INTERNATIONAL STANDARD

ISO 8782-1

First edition
1998-12-15

Safety, protective and occupational footwear for professional use —

Part 1:
Requirements and test methods

Chaussures de sécurité, de protection et de travail à usage professionnel —

Partie 1: Exigences et méthodes d'essais

Reference number
ISO 8782-1:1998(E)

Contents

Page

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Printed in Switzerland

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.

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.

International Standard ISO 8782-1 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment,* Subcommittee SC 3, *Foot protection*.

ISO 8782 consists of the following parts, under the general title *Safety, protective and occupational footwear for professional use*:

— *Part 1: Requirements and test methods*

— *Part 2: Specification for safety footwear*

— *Part 3: Specification for protective footwear*

— *Part 4: Specification for occupational footwear*

— *Part 5: Additional requirements and test methods*

— *Part 6: Additional specifications for safety footwear*

— *Part 7: Additional specifications for protective footwear*

— *Part 8: Additional specifications for occupational footwear*

Annex A forms an integral part of this part of ISO 8782. Annexes B, C and D are for information only.

Safety, protective and occupational footwear for professional use —

Part 1:
Requirements and test methods

1 Scope

This part of ISO 8782 specifies requirements and, where appropriate, test methods to establish conformity with these requirements for footwear intended to protect the wearer's feet and legs against foreseeable hazards in a variety of working sectors.

This part of ISO 8782 can be used only in conjunction with ISO 8782-2, ISO 8782-3 or ISO 8782-4, which give requirements for footwear relating to specific levels of risk.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 8782. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 8782 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 868:1985, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness).*

ISO 1817:—[1)], *Rubber, vulcanized — Determination of the effect of liquids.*

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

ISO 3376:1976, *Leather — Determination of tensile strength and elongation.*

ISO 3377:1975, *Leather — Determination of tearing load*.

ISO 4045:1977, *Leather — Determination of pH.*

ISO 4643:1992, *Moulded plastics 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 4649:1985, *Rubber — Determination of abrasion resistance using a rotating cylindrical drum device.*

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1) To be published. (Revision of ISO 1817:1985)

ISO 4674-1:—[2], *Rubber- or plastics-coated fabrics — Determination of tear resistance — Part 1: Constant rate of tear methods.*

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

ISO 8782–2:1998, *Safety, protective and occupational footwear for professional use — Part 2: Specification for safety footwear.*

ISO 8782–3:1998, *Safety, protective and occupational footwear for professional use — Part 3: Specification for protective footwear.*

ISO 8782–4:1998, *Safety, protective and occupational footwear for professional use — Part 4: Specification for occupational footwear.*

3 Definitions

For the purposes of this part of ISO 8782, the following definitions apply.

NOTE The component parts of footwear are illustrated in figures 1 and 2.

3.1
safety footwear for professional use
footwear incorporating protective features to protect the wearer from injuries which could arise through accidents in the working sectors for which the footwear was designed, fitted with toecaps designed to give protection against impact when tested at an energy level of 200 J

3.2
protective footwear for professional use
footwear incorporating protective features to protect the wearer from injuries which could arise through accidents in the working sectors for which the footwear was designed, fitted with toecaps designed to give protection against impact when tested at an energy level of 100 J

3.3
occupational footwear for professional use
footwear incorporating protective features to protect the wearer from injuries which could arise through accidents in the working sectors for which the footwear was designed

3.4 Leather

NOTE This term covers full-grain leather, corrected-grain leather and leather split.

3.4.1
full-grain leather
hide or skin tanned to be imputrescible, with its original fibrous structure more or less intact and still possessing the full-grain layer

3.4.2
corrected-grain leather
hide or skin tanned to be imputrescible, with its original fibrous structure more or less intact, but which has been subjected to mechanical buffing to modify its grain structure

2) To be published. (Revision of ISO 4674:1977)

3.4.3
leather split
flesh or middle part of a skin or hide tanned to be imputrescible, with its original fibrous structure more or less intact and split or shaved to eliminate completely the grain layer

3.5
rubber
vulcanized elastomers

3.6
polymeric materials
materials made of polyurethane, poly(vinyl chloride) or thermoplastic rubber

3.7
height of the upper
vertical distance between the top surface of the extreme rear edge of the insole and the highest point of the back of the upper

3.8
insole
non-removable bottom inside component of the footwear adjacent to the foot

3.9
lining
inside layer of the upper which is adjacent to the foot

3.10
fuel oil
aliphatic hydrocarbon constituent of petroleum

4 Requirements

4.1 Sampling and conditioning

The minimum number of samples (i.e. separate items of footwear) to be tested in order to check compliance with the requirements specified in this clause, together with the minimum number of test pieces taken from each sample, shall be as given in table 1.

Wherever possible, test pieces shall be taken from the whole footwear unless otherwise stated.

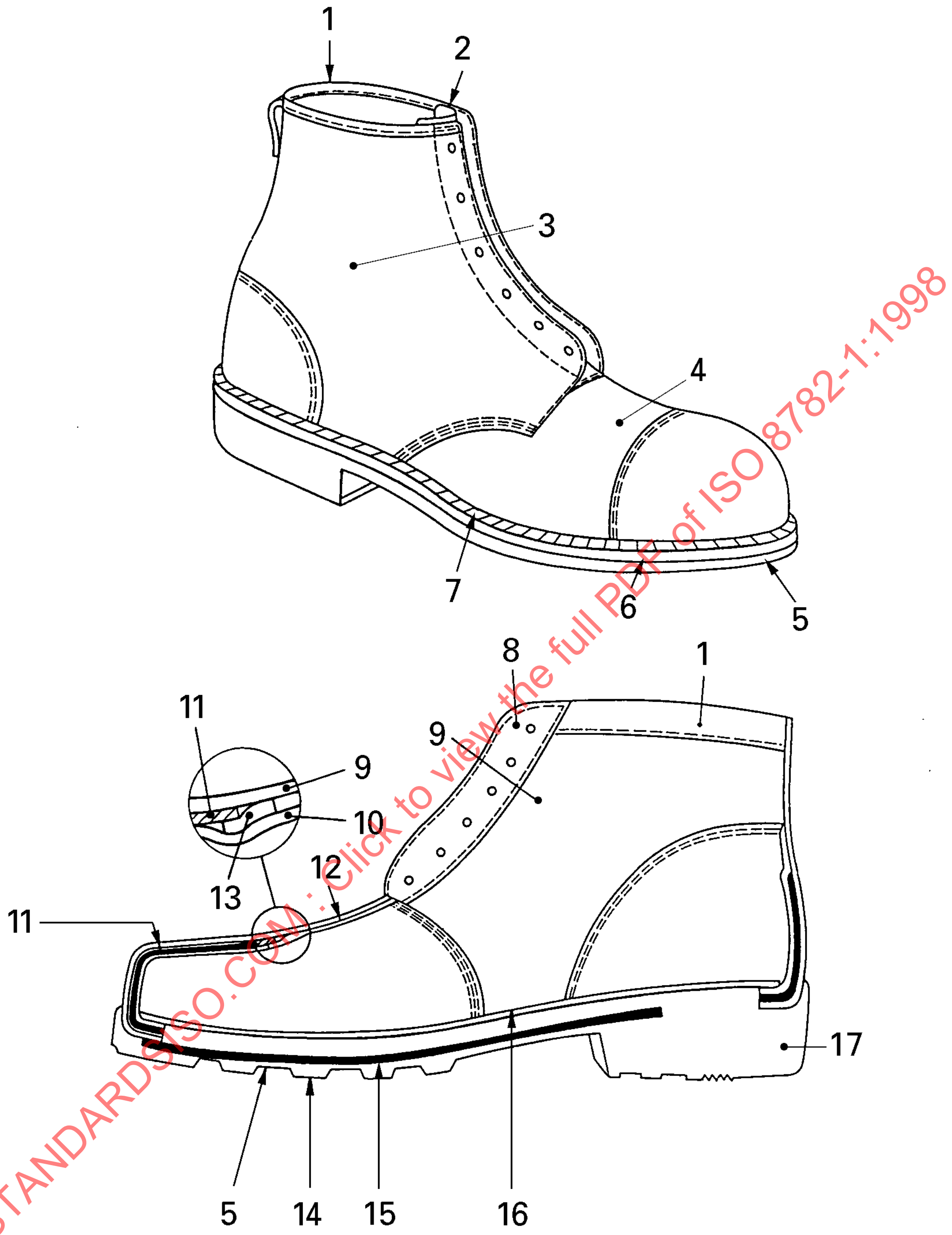
NOTE If it is not possible to obtain a test piece from the footwear large enough to comply with requirements, then a sample of the material from which the component has been manufactured may be used instead. However, this should be noted in the test report.

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

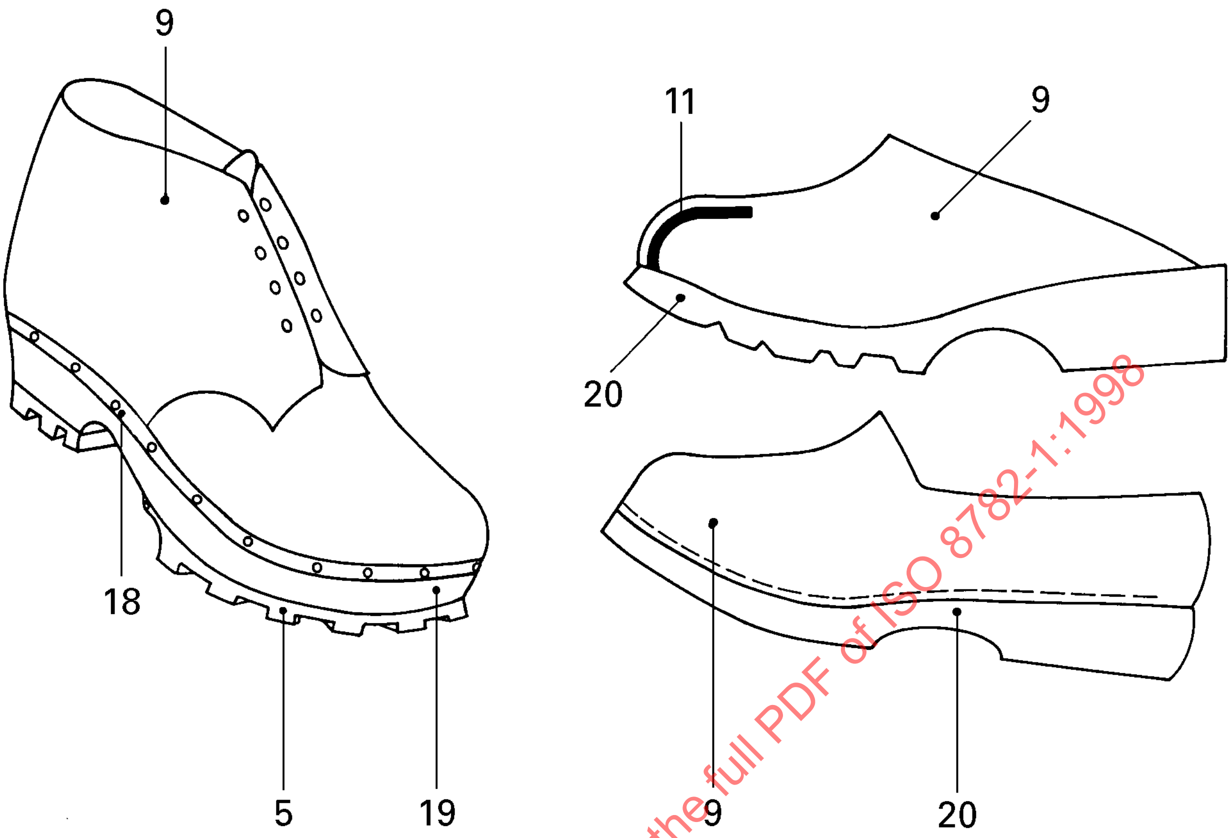
All test pieces shall be conditioned in a standard atmosphere of (20 ± 2) °C and (65 ± 5) % relative humidity (RH) for a minimum of 48 h before testing, unless otherwise stated in the test method.

