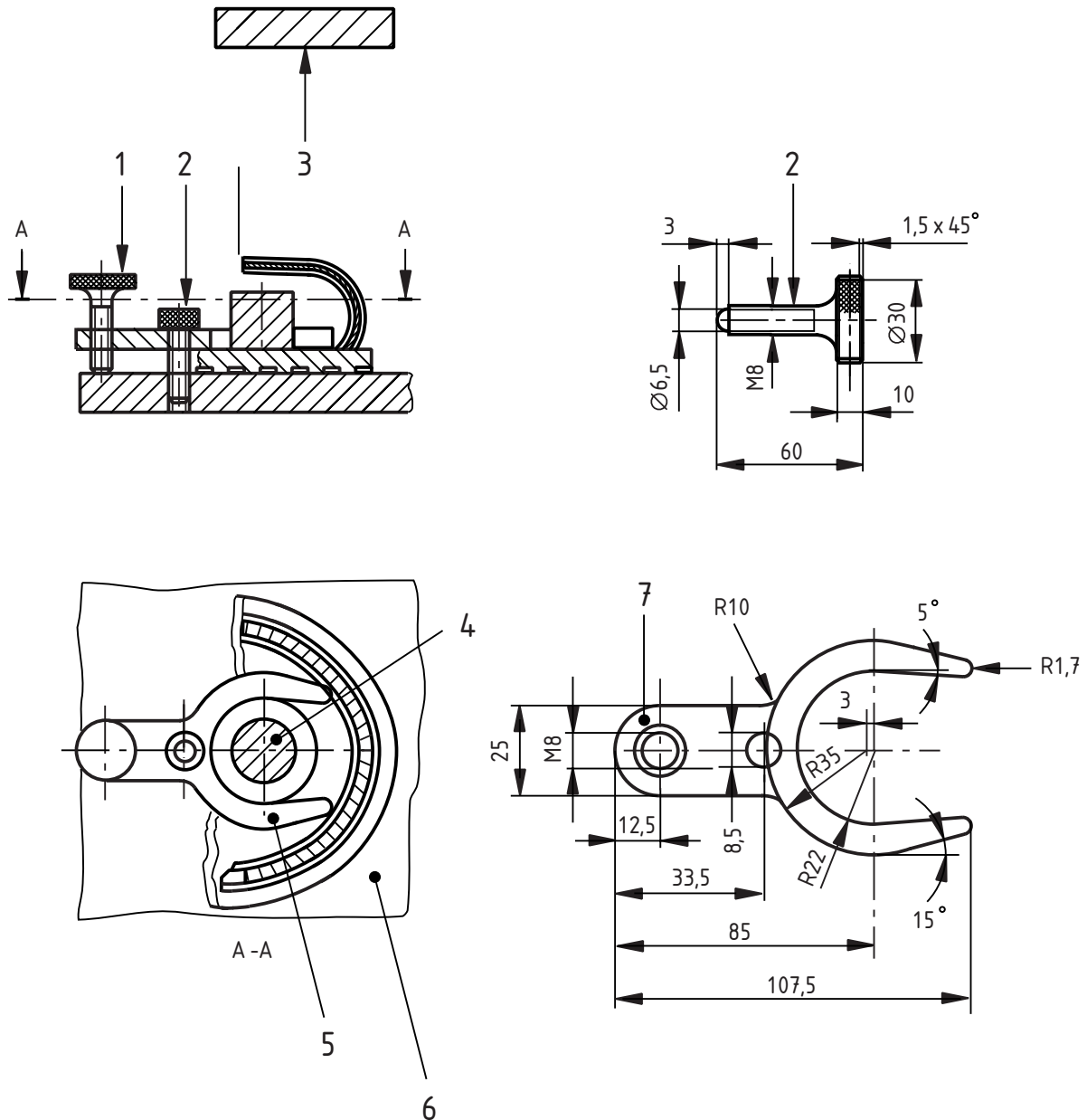
5.4.1.3 Cylinders, of modelling clay of diameter (25 ± 2) mm and of height (20 ± 2) mm for footwear up to and including size 40 (French) and of height (25 ± 2) mm for footwear above size 40. The flat ends of the cylinder shall be covered with aluminium foil to prevent them sticking to either the test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

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 of not greater than 250 mN.