The maximum time which shall elapse between removal from the conditioning atmosphere and the start of testing shall be no greater than 10 min, unless otherwise stated in the test method.

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



a)

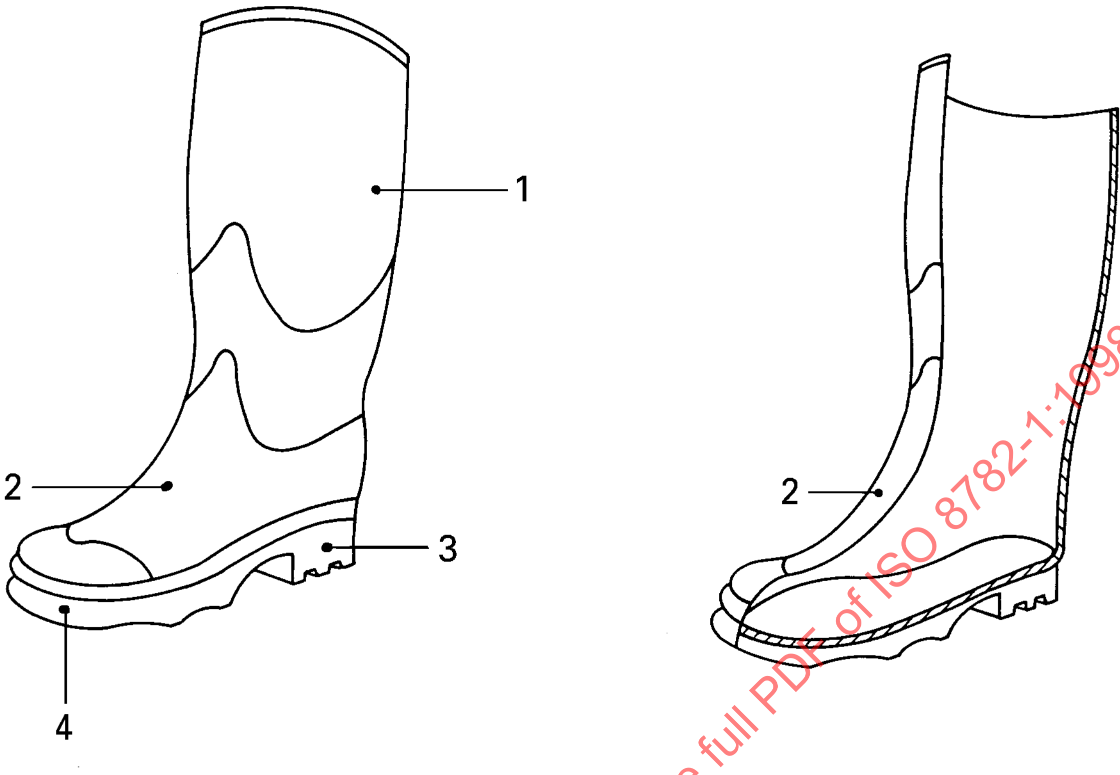


b)

Key

1 Collar
2 Tongue
3 Quarter
4 Vamp
5 Outsole
6 Through sole
7 Feather line
8 Facing
9 Upper
10 Lining
11 Safety or protective toe cap
12 Vamp lining
13 Foam strip
14 Cleat
15 Penetration-resistant insert
16 Insole
17 Heel
18 Reinforcing welt with nails
19 Wooden sole
20 Rigid sole

Figure 1 — Parts of footwear



Key

1 Upper

2 Vamp

3 Heel

4 Outsole

Figure 2 — Parts of all-rubber (i.e. vulcanized) or all-polymeric (i.e. entirely moulded) footwear

Table 1 — Minimum number of samples and test pieces

Requirement	Subclause	Number of samples	Number of test pieces from each sample
Upper/outsole and sole interlayer bond strength	4.3.1.2 4.8.7	1 from each of 3 sizes	1
Internal toecap length	4.3.2.2	1 pair from each of 3 sizes	1 pair
Impact resistance	4.3.2.3.1 4.3.2.3.2	1 pair from each of 3 sizes	1 pair
Compression resistance	4.3.2.4.1 4.3.2.4.2	1 pair from each of 3 sizes	1 pair
Corrosion resistance of metal toecaps or metal penetration-resistant inserts	4.3.2.5 4.3.3.2.3	2	1
Penetration resistance	4.3.3.1	1 pair from each of 3 sizes	1 pair
Dimensions of penetration-resistant inserts	4.3.3.2.2	1 pair from each of 3 sizes	1 pair
Electrical resistance	4.3.4	1 pair from each of 3 sizes	1 pair
Insulation against heat	4.3.5.1	2	1
Insulation against cold	4.3.5.2	2	1
Energy absorption of seat region	4.3.6	1 pair from each of 3 sizes	1 pair
Leakproof footwear	4.3.7	2	1
Thickness	4.4.1	1 from each of 3 sizes	3
Tear strength	4.4.2 4.5.2 4.6.1 4.8.3	1 from each of 3 sizes	3
Tensile properties	4.4.3	1 from each of 3 sizes	3
Flexing resistance	4.4.4	1 from each of 3 sizes	1
Water penetration and water absorption	4.4.5	1 from each of 3 sizes	1
Water vapour permeability and water vapour coefficient	4.4.6 4.5.4	1 from each of 3 sizes	1
pH value	4.4.7 4.5.5 4.6.2 4.7.2	1 from each of 3 sizes	1
Hydrolysis	4.4.8 4.8.6	1 from each of 3 sizes	1

Table 1 *(concluded)*

Requirement	Subclause	Number of samples	Number of test pieces from each sample
Abrasion resistance of lining	4.5.3	1 from each of 3 sizes	4
Thickness of insole	4.7.1	1 from each of 3 sizes	1
Water absorption and water desorption of insole	4.7.3	1 from each of 3 sizes	1
Abrasion resistance of insole	4.7.4	1 from each of 3 sizes	1
Thickness of outsole	4.8.1 4.8.2	1 from each of 3 sizes	1
Abrasion resistance of outsole	4.8.4	1 from each of 3 sizes	1
Flexing resistance of outsole	4.8.5	1 from each of 3 sizes	1
Resistance to hot contact	4.8.8	1 from each of 3 sizes	1
Resistance to fuel oil	4.8.9	1 from each of 3 sizes	1

4.2 Design

NOTE The designs of footwear covered by this part of ISO 8742 are illustrated in figure 3.

4.2.1 Height of upper

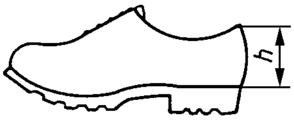
The height of the upper (h) shall be as given in table 2.

Table 2 — Height of upper

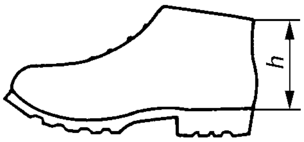
Size of footwear			Height h			
Mondopoint	**Paris points**	**English**	**Design A** mm	**Design B** min. mm	**Design C** min. mm	**Design D** min. mm
225 and below	36 and below	3 and below	< 103	103	162	255
230 to 240	37 and 38	4 and 5	< 105	105	165	260
245 to 250	39 and 40	6	< 109	109	172	270
255 to 265	41 and 42	7 and 8	< 113	113	178	280
270 to 280	43 and 44	9 and 10	< 117	117	185	290
285 and above	45 and above	11 and above	< 121	121	192	300

4.2.2 Seat region

The seat region shall be closed.

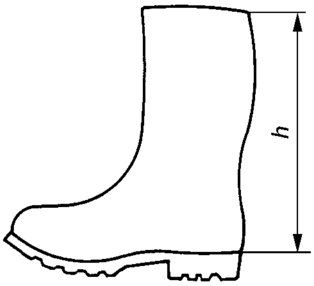


a) Design A: low shoe

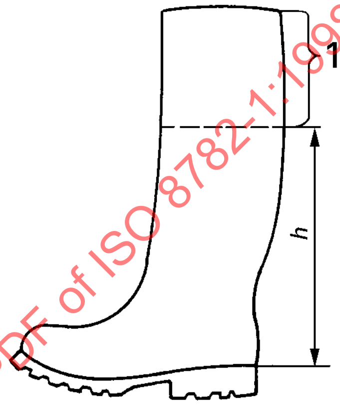


b) Design B: ankle boot

c) Design C: half-knee boot



d) Design D: knee-high boot



e) Design E: thigh boot

Key

1 Variable extension which can be adapted to the wearer

NOTE Design E is a knee-height boot (design D) equipped with a thin, impermeable material which extends the upper and which can be cut to adapt the boot to the wearer.

Figure 3 — Designs of footwear

4.3 Whole footwear

4.3.1 Sole performance

4.3.1.1 Construction

Unless the footwear has a rigid sole, an insole shall be present in such a way that it cannot be removed without damaging the footwear.

4.3.1.2 Upper/outsole bond strength

When footwear, other than that with a rigid sole, is tested in accordance with the method given in 5.1, the bond strength shall be no less than 4,0 N/mm, unless there is tearing of the sole, in which case the bond strength shall be no less than 3,0 N/mm.

4.3.2 Toe protection

4.3.2.1 General

Safety or protective toecaps shall be incorporated in the footwear in such a manner that they cannot be removed without damaging it.

With the exception of all-rubber and all-polymeric footwear, footwear fitted with internal toecaps shall have a vamp lining or an element of the upper that serves as a lining, and in addition the toecaps shall have an edge covering extending from the back edge of the toecap to at least 5 mm beneath it and at least 10 mm in the opposite direction.

Scuff-resistant coverings for the toe region shall be no less than 1 mm in thickness.

NOTE Recommendations for the assessment of toecaps to be used in safety or protective footwear are given for information only in annex B.