5.4.2 Procedure

5.4.2.1 Determination of the test axis (see figure 11)

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.



- 1 Clamping screw
- 2 Adjusting screw
- 3 Striker
- 4 Modelling clay cylinder

- 5 Stabilizing fork
- 6 Baseplate
- 7 Thickness = 10 mm
- Dimensions are in 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 10 — Example of footwear clamp

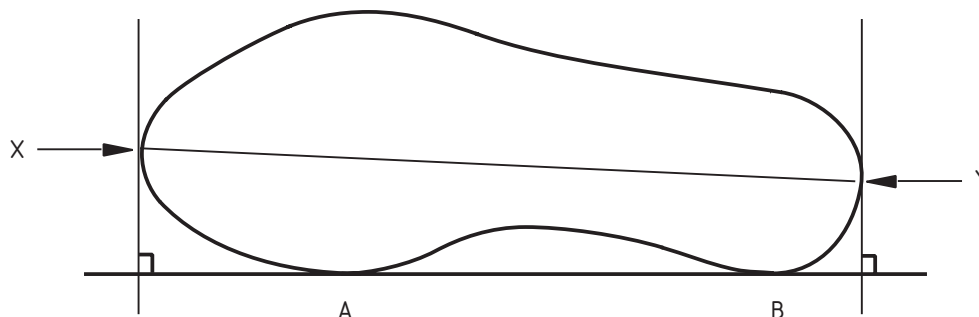


Figure 11 — Test axis for footwear

5.4.2.2 Preparation of 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 12.

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 or (100 ± 2) J for protective 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.

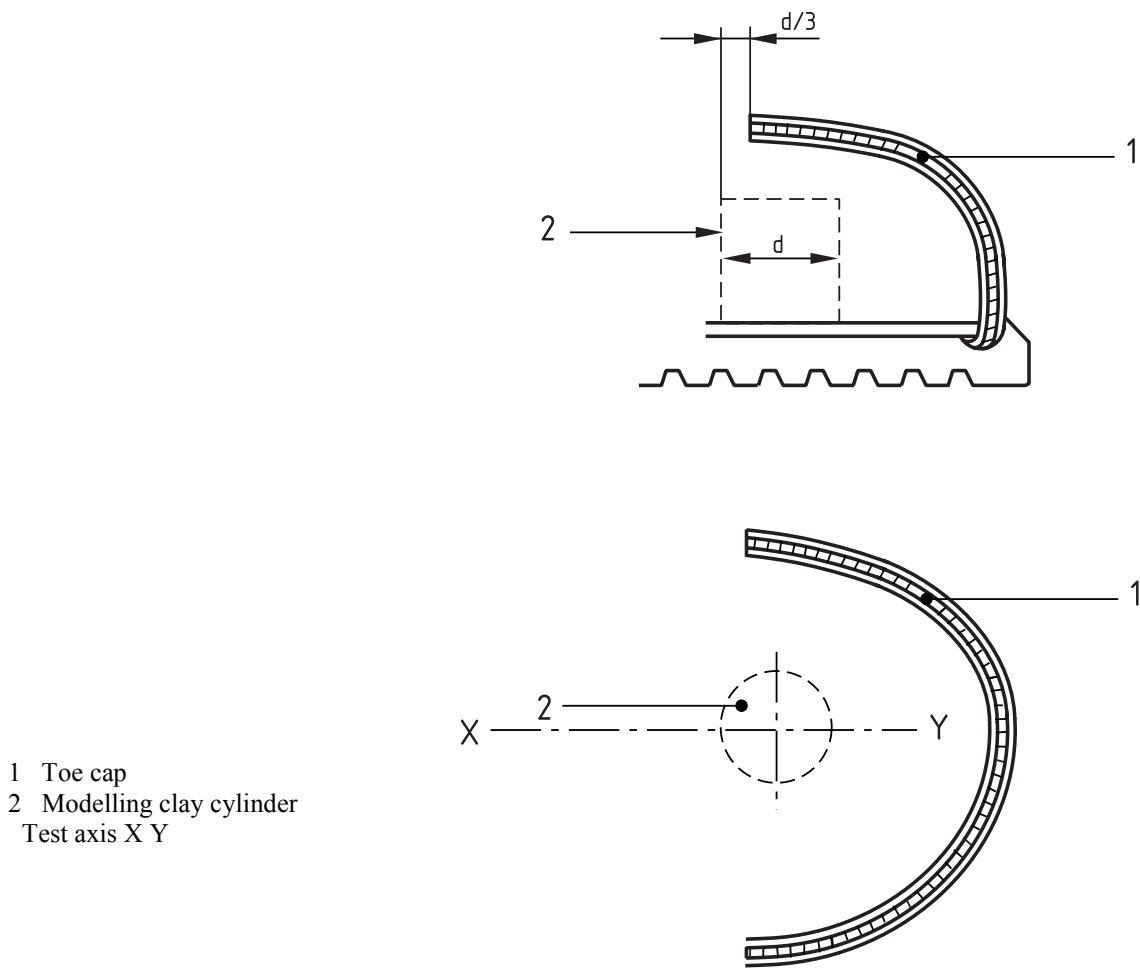


Figure 12 — Position of cylinder for impact or compression test of footwear

5.5 Determination of compression resistance

5.5.1 Apparatus

5.5.1.1 Compression testing machine, capable of subjecting the test piece to a force of at least 20 kN (to a tolerance of $\pm 1\%$) between platens which move at a speed of (5 ± 2) mm/min. The platens shall remain parallel during the application of the load and shall have a minimum hardness of 60 HRC. The measurement of the force shall not be affected by eccentrically applied forces.

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 test piece

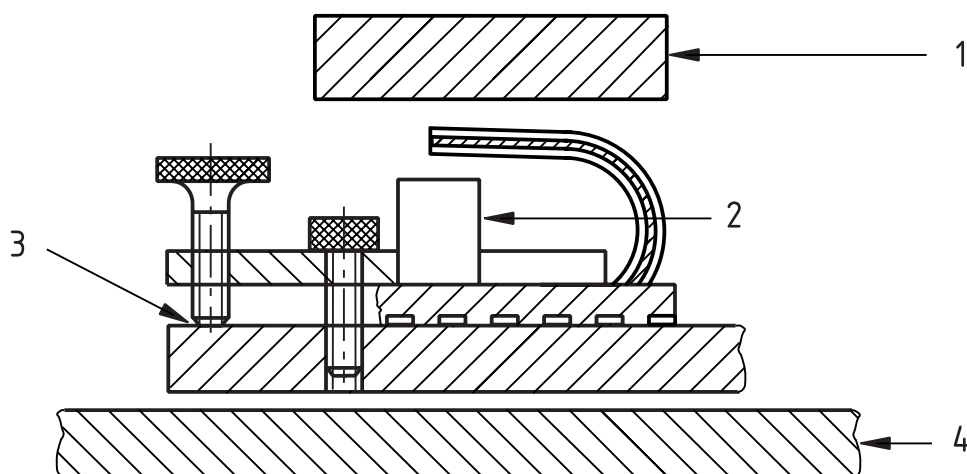
Prepare the test piece as described in 5.4.2.2.

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 12. Place the test piece in the clamping device (5.5.1.4) and adjust.

Position the clamping device and test piece between the platens of the compression machine (5.5.1.1) and compress the specimen with a load of either $(15 \pm 0,1)$ kN for safety footwear or $(10 \pm 0,1)$ kN for protective footwear (see figure 13).



- | | |
|---------------------------|-------------------|
| 1 Upper platen | 3 Clamping device |
| 2 Modelling clay cylinder | 4 Lower platen |

Figure 13 — Apparatus for compression test

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 Determination of corrosion resistance

5.6.1 Determination of corrosion resistance of metallic toecaps or penetration-resistant metallic inserts in classification II footwear

5.6.1.1 Preparation of test piece

Use the complete item of footwear as the test piece.

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 to a depth of 150 mm. Cover the top of the footwear with, for example, a polyethylene cover, to minimise evaporation.

Allow to stand for 7 days and then discard the test solution.