4.3.2.2 Internal length of toecaps

When measured in accordance with the method given in 5.2, the internal toecap length shall be no less than the appropriate value given in table 3.

Table 3 — Minimum internal length of toecaps

Size of footwear			Minimum internal length
Mondopoint	**Paris points**	**English**	mm
225 and below	36 and below	3 and below	34
230 to 240	37 and 38	4 and 5	36
245 to 250	39 and 40	6	38
255 to 265	41 and 42	7 and 8	39
270 to 280	43 and 44	9 and 10	40
285 and above	45 and above	11 and above	42

4.3.2.3 Impact resistance

4.3.2.3.1 Impact resistance of safety footwear

When safety footwear is tested in accordance with the method given in 5.3 at an energy level of (200 ± 4) J, the clearance under the toecap at the moment of impact shall be no less than the appropriate value given in table 4. In addition, the toecap shall not develop any cracks on the test axis which go through the material, i.e. through which light can be seen.

4.3.2.3.2 Impact resistance of protective footwear

When protective footwear is tested in accordance with the method given in 5.3 at an energy level of (100 ± 2) J, the clearance under the toecap at the moment of impact shall be no less than the appropriate value given in table 4. In addition the toecap shall not develop any cracks on the test axis which go through the material, i.e. through which light can be seen.

Table 4 — Minimum clearance under toecaps at impact

Size of footwear			Minimum clearance
Mondopoint	**Paris points**	**English**	mm
225 and below	36 and below	3 and below	12,5
230 to 240	37 and 38	4 and 5	13,0
245 to 250	39 and 40	6	13,5
255 to 265	41 and 42	7 and 8	14,0
270 to 280	43 and 44	9 and 10	14,5
285 and above	45 and above	11 and above	15,0

4.3.2.4 Compression resistance

4.3.2.4.1 Compression resistance of safety footwear

When safety footwear is tested in accordance with the method given in 5.4, the clearance under the toecap at a compression load of (15 ± 0,1) kN shall be no less than the appropriate value given in table 4.

4.3.2.4.2 Compression resistance of protective footwear

When protective footwear is tested in accordance with the method given in 5.4, the clearance under the toecap at a compression load of (10 ± 0,1) kN shall be no less than the appropriate value given in table 4.

4.3.2.5 Corrosion resistance of metal toecaps

When all-rubber footwear is tested and assessed in accordance with the method given in 5.5.1, the metal toecap shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 mm^2 in area.

When metal toecaps to be used in all other types of footwear are tested and assessed in accordance with the method given in 5.5.2, they shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 mm^2 in area.

4.3.3 Penetration resistance

4.3.3.1 All penetration-resistant footwear

When footwear is tested in accordance with the method given in 5.6, the force required to penetrate the sole unit shall be no less than 1 100 N.

4.3.3.2 Additional requirements for footwear which incorporates penetration-resistant inserts

NOTE Recommendations for further tests which may be used to assess the suitability of penetration-resistant inserts before they are incorporated in footwear are given for information only in annex C.

4.3.3.2.1 Construction

The penetration-resistant insert shall be built into the bottom of the shoe in such a manner that it cannot be removed without damaging the footwear.

The insert shall not lie above the flange of the safety or protective toecap and shall not be attached to it.

4.3.3.2.2 Dimensions

With the exception of the heel region, the penetration-resistant insert shall be of such a size that the maximum distance between the line represented by the feather edge of the last and the edge of the insert is 6,5 mm. In the heel region the maximum distance between the line represented by the feather edge of the last and the insert shall be 17 mm. (See figure 4.)

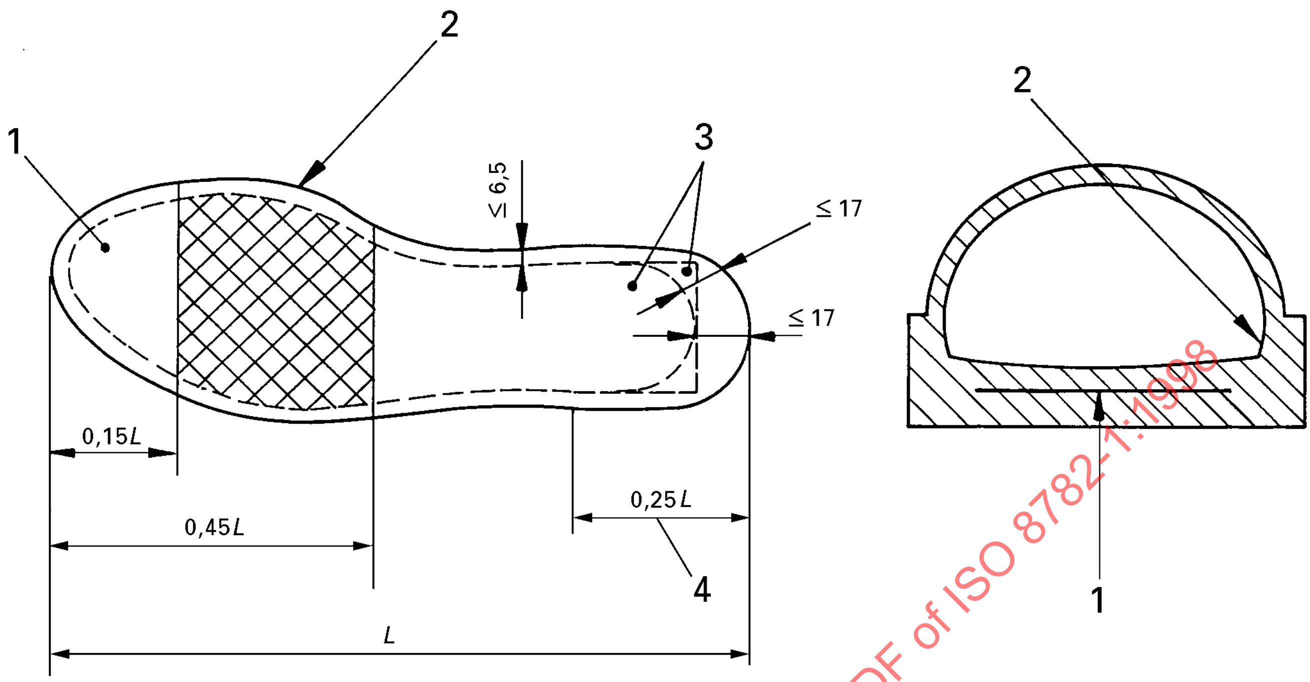
The penetration-resistant insert shall have no more than three holes of maximum diameter 3 mm to attach it to the bottom of the footwear. The holes shall not lie in the shaded area shown in figure 4.

4.3.3.2.3 Corrosion resistance of metal penetration-resistant inserts

When all-rubber footwear is tested and assessed in accordance with the method given in 5.5.1 the metal penetration-resistant insert shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 mm^2 in area.

In all other types of footwear, when metal penetration-resistant inserts are to be used, they shall be tested in accordance with the method given in 5.5.3. They shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 mm^2 in area.

Dimensions in millimetres



Key

1 Insert

2 Line left by the feather edge of the last

3 Alternative shapes of insert

4 Heel region

NOTE L is the length of the inside of the bottom of the footwear

Figure 4 — Position of penetration-resistant insert

4.3.4 Electrical resistance

4.3.4.1 Conductive footwear

When measured in accordance with the method given in 5.7 after conditioning in a dry atmosphere [5.7.2.3 a)], the electrical resistance shall be no greater than 100 kΩ.

4.3.4.2 Antistatic footwear

When measured in accordance with the method described in 5.7 and after conditioning in a dry and wet atmosphere [5.7.2.3 a) and b)], the electrical resistance shall be no less than 100 kΩ and shall be no greater than 1 000 MΩ.

4.3.5 Resistance to harsh environments

4.3.5.1 Heat-insulation of sole complex

When footwear is tested in accordance with the method given in 5.8, the temperature increase on the upper surface of the insole shall be no greater than 22 °C.

The insulation shall be incorporated in the footwear in such a manner that it cannot be removed without damaging the bottom of the footwear.

4.3.5.2 Cold insulation of sole complex

When footwear is tested in accordance with the method given in 5.9, the temperature decrease on the upper surface of the insole shall be no more than 10 °C.

The insulation shall be incorporated in the footwear in such a manner that it cannot be removed without damaging the bottom of the footwear.

4.3.6 Energy absorption of seat region

When footwear is tested in accordance with the method given in 5.10, the energy absorption of the seat region shall be no less than 20 J.

4.3.7 Leakproof footwear

When tested in accordance with the method given in 5.11, there shall be no leakage of air.

4.4 Upper

NOTE 1 The requirements specified for uppers do not apply to the extension of the upper indicated for design E (see figure 3).

NOTE 2 The textile layer in all-rubber and all-polymeric footwear is a part of the upper and should not be removed before testing, except where otherwise indicated in the relevant test method.

4.4.1 Thickness

When determined in accordance with the appropriate method, the thickness of the upper at any point shall be no less than the value given in table 5.

NOTE The thickness of the upper should include the textile layer.

Table 5 — Minimum thickness of upper

Type of material	Test method	Minimum thickness mm
Rubber	ISO 4648 1)	1,50
Polymeric	ISO 4648 1)	1,00
1) Using a thickness gauge with a flat-presser foot of 10 mm diameter and a load of 1 N.		

4.4.2 Tear strength

When determined in accordance with the appropriate method, the tear strength of the upper shall be no less than the value given in table 6, with the exception of non-leather uppers required to have particular resistance to animal fats, when the minimum tear strength shall be 30 N.

Table 6 — Minimum tear strength of upper

Type of material	Test method	Minimum force N
Leather	ISO 3377	120
Coated fabric and textile	Method B 1) of ISO 4674-1:—	60
1) Using a rectangular test piece 50 mm × 25 mm with a cut 20 mm long placed centrally and parallel with the longer sides to form a trouser tear test piece. Carry out the test at a constant rate of traverse of 100 mm/min. For knitted and non-woven fabrics, use the largest possible test piece obtainable from the footwear.		

4.4.3 Tensile properties

When determined in accordance with the appropriate method, the tensile properties shall be as given in table 7.

Table 7 — Tensile properties

Type of material	Test method	Tensile property	Value
Leather split	ISO 3376 1)	Tensile strength	15 N/mm^2 min.
Rubber	Annex C of ISO 2023:1994	Breaking force	180 N min.
Polymeric 2)	ISO 4643	Modulus at 100 % elongation	1,3 N/mm^2 to 4,6 N/mm^2
		Elongation at break	250 % min.

1) Using the test piece, length l = 90 mm and the width b_1 = 25 mm.

2) Remove the textile layer before testing.

4.4.4 Flexing resistance

When tested in accordance with the appropriate method, the upper shall withstand no less than the number of continuous flexes given in table 8 without cracking.

Table 8 — Minimum number of flexes

Type of material	Test method	Minimum number of flexes
Rubber	Annex E of ISO 2023:1994	125 000
Polymeric	Annex B 1) of ISO 4643:1992	150 000

1) Test carried out at – 5 °C.