Remove the toecap or insert from the footwear and examine for any evidence of corrosion. When present, measure the size of each area of corrosion in mm² and record also the number of such areas.

5.6.2 Determination of corrosion resistance of metallic toecaps in classification I footwear

Remove the toecap from the footwear or take a new identical toecap and test in accordance with the method described in EN 12568:1998 (4.2).

5.6.3 Determination of the corrosion resistance of penetration-resistant metallic inserts in footwear other than all-rubber footwear

Remove the insert from the footwear or take a new identical insert and test in accordance with the method described in EN 12568:1998 (5.1).

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 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 specimen in a waterbath up to the edge and apply a constant internal pressure of (10 ± 1) 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 14 the shaded areas N°1 and N°2.

Section the footwear and measure the distances X and Y (see figure 14) 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, using, for example, a ruler.

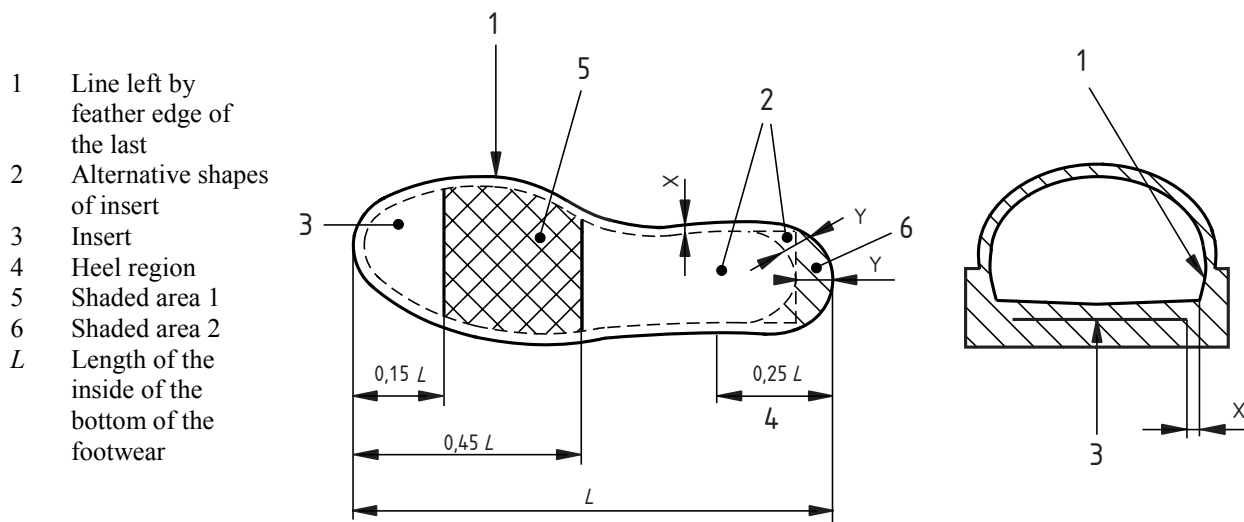


Figure 14 — Determination of dimensions for the insert

5.8.2 Determination of the penetration resistance of the sole

5.8.2.1 Apparatus

5.8.2.1.1 Test equipment, capable of measuring a compressive force up to at least 2 000 N, fitted with a pressure plate, in which a test nail (5.8.2.1.2) is fixed, and a parallel base plate with a circular opening of diameter 25 mm. The axes of this opening and the test nail shall be coincident (see figure 15).

5.8.2.1.2 Test nail, of diameter $(4,50 \pm 0,05)$ mm with a truncated end of the form and dimensions shown in figure 16. The point of the nail shall have a minimum hardness of 60 HRC.

The form of the test nail shall be examined at intervals and if deviations from the dimensions shown in figure 16 are observed the test nail shall be replaced.

5.8.2.2 Preparation of test piece

Remove the upper from the bottom of the footwear and use the bottom as the test piece.

For absorbent soling material (e.g. leather) carry out the tests after the sole unit has been immersed in deionised water at $(23 \pm 2)^\circ\text{C}$ for (16 ± 1) h.

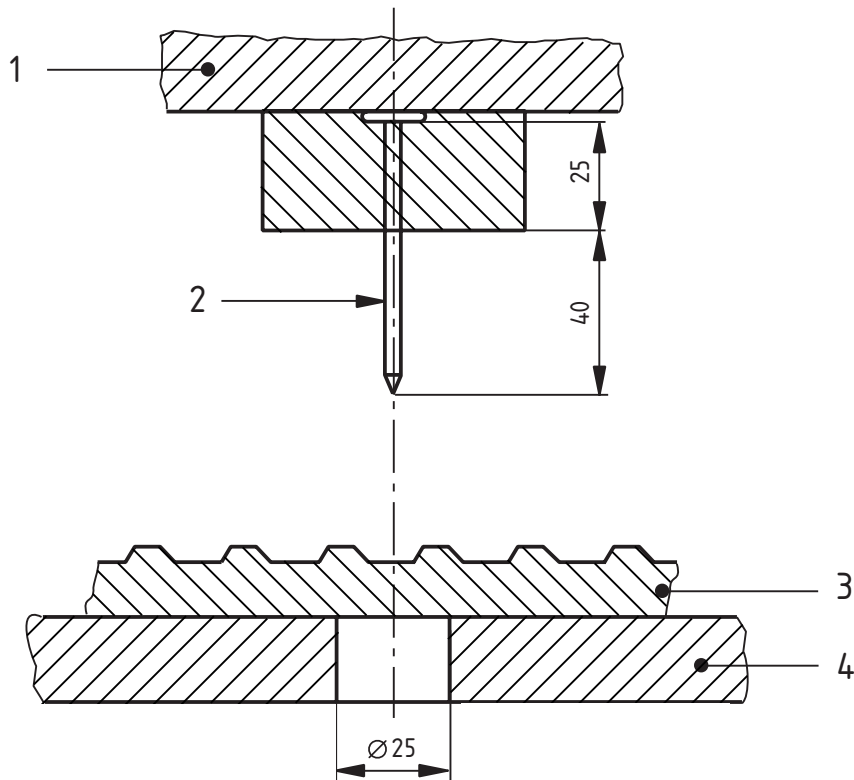
NOTE Preconditioning of non-absorbent test piece is unnecessary.

5.8.2.3 Test procedure

Place the test piece on the base plate in such a way that the steel nail can penetrate it through the bottom. Press the nail against the sole unit at a speed of (10 ± 3) mm/min until the point has penetrated completely and measure the maximum force.

Carry out the test at four different points on the sole unit (at least one in the heel region) with a minimum distance of 30 mm between any two penetration points and a minimum distance of 10 mm from the edge of the insole. For cleated soles, carry out the test between cleats. Two of the four measurements shall be made at a distance of 10 mm to 15 mm from the line represented by the feather edge of the last.

Report the minimum value of the individual measurements as the test result.

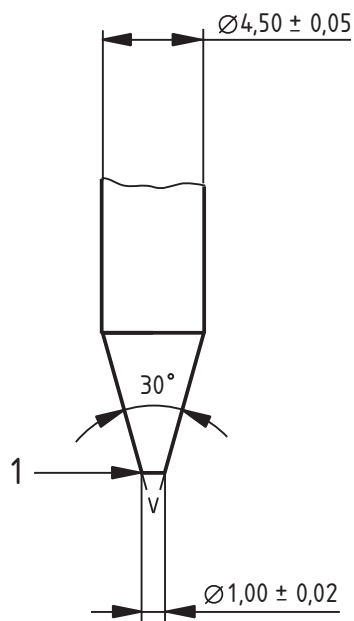


- 1 Pressure plate
2 Nail

- 3 Sole unit of the test piece
4 Base plate

Dimensions in mm

Figure 15 — Apparatus for penetration resistance test



- 1 Truncated end

Dimensions in mm

Figure 16 — Nail for penetration resistance test

5.9 Determination of the flex resistance of penetration-resistant inserts

Determine the flex resistance of penetration-resistant inserts according to the method described in 7.2.2.3 of EN 12568:1998.