4.4.5 Water penetration and water absorption

When tested in accordance with the method given in 5.12, the water absorption shall be no higher than 30 % after 60 min from the start of the test. Water penetration shall not occur during this period, nor exceed 2 g after a further 30 min.

4.4.6 Water vapour permeability and water vapour coefficient

When tested in accordance with the methods described in 5.13, the water vapour permeability shall be no less than 0,8 mg/(cm^2·h), and the water vapour coefficient shall be no less than 20 mg/cm^2.

4.4.7 pH value

When leather uppers are tested in accordance with the method given in ISO 4045, the pH value shall be no less than 3,5. If the pH is below 4, the difference figure shall be less than 0,7.

4.4.8 Hydrolysis

When polyurethane uppers are tested in accordance with the method given in annex B of ISO 5423:1992 after being prepared and conditioned as described in annex E of that International Standard, no cracking shall occur before 150 000 flex cycles. Conditioning at ambient temperature shall be carried out at (20 ± 2) °C.

4.5 Lining

4.5.1 General

Where an upper is split at the fore-part to house the toecap or if an external piece of material is stitched to the upper to form a pocket to house the toecap, the material under the toecap acts as a lining and shall be tested as such.

NOTE The textile layer in all-rubber and all-polymeric footwear is a part of the upper and should not be tested.

4.5.2 Tear strength

When determined in accordance with the appropriate method, the tear strength of the lining shall be no less than the value given in table 9.

Table 9 — Minimum tear strength of lining

Type of material	Test method	Minimum force N
Leather	ISO 3377	30
Coated fabric and textile	Method B 1) of ISO 4674-1:—	15

1) See table 6 for test conditions.

4.5.3 Abrasion resistance

When tested in accordance with the method given in 5.14, the wearing surface of textile linings shall not develop any holes before the following number of cycles has been performed:

— dry 25 600 cycles;

— wet 12 800 cycles.

4.5.4 Water vapour permeability and water vapour coefficient

When tested in accordance with the methods described in 5.13, the water vapour permeability shall be no less than 2,0 mg/(cm^2·h) and the water vapour coefficient shall be no less than 30 mg/cm^2.

4.5.5 pH value

When leather linings are tested in accordance with the method given in ISO 4045, the pH value shall be no less than 3,5. If the pH is below 4, the difference figure shall be less than 0,7.

4.6 Tongue

NOTE The tongue need only be tested if the material from which it is made or its thickness differs from that of the upper material.

4.6.1 Tear strength

When determined in accordance with the appropriate method, the tear strength of the tongue shall be no less than the value given in table 10.

Table 10 — Minimum tear strength of tongue

Type of material	Test method	Minimum force N
Leather	ISO 3377	36
Coated fabric and textile	Method B [1] of ISO 4674-1:—	18

1) See table 6 for test conditions.

4.6.2 pH value

When leather tongues are tested in accordance with the method given in ISO 4045, the pH value shall be no less than 3,5. If the pH is below 4, the difference figure shall be less than 0,7.

4.7 Insole

4.7.1 Thickness

When determined by the following method, the thickness of the insole shall be no less than 2,0 mm.

Cut through the sole in the region of the cleat and measure the thickness using a graduated eyepiece with 0,1 mm scale graduations.

4.7.2 pH value

When leather insoles are tested in accordance with the method given in ISO 4045, the pH value shall be no less than 3,5. If the pH is below 4, the difference figure shall be less than 0,7.

4.7.3 Water absorption and water desorption

When tested in accordance with the method given in 5.15, the water absorption shall be no less than 35 % (*m/m*) and the water desorption shall be no less than 40 % (*m/m*) of the water absorbed.

4.7.4 Abrasion resistance

When non-leather insoles are tested in accordance with the method given in 5.16, there shall be no surface tearing before 400 cycles.

4.8 Outsole

4.8.1 Cleated outsoles

4.8.1.1 Cleated area

With the exception of the region under the flange of the toecap, at least the shaded area as shown in figure 5 shall have cleats which are open to the side.

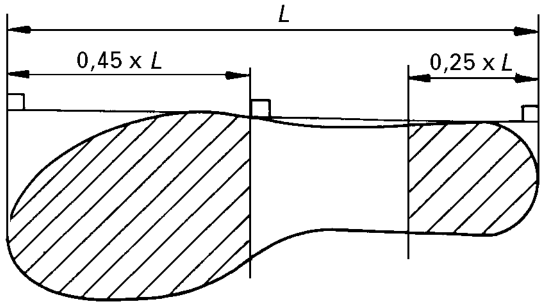


Figure 5 — Cleated area

4.8.1.2 Thickness

For direct-injected, vulcanized or cemented outsoles, the thickness d_1, as shown in figure 6 a) and 6 b), shall be no less than 4 mm.

For multilayered outsoles, the thickness d_1, as shown in figure 7, shall be no less than 4 mm.

For all-rubber and all-polymeric footwear, the thickness d_1, as shown in figure 8, shall be no less than 3 mm and the thickness d_3 shall be no less than 6 mm.

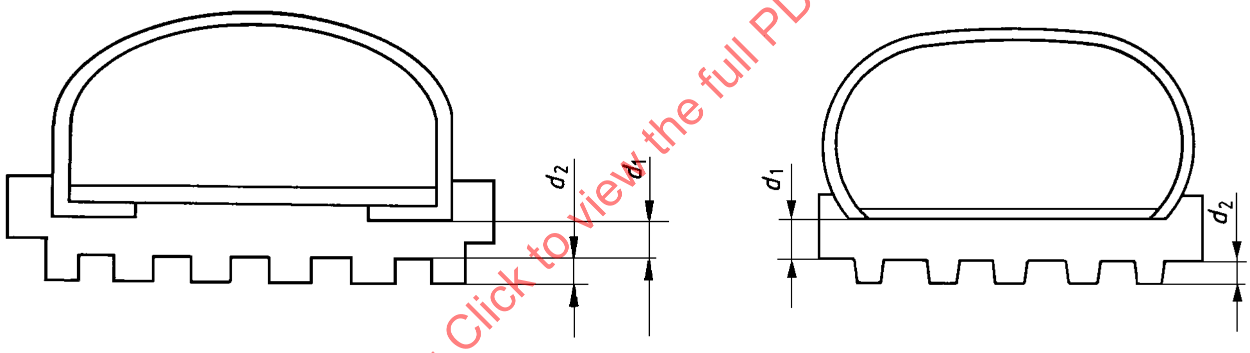
4.8.1.3 Cleat height

For direct-injected, vulcanized or cemented outsoles, the cleat height d_2, as shown in figure 6(a) and 6(b), shall be no less than 2,5 mm.

For multilayered outsoles, the cleat height d_2, as shown in figure 7, shall be no less than 2,5 mm.

For all-rubber and all-polymeric footwear, the cleat height d_2, as shown in figure 8, shall be no less than 4 mm.

NOTE Thickness or cleat height should be measured as indicated in figure 6 a), 6 b), 7 or 8, using a graduated eyepiece with 0,1 mm scale graduations after cutting through the sole in the region of the tread.



a) Conventional construction b) Strobel construction

Figure 6 — Direct-injected, vulcanized and cemented outsoles

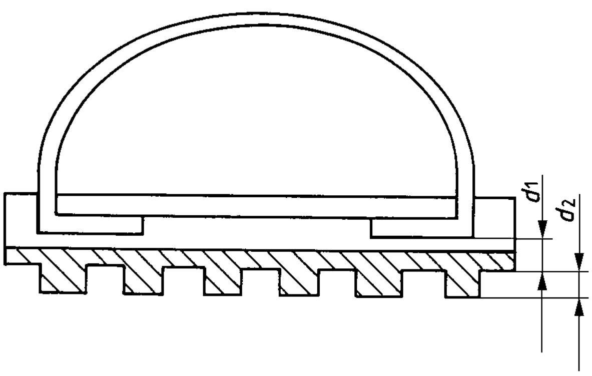


Figure 7 — Multilayered outsoles

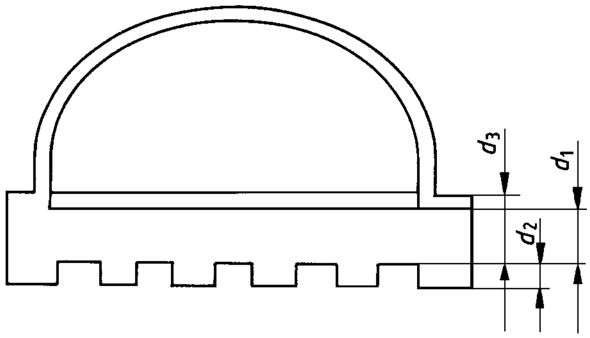


Figure 8 — All-rubber and all-polymeric footwear

4.8.2 Thickness of non-cleated outsoles

The total thickness of a non-cleated outsole at any point shall be no less than 6 mm.

4.8.3 Tear strength

When non-leather outsoles are tested in accordance with the method given in ISO 34-1:1994 using the trouser test piece (method A), the tear strength shall be no less than 8 kN/m, except for mono-density polyurethane outsoles where the tear strength shall be no less than 5 kN/m.

The test piece shall be taken transverse to the longitudinal axis in the waist region, if possible.

4.8.4 Abrasion resistance

When non-leather outsoles other than those from all-rubber or all-polymeric footwear are tested in accordance with method A given in ISO 4649:1985 (with a vertical force of 10 N over an abrasion distance of 40 m), the relative volume loss shall be no greater than 250 mm^3 for materials with a density of 0,9 g/ml or less and shall be no greater than 150 mm^3 for materials with a density higher than 0,9 g/ml. Test pieces may be taken from anywhere on the sole.

For outsoles from all-rubber or all-polymeric footwear, tested as described, the relative volume loss shall be no greater than 250 mm^3.

4.8.5 Flexing resistance

When non-leather outsoles, other than those from footwear with penetration-resistant inserts or rigid soles, are tested in accordance with the method given in 5.17, the cut growth shall be no greater than 4 mm before 30 000 flex cycles.

4.8.6 Hydrolysis

When polyurethane outsoles are tested in accordance with the method given in annex C of ISO 5423:1992, and after being prepared and conditioned as described in annex E of that International Standard, the cut growth shall be no greater than 6 mm before 150 000 flex cycles. The thickness of the test piece shall be 3 mm and conditioning at ambient temperature shall be carried out at (20 ± 2) °C.

4.8.7 Interlayer bond strength

When tested in accordance with the method given in 5.1, the bond strength between the outer or cleated layer and the adjacent layer shall be no less than 4,0 N/mm, unless there is tearing of the sole, in which case the bond strength shall be no less than 3,0 N/mm.

4.8.8 Resistance to hot contact

When tested in accordance with the method given in 5.18 at a temperature of 300 °C, rubber and polymeric outsoles shall not melt and shall develop no cracks when bent around the mandrel. When tested in the same way, leather outsoles shall develop no cracks or charring which extend into the corium when bent around the mandrel.