5.10 Determination of electrical resistance

5.10.1 Principle

The electrical resistance of conductive footwear is measured after conditioning in a dry atmosphere (5.10.3.3 a.). The electrical resistance of antistatic footwear is measured after conditioning in a dry atmosphere and after conditioning in a wet atmosphere (5.10.3.3 a. and b.).

5.10.2 Apparatus

5.10.2.1 Testing instrument, capable of measuring electrical resistance to an accuracy of $\pm 2,5\%$ while applying a voltage of (100 ± 2) V DC.

5.10.2.2 Internal electrode, comprising stainless steel balls of 5 mm diameter and of total mass 4 kg. The steel balls shall conform to the requirements of ISO 3290. Steps should be taken to prevent or remove oxidation of the steel balls and the copper plate since oxidation could affect their conductivity.

5.10.2.3 External electrode, comprising a copper contact plate cleaned with ethanol before use.

5.10.2.4 Conductive lacquer.

5.10.2.5 Device for measuring the conductive resistance of the lacquer, consisting of three conductive metal probes, each $(3 \pm 0,2)$ mm radius, attached to a base plate. Two of the probes are (45 ± 2) mm apart and connected by a metal strap. The third probe is set at a distance of (180 ± 5) mm from the centre line joining the other two and is electrically insulated from them.

5.10.3 Preparation for conditioning of test piece

5.10.3.1 Preparation

If the footwear has been supplied with a removable insock, carry out the test with it in place. Clean the surface of the sole of the footwear with ethanol to eliminate all traces of mould silicone, wash with distilled water and allow to dry at $(23 \pm 2)^{\circ}\text{C}$. The surface shall not be buffed or abraded or cleaned with organic materials which attack or swell the sole.

5.10.3.2 Specific preparation for wet condition

For test pieces which are tested following conditioning under wet conditions (see 5.10.3.3), apply a conductive lacquer (5.10.2.4) to the sole over an area 200 mm by 50 mm, including the heel and the fore part. Allow to dry and then check that the resistance of the lacquer is less than $1 \times 10^3 \Omega$.

Fill the footwear with clean steel balls and place on the metal probes of the device (5.10.2.5) such that the front area of the outsole is supported by the two probes spaced 45 mm apart and the heel area is supported by the third probe. Using the testing instrument (5.10.2.1), measure the resistance between the front probes and the third probe.

5.10.3.3 Conditioning

Condition the prepared test piece in one after the following atmospheres, according to the type of footwear being tested:

- a) Dry conditions. $(20 \pm 2)^{\circ}\text{C}$ and $(30\% \pm 5)\%$ r.h. (for 7 days)
- b) Wet conditions. $(20 \pm 2)^{\circ}\text{C}$ and $(85\% \pm 5)\%$ r.h. (for 7 days)

The test shall be performed within 5 min of the removal of the test piece from the conditioning atmosphere if the test is not carried out in that atmosphere.

5.10.4 Procedure

Fill the test piece with clean steel balls to a total mass of 4 kg using a piece of insulating material to extend the height of the upper if necessary. Place the filled specimen on the copper plate, apply a test voltage of (100 ± 2) V DC between the copper plate and the steel balls for 1 min and calculate the resistance.

The energy dissipation in the sole shall not be greater than 3 W.

Wherever necessary, reduce the voltage in order to respect the 3 W limit and record the voltage value in the test report.

5.11 Determination of the electrical insulation

Determine the electrical insulation according to the method described in EN 50321:1999 clause 6.3.

5.12 Determination of insulation against heat

5.12.1 Apparatus

5.12.1.1 Sandbath,

The size of the bath holding the sand shall be (40 ± 2) cm x (40 ± 2) cm with a height of at least 5 cm (see figure 17)

Volume of sand $(5\,000 \pm 250)$ cm³, granular size 0.3 mm to 1.0 mm

The temperature of the plate shall be measured where the footwear will contact the plate (forepart and heel) and shall be regulated according to the test temperature. Depending on the properties claimed by the tested footwear, the temperature of the hot plate T_{hp} can be either 150°C or 250°C (tolerance $\pm 5^{\circ}\text{C}$).