4.8.9 Resistance to fuel oil

When tested in accordance with the method given in 5.19.1, the increase in volume shall be no greater than 12 %.

If, after testing in accordance with the method given in 5.19.1, the test piece shrinks by more than 0,5 % in volume or increases in hardness by more than 10 Shore A hardness units, a further test specimen shall be taken and tested in accordance with the method given in 5.19.2. The cut growth shall be no greater than 6 mm before 150 000 flexure cycles.

5 Test methods

5.1 Upper/outsole and sole interlayer bond strength

5.1.1 Principle

Measurement of 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.

5.1.2 Apparatus

5.1.2.1 Tensile machine, with a means of continuously recording load, and 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 pincer or flat jaws (depending on the type of construction of the test sample), 25 mm to 30 mm wide, capable of firmly gripping the test pieces.

5.1.3 Preparation of test pieces

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.

5.1.3.1 Sole/upper bond strength: construction type a (see figure 9)

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

Cut the test piece with sides at right angles to the edge of the sole, using a press knife or bandsaw to cut through the upper, 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 10.) Remove the insole.

5.1.3.2 Sole/upper bond strength: construction types b, c, d and e (see figure 9)

Take a test piece from either the inner or the 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 no 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 into the adhesive layer. (See figure 11.)

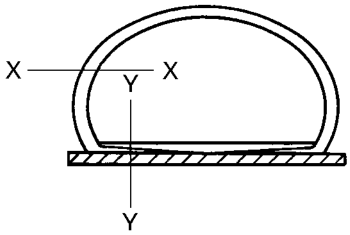
NOTE It is considered that a construction is type c or type d when the distance from the line X–X to the upper face of the insole is at least 8 mm.

5.1.3.3 Sole interlayer bond strength: construction types f and g (see figure 9)

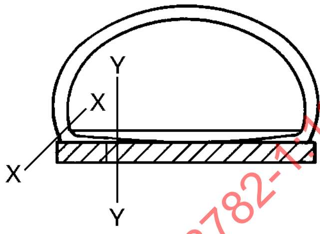
Take a test piece from either the inner or the outer joint region.

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.

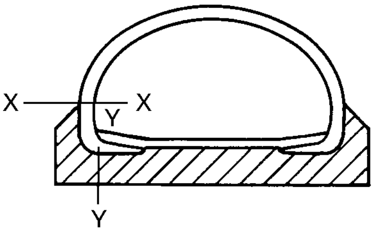
Separate the sole layers for a length of about 10 mm by inserting a hot knife into the adhesive layer. (See figure 11.)



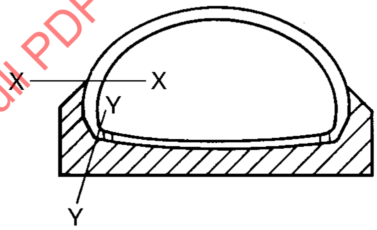
a) Type a: conventional lasting with cemented or moulded outsole having an extended edge



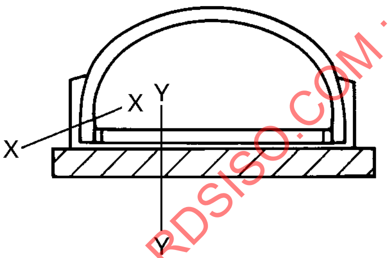
b) Type b: conventional lasting with close-trimmed outsole



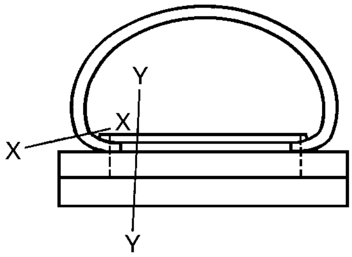
c) Type c: conventional lasting with direct-injected or vulcanized outsole or cemented-dished outsole



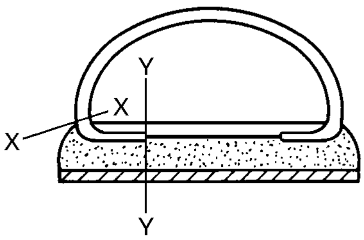
d) Type d: Strobel-stitched with cemented-dished, direct-injected or vulcanized outsole



e) Type e: conventional lasting or Strobel-stitched with rubber mudguard and cemented outsole



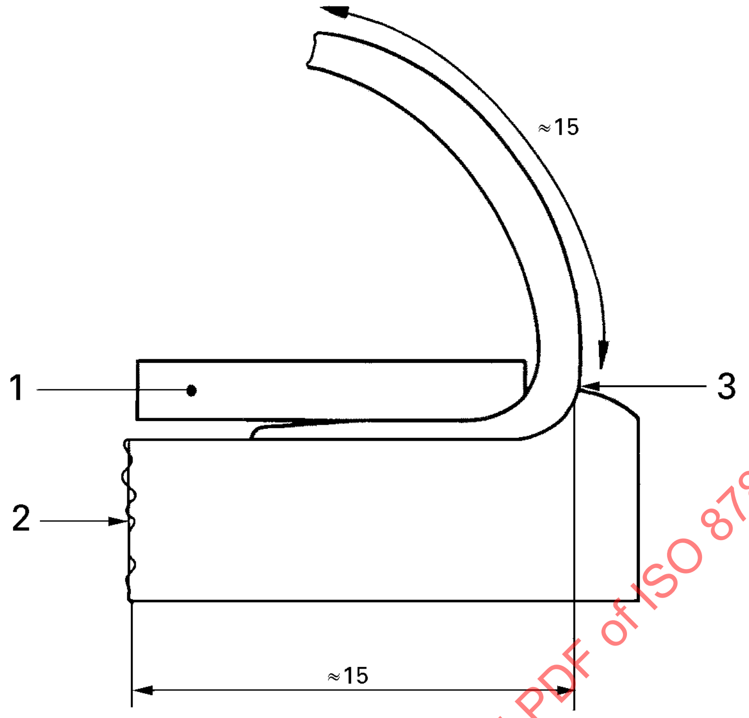
f) Type f: machine-sewn or welted where the outsole is bonded to the throughsole



g) Type g: multilayered sole with moulded-on sole, moulded unit or built unit

Figure 9 — Types of construction showing position for preparation of the test piece for bond strength test

Dimensions in millimetres



Key

1 Insole (removed)

2 Outsole

3 Feather line

Figure 10 — Cross-section of test piece

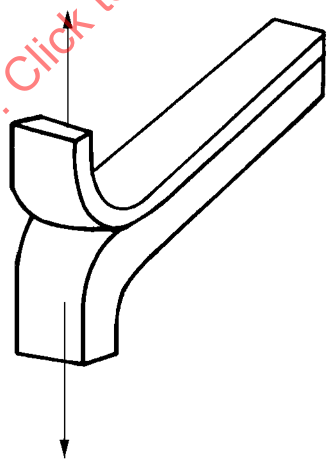


Figure 11 — Prepared test piece

5.1.4 Measurement of bond strength

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

a) For sole/upper bond strength: construction type a.

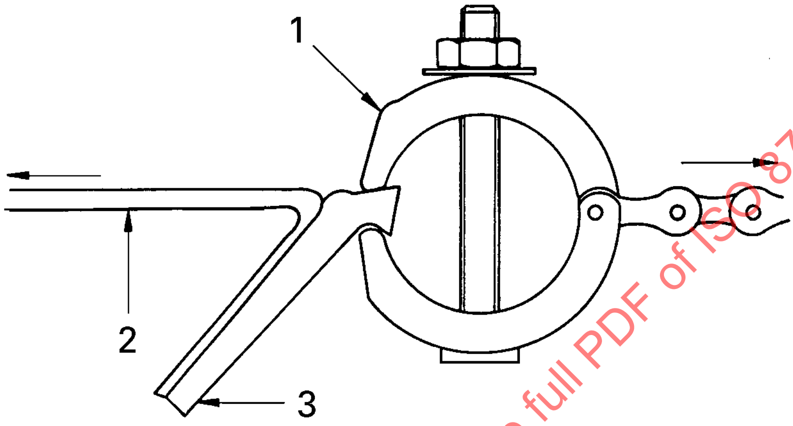
Clamp the test piece in the jaws of the tensile machine, using a pincer jaw to grip the short edge of the sole (see figure 12), and record the load/deformation graph at a jaw separation speed of (100 ± 20) mm/min.

b) 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 13) at a jaw separation speed of (100 ± 20) mm/min.

5.1.5 Calculation and expression of results

Estimate, from the load/deformation graph, the average peeling load in newtons and divide by the average width to give the bond strength in N/mm.



Key

1 Pincer jaw for sole edge

2 Upper

3 Sole

Figure 12 — Pincer jaw showing position of test piece

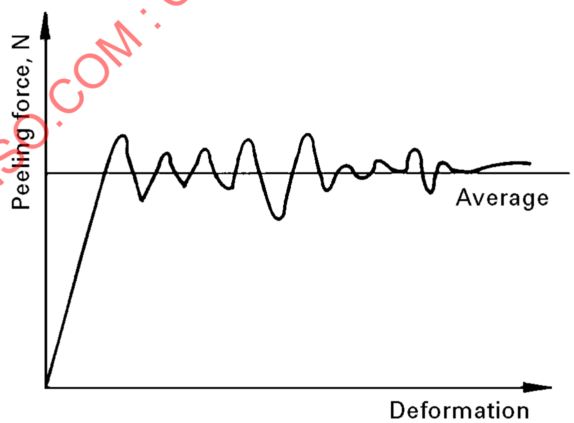


Figure 13 — Example of load/deformation graph

5.2 Internal toecap length

5.2.1 Preparation of test piece

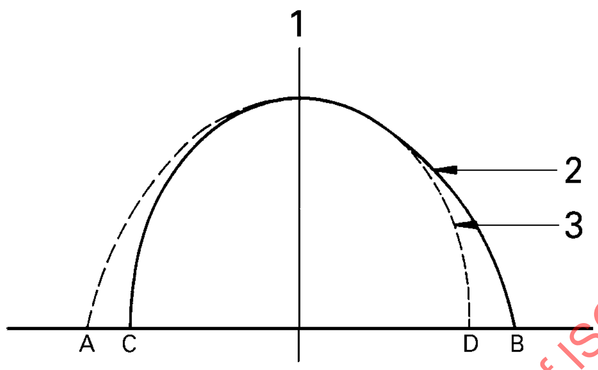
Carefully extract the toecaps from an untested pair of footwear. Remove all foreign matter adhering to them.

Preconditioning of the test piece is unnecessary.

5.2.2 Determination of the test axis

Position the left toecap with its rear edge in line with a baseline 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 the toe end of the toecaps coincide and the baselines coincide. (See figure 14.)

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



Key

1 Test axis

2 Right cap

3 Left cap

Figure 14 — Determination of test axis

5.2.3 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 15.) l is the maximum length which can be measured.

5.3 Impact resistance

5.3.1 Apparatus

5.3.1.1 Impact apparatus, incorporating a steel striker of mass (20 ± 0,2) kg adapted to fall freely on vertical guides from a predetermined height to give the required impact energy calculated as potential energy.

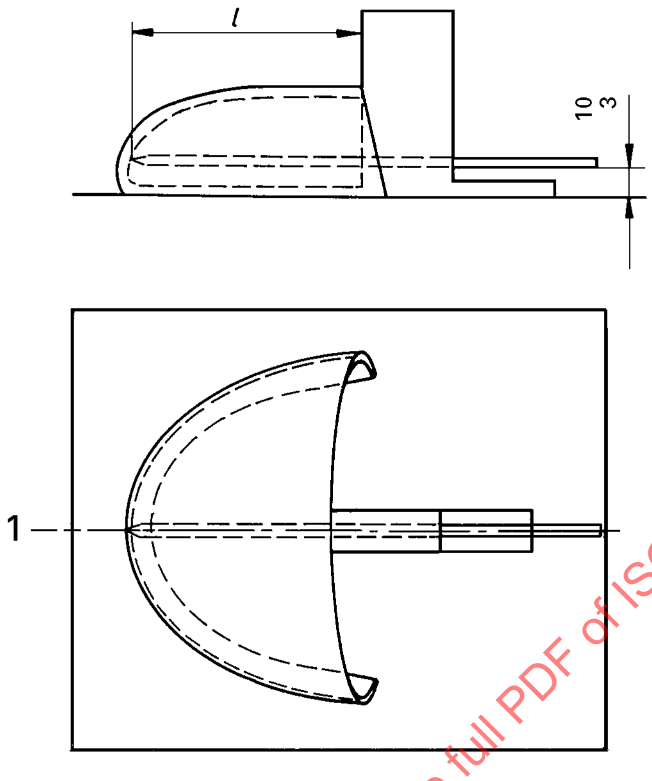
The striker (see figure 16) shall consist of a wedge at least 60 mm long, the faces of which subtend an angle of 90° ± 1°. The apex where the faces meet shall be rounded to a (3 ± 0,1) mm radius. During the test the apex shall be parallel within ± 17′ to the surface of the clamping device.

The base of the apparatus shall have a mass of at least 600 kg. A metal block of dimensions at least 400 mm × 400 mm × 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.

NOTE Provision should be made for a mechanism to catch the striker after the first impact so that the test specimen is struck only once.

Dimensions in millimetres



Key

1 Test axis

Figure 15 — Measurement of internal toecap length

Dimensions in millimetres

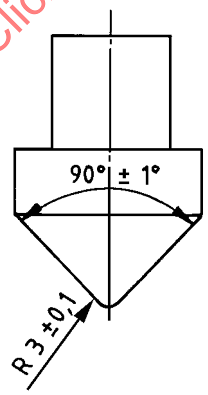
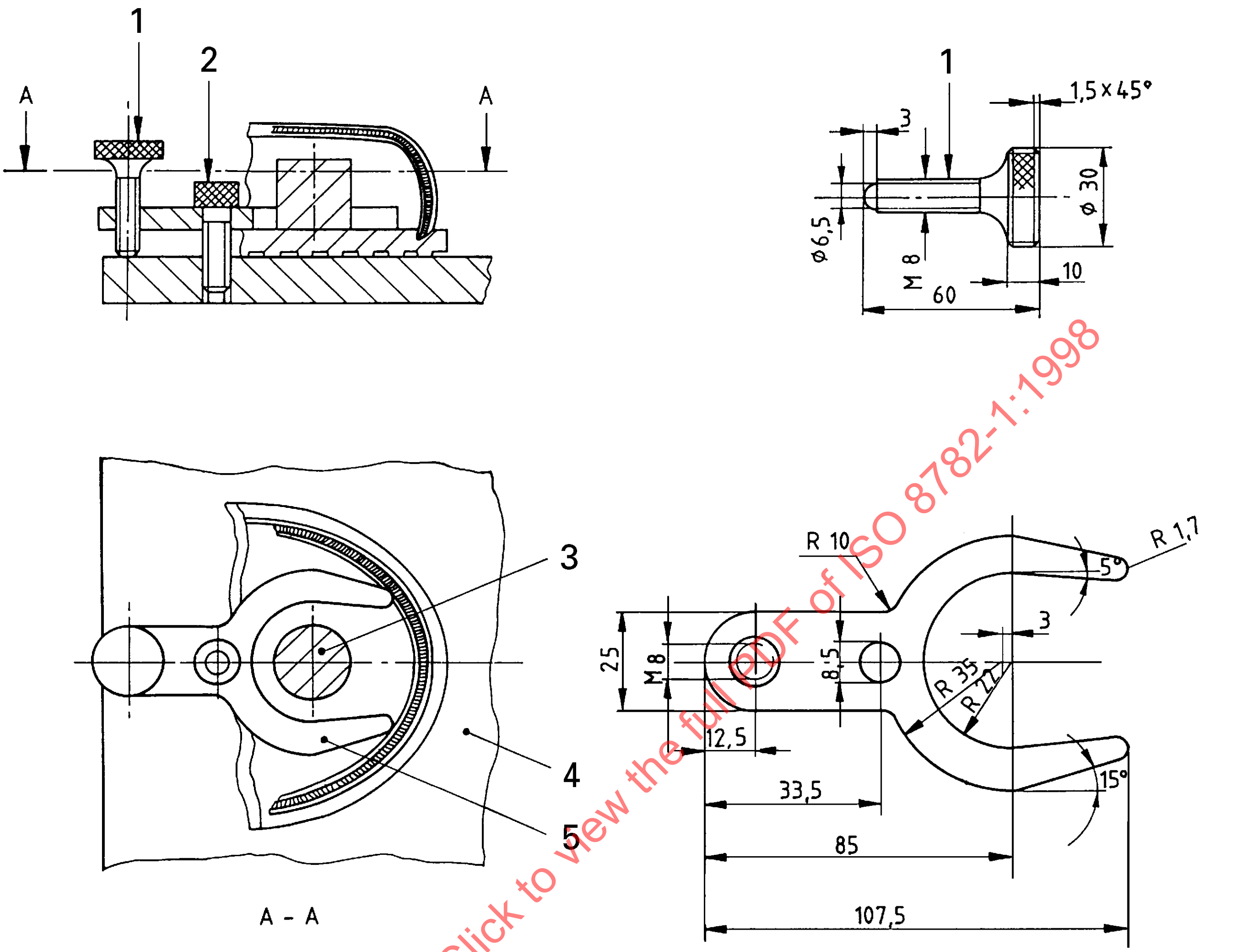


Figure 16 — Impact striker

5.3.1.2 Clamping device, consisting of a smooth steel plate at least 19 mm thick and 150 mm × 150 mm in area of minimum hardness 60 HRC with a screw clamp for clamping the insole of the toe-end of the footwear under test to the plate in a way which will not restrict any lateral expansion of the toecap during the impact test. (See figure 17.)

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.

Dimensions in millimetres



Key

1 Clamping screw
2 Adjusting screw
3 Modelling clay cylinder
4 Baseplate
5 Stabilizing fork

NOTE 1 The thickness of the clamp is 10 mm.

NOTE 2 The dimensions given in this figure are illustrative only. Smaller stabilizing forks of the same proportions may be used for smaller toecaps.

Figure 17 — Footwear clamp

5.3.1.3 Cylinders, of modelling clay, of diameter (25 ± 2) mm and of height (20 ± 2) mm for footwear up to and including size 40 (Paris points), and (25 ± 2) mm for footwear above size 40.

The flat surfaces of the cylinders shall be covered with aluminium foil to prevent them sticking to either the test specimen or the test equipment.

5.3.1.4 Dial gauge, with a hemispherical foot of (3,0 ± 0,2) mm radius and a hemispherical anvil of (15 ± 2) mm radius, exerting a force of no greater than 250 mN.

5.3.2 General procedure

5.3.2.1 Determination of the test axis (see figure 18)

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.

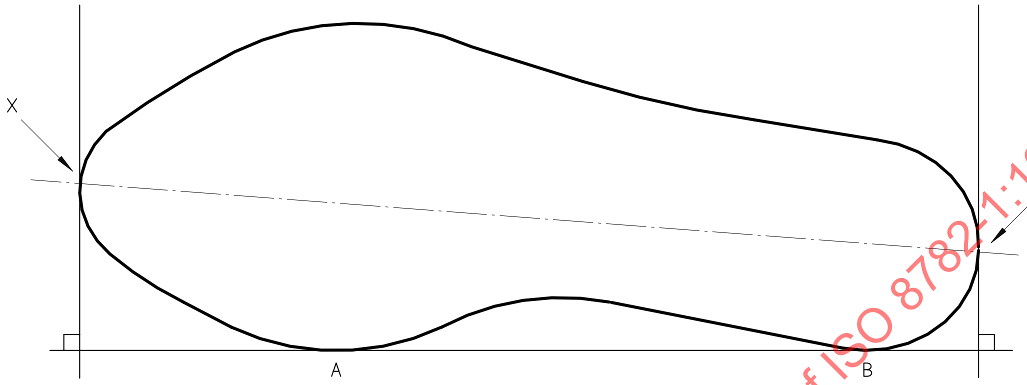


Figure 18 — Test axis for footwear

5.3.2.2 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. Do not remove the upper and lining. If the footwear has been supplied with a removable insock, carry out the test with it in place.

Preconditioning of the test piece is unnecessary.

5.3.2.3 Testing procedure

Position a cylinder (5.3.1.3) on one of its ends inside the test piece, with the centre of the cylinder on the test axis and the back edge of the cylinder level with the rear edge of the cap. (See figure 19.)

Position the test piece in the impact apparatus (5.3.1.1) so that when the striker hits it, the striker will project over the back and front of the toecap. Adjust the clamping device (5.3.1.2).

Allow the striker to drop onto 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.

Measure, to the nearest 0,5 mm, the lowest height to which the cylinder has been compressed within 10 mm of the impression of the back edge of the toecap using the dial gauge (5.3.1.4). This value is the clearance at the moment of impact.

5.4 Compression resistance

5.4.1 Apparatus

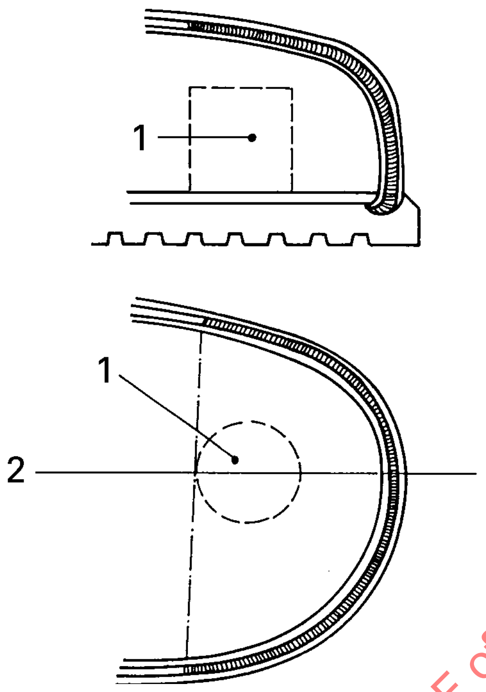
5.4.1.1 Compression testing machine, capable of subjecting the test piece to a force of at least 20 kN (to a tolerance of ± 1 %) between platens which move at a speed of (5 ± 2) mm/min.

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.

5.4.1.2 Cylinders, as described in 5.3.1.3.

5.4.1.3 Dial gauge, as described in 5.3.1.4.

5.4.1.4 Clamping device, as described in 5.3.1.2.



Key

1 Modelling clay cylinder

2 Test axis

Figure 19 — Position of cylinder for impact or compression test of footwear

5.4.2 General procedure

5.4.2.1 Determination of the test axis

Determine the test axis as described in 5.3.2.1.

5.4.2.2 Preparation of test piece

Prepare the test piece as described in 5.3.2.2.

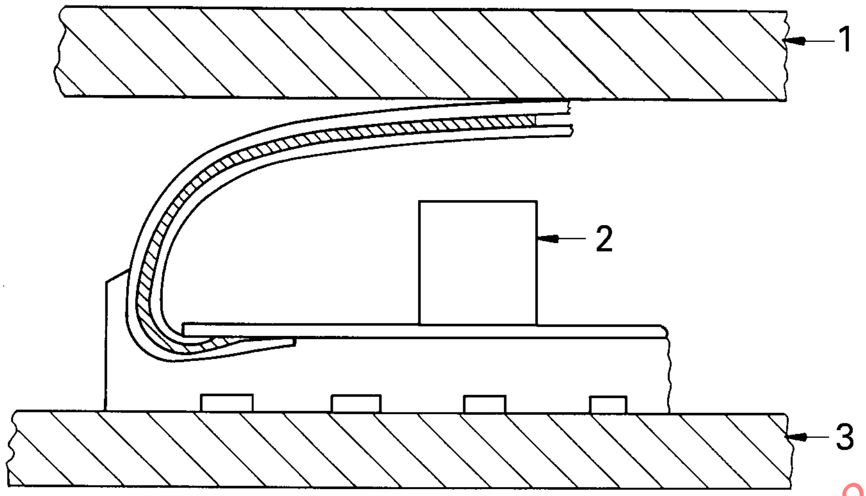
Preconditioning of the test piece is unnecessary.

5.4.2.3 Testing procedure

Position a cylinder (5.4.1.2) on one of its ends inside the test piece with the centre of the cylinder on the test axis and the back edge of the cylinder level with the rear edge of the cap. (See figure 19.) Place the test piece in the clamping device (5.4.1.4) and adjust.

Position the clamping device and test piece between the platens of the compression machine (5.4.1.1) and compress the test specimen to a load of either (15 ± 0,1) kN for safety footwear, or (10 ± 0,1) kN for protective footwear. (See figure 20.)

Reduce the load, remove the cylinder and measure, to the nearest 0,5 mm, the lowest height to which the cylinder has been compressed within 10 mm of the impression of the back edge of the toecap using the dial gauge (5.4.1.3). This value is the compression clearance.



Key

1 Upper platen

2 Modelling clay cylinder

3 Lower platen

Figure 20 — Apparatus for compression test

5.5 Corrosion resistance

5.5.1 Determination of corrosion resistance of metal toecaps or metal penetration-resistant inserts in all-rubber footwear

5.5.1.1 Preparation of test piece

Use the complete item of footwear as the test piece.

Preconditioning of the test piece is unnecessary.

5.5.1.2 Test solution

Use a 1 % (*m/m*) aqueous solution of sodium chloride.

5.5.1.3 Procedure

Pour sufficient test solution into the 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 minimize 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 mm^2 and record also the number of such areas.

5.5.2 Determination of corrosion resistance of metal toecaps in footwear other than all-rubber footwear

Remove the toecap from the footwear or take a new, identical toecap and test using a method such as that given in B.2.1.2.

5.5.3 Determination of corrosion resistance of metal penetration-resistant inserts in footwear other than all-rubber footwear

Remove the insert from the footwear or take a new, identical insert and test using a method such as that given in C.2.3.2.

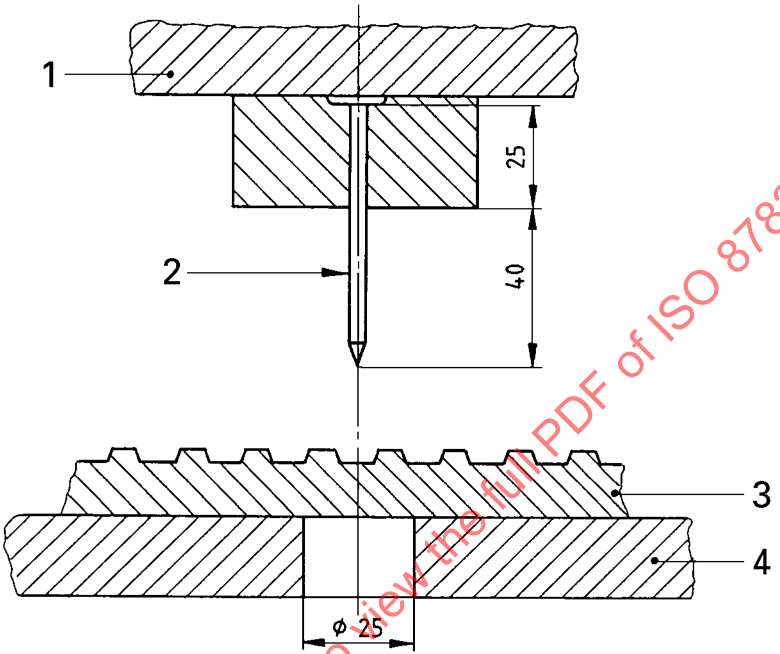
5.6 Penetration resistance

5.6.1 Apparatus

5.6.1.1 Test equipment, capable of measuring compressive force up to at least 2 000 N, fitted with a pressure plate in which a test nail (5.6.1.2) 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 coincide (see figure 21).

Dimensions in millimetres



Key

1 Pressure plate

2 Nail

3 Sole unit of the test piece

4 Base plate

Figure 21 — Apparatus for penetration-resistance test

5.6.1.2 Test nail, of diameter (4,50 ± 0,05) mm with a truncated end of the form and dimensions shown in figure 22.

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 departures from the dimensions shown in figure 22 are observed, the test nail shall be replaced.

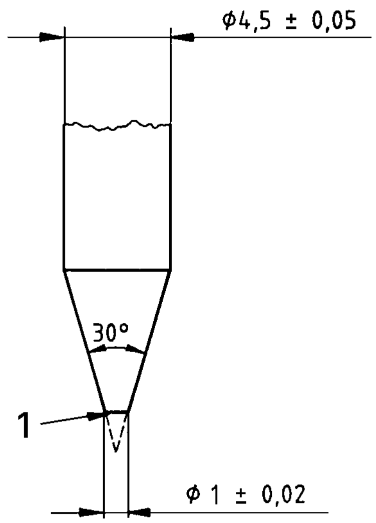
5.6.2 General procedure

5.6.2.1 Preparation of test piece

Remove the upper from the sole unit and use the sole unit as the test piece.

Preconditioning of the test piece is unnecessary.

Dimensions in millimetres



Key

1 Truncated end

Figure 22 — Nail for penetration-resistance test

5.6.2.2 Testing procedure

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

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 at 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.

If moisture can affect the results obtained, carry out the tests after the sole unit has been immersed in deionized water at (20 ± 2) °C for (16 ± 1) h.

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

5.7 Electrical resistance

5.7.1 Apparatus

5.7.1.1 Testing instrument, capable of supplying a voltage of (100 ± 2) V, with a measuring accuracy within 5 %, and including a device to ensure that it does not dissipate more than 3 W in the product.

5.7.1.2 Internal electrode, comprising steel balls of 5 mm diameter and of total mass 4 kg.

NOTE Ball bearings complying with the requirements of ISO 3290:1975 are suitable.

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

Steps shall be taken to prevent oxidation of the steel balls and the copper plate since oxidation could affect their conductivity.

5.7.1.4 Conductive lacquer.

5.7.1.5 Device for measuring the electrical resistance of the lacquer, consisting of three conductive metal probes, each of (3 ± 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 of a line joining the other two and is electrically insulated from them.

5.7.2 Preparation and conditioning of test piece

5.7.2.1 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 (20 ± 2) °C. The surface shall not be buffed or abraded, or cleaned with organic materials which attack or swell the sole.

For test pieces which are to be tested following conditioning under wet conditions, apply a conductive lacquer (5.7.1.4) to the sole over an area 200 mm by 50 mm, including the heel and fore part. Allow to dry and then check that the resistance of the lacquer is less than 10^3 Ω by testing in accordance with 5.7.2.2.

5.7.2.2 Measurement of the electrical resistance of the applied lacquer

Fill the footwear with clean steel balls and place on the metal probes of the device (5.7.1.5) 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 (5.7.1.1), measure the resistance between the front probes and the third probe.

5.7.2.3 Conditioning

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

a) dry conditions, (20 ± 2) °C and (30 ± 5) % RH for 7 d;

b) wet conditions, (20 ± 2) °C and (85 ± 5) % RH for 7 d.

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

5.7.3 Procedure

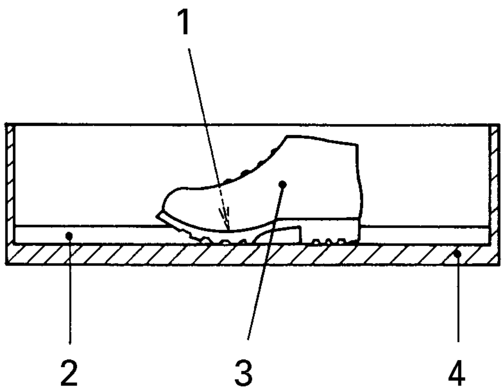
Fill the test piece with clean steel balls to a total mass of 4 kg, using a piece of insulating material to extend the height of the upper if necessary. Place the filled specimen on the copper plate, apply a test voltage of (100 ± 2) V d.c. between the copper plate and the steel balls for 1 min and calculate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

If the voltage falls below the value specified, because of the limit of 3 W maximum dissipated energy, take measurements at that lower voltage and record it.

5.8 Insulation against heat

5.8.1 Apparatus

5.8.1.1 Sandbath, fitted with a **hotplate** which can be regulated to (150 ± 5) °C (see figure 23).



Key

1 Measuring point for temperature
2 Sandbath
3 Footwear filled with steel balls
4 Hotplate

Figure 23 — Heat-insulation test apparatus

5.8.1.2 Heat-transfer medium, comprising steel balls of 5 mm diameter and of total mass 4 kg.

NOTE Ball bearings complying with the requirements of ISO 3290 are suitable.

5.8.1.3 Copper/copper-nickel thermocouple, soldered to a copper disc (2 ± 0,1) mm thick and (15 ± 1) mm in diameter.

5.8.1.4 Temperature-measuring device, with a compensator, suitable for use with 5.8.1.3.

5.8.2 General procedure

5.8.2.1 Preparation of test piece

Use the complete item of footwear as the test piece. If the footwear has been supplied with a removable insock, carry out the test with it in place. Condition it for 7 d at (20 ± 2) °C and (65 ± 5) % RH. Fix the thermocouple to the insole in the centre of the joint area and place the steel balls inside the footwear. If the upper is not high enough to accommodate the balls, increase its height with a collar.

5.8.2.2 Testing procedure

Condition the prepared test piece until the temperature of the insole is constant at (20 ± 2) °C and carry out the test under ambient conditions of (20 ± 2) °C.

Set the temperature of the hotplate (5.8.1.1) to 150 °C and place the test piece on it with sand up to the upper edge of the outsole. Use the temperature-measuring device connected to the thermocouple to measure the temperature on the insole as a function of time, recording the temperature increase graphically.

Calculate, to the nearest 0,5 °C, the increase in temperature after 30 min from the time the test piece was placed on the sand bath.

5.9 Insulation against cold

5.9.1 Apparatus

5.9.1.1 Insulated cold box, the internal air temperature of which can be regulated to (– 20 ± 2) °C (see figure 24).

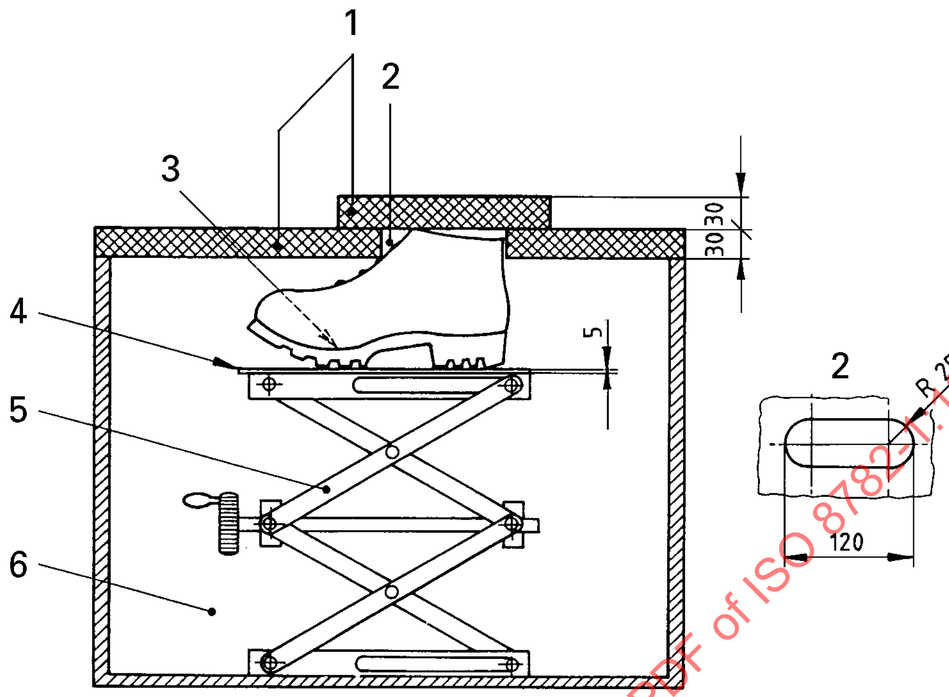
5.9.1.2 Heat-transfer medium, as described in 5.8.1.2.

5.9.1.3 Copper/copper-nickel thermocouple, as described in 5.8.1.3.

5.9.1.4 Temperature-measuring device, as described in 5.8.1.4.

5.9.1.5 Copper/zinc alloy plate, of 5 mm thickness, positioned as illustrated in figure 24.

Dimensions in millimetres



Key

1 Thermal insulating cover
2 Elongated hole
3 Measuring point for temperature
4 Copper/zinc plate
5 Laboratory jack
6 Cold box

Figure 24 — Cold insulation test apparatus

5.9.2 General procedure

5.9.2.1 Preparation of test piece

Use the complete item of footwear as the test piece. If the footwear has been supplied with a removable insock, carry out the test with it in place.

Prepare the test piece as described in 5.8.2.1.

5.9.2.2 Testing procedure

Condition the prepared test piece until the temperature of the outsole is constant at (20 ± 2) °C and carry out the test under ambient conditions of (20 ± 2) °C.

Adjust the temperature of the cold box to (– 20 ± 2) °C. Place the test piece on the laboratory jack inside the cold box, adjusting the height so that the top line of the footwear is level with the opening and seal the opening with a heat insulating cover.

Use the temperature-measuring device connected to the thermocouple to measure the temperature on the insole as a function of time, recording the temperature decrease graphically.

Calculate, to the nearest 0,5 °C, the decrease in temperature after 30 min from the time the test piece was placed in the cold box.

5.10 Energy absorption of seat region

5.10.1 Apparatus

5.10.1.1 Test equipment, capable of measuring compressive forces up to 6 000 N, with a means of recording load/deformation characteristics.

5.10.1.2 Test punch, being the back part of a standardized last made in polyethylene[3].

The last is sectioned on a plane vertical to the feather edge and at 90° to the axis of the back part. (See figure 25.) The length of the punch in relation to footwear size is given in table 11.

Table 11 — Length of test punch

Size of footwear			Length L mm
Mondopoint	**Paris points**	**English**	
225 and below	36 and below	3 and below	65,0
230 to 240	37 and 38	4 and 5	67,5
245 to 250	39 and 40	6	70.0
255 to 265	41 and 42	7 and 8	72,5
270 to 280	43 and 44	9 and 10	75,0
285 and above	45 and above	11 and above	77,5

5.10.2 Procedure

Place the footwear with the heel on a steel base and press the test punch against the sole unit from the inside at the centre of the heel area at a test rate of (10 ± 3) mm/min until a force of 5 000 N is obtained.

Plot a load/compression curve for each test and determine the energy absorption, E, in joules, rounded to the nearest 1 J, from the equation:

$$E = \int_{50\,\text{N}}^{5\,000\,\text{N}} F\,\text{d}s$$

where

F is the applied force, in newtons;

s is the distance, in millimetres.

3) Information on the availability of suitable punches may be obtained from the Secretariat of ISO/TC 94/SC 3 at the British Standards Institution, 389 Chiswick High Road, London W4 AL, UK.

Dimensions in millimetres

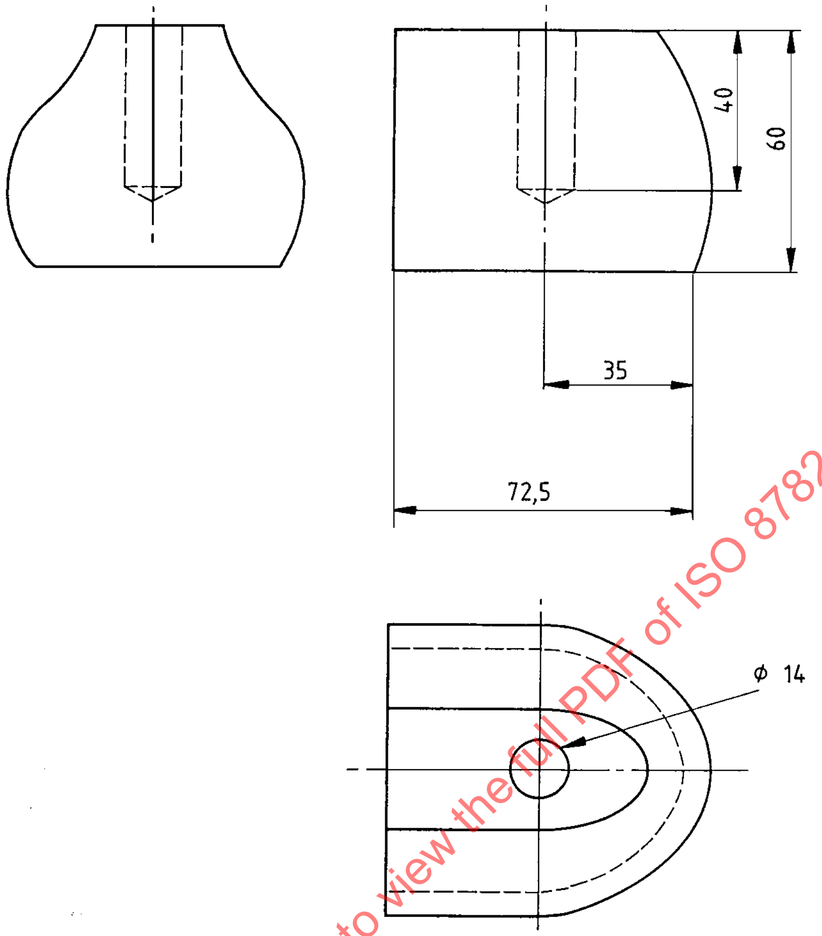


Figure 25 — Test punch for energy absorption test

5.11 Leakproof test

5.11.1 Apparatus

5.11.1.1 Water bath.

5.11.1.2 Supply of compressed air.

5.11.2 Preparation of test piece

Take the entire item of footwear as the test piece.

5.11.3 Procedure

Carry out the test at a temperature of (20 ± 2) °C.

Seal the top edge of the test piece, for example with a rubber collar through which compressed air may be fed via appropriate connections. Immerse the test specimen in a water bath up to the edge and apply a constant internal pressure of (50 ± 10) 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.

5.12 Water penetration and water absorption

5.12.1 Principle

The material is partially immersed in water and flexed on a machine in a manner simulating conditions of wear. The following measurements are made:

a) the percentage gain in mass of the test piece due to water absorption 60 min from the start of the test;

b) the time taken from the start of the test for water just to penetrate through the test piece;

c) the mass of water which has passed through the test piece after a further 30 min.

5.12.2 Apparatus

5.12.2.1 Two cylinders, 30 mm diameter, made of inert rigid material, mounted with their axes horizontal and co-axial.

One cylinder is fixed and the other is movable along the direction of its axis.

5.12.2.2 Electric motor, which drives the movable cylinder backwards and forwards along its axis with crank motion at 50 cycles/min and with amplitude which can be varied from 1,0 mm to 3,0 mm about its mean position.

When the movable cylinder is at its greatest distance from the fixed one, the adjacent flat faces of the two cylinders are 40 mm apart.

5.12.2.3 Ring-shaped clamps, to clamp the longer edges of the test piece round the adjacent ends of the cylinders so that it forms a trough whose ends are closed by the cylinders.

5.12.2.4 Tank, containing distilled water, in which the trough-shaped test piece can be partly immersed.

5.12.2.5 Mass of fine spiral brass lathe turnings, forming an easily compressible conductive