The power of the heating system should be at least $(2\,500 \pm 250)$ W

5.12.1.2 Heat transfer medium, comprising stainless steel balls 5 mm diameter and a total mass $(4\,000 \pm 40)$ g. The stainless steel balls shall conform to the requirements of ISO 3290.

5.12.1.3 Temperature probe with an accuracy of $\pm 0,5^{\circ}\text{C}$, soldered to a copper disc $(2 \pm 0,1)$ mm thick and (15 ± 1) mm diameter.

5.12.1.4 Temperature measuring device, with a compensator, suitable for use with 5.12.1.3

5.12.2 Preparation of test piece

Use the complete item of footwear as the test piece. Fix the temperature probe to the insole. The temperature inside the footwear shall be measured in the forepart in an area directly above the area where the sole contacts the hot plate. Place the steel balls inside the footwear. If the footwear has been supplied with a removable insock, carry out the test with it in place. If the upper is not high enough to support the balls, increase its height with a collar.

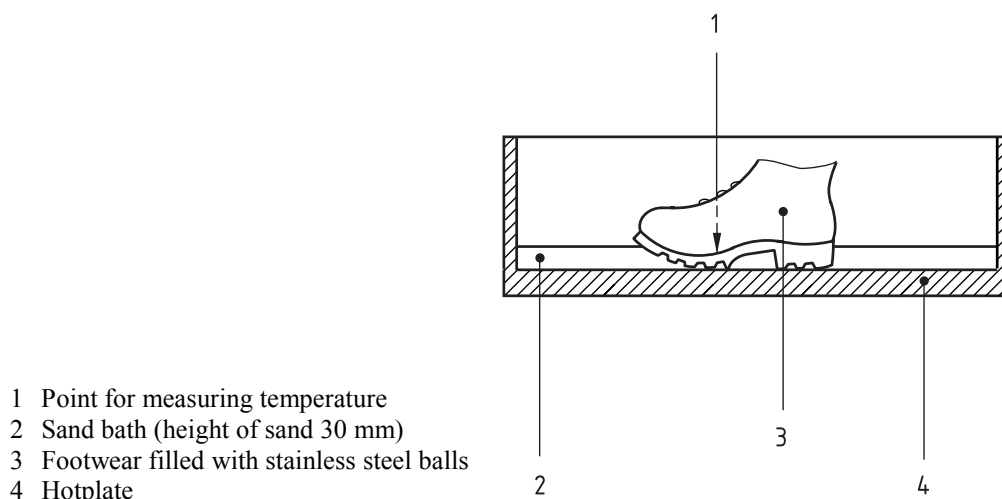


Figure 17 — Heat insulation test apparatus

5.12.3 Test procedure

Condition the prepared test piece until the temperature of the insole is constant at $(23 \pm 2)^{\circ}\text{C}$ and carry out the test under ambient conditions of $(23 \pm 2)^{\circ}\text{C}$.

Preheat the sandbath for 2 h minimum, and adjust the temperature of the hot plate to T_{hp} , maintain this temperature during the test. Place the test piece on it. Move the footwear forward and backward in order to get the best possible contact between the footwear and the hot plate.

Replace the sand around the footwear at the correct height. Then ensure that the surface of the sand is homogenously flat.

Use the temperature measuring device connected to the temperature probe to measure the temperature on the insole as a function of time, recording the temperature increase.

t_1 is the time when the final increase of temperature inside the footwear (θ in $^{\circ}\text{C}$) is measured.

t_2 is the total duration of the test.

Calculate to the nearest $0,5^{\circ}\text{C}$, the increase in temperature (I_t in $^{\circ}\text{C}$) after the test piece was placed on the hot plate for t_1 .

$$I_t = \theta - 23$$

Continue the test until t_2 . Immediately after heating over a period t_2 remove the sample and then the steel balls for inspection and note signs of serious damage, which affect the functionality of the footwear.

The results of the test are :

- the increase of temperature inside the footwear after t_1 .
- report of damage which can seriously affect the functionality of the footwear (for example beginning of separation of upper and sole).

5.13 Determination of insulation against cold

5.13.1 Apparatus

5.13.1.1 Insulated cold box, the internal air temperature of which can be regulated to $(-17 \pm 2)^{\circ}\text{C}$ (see figure 18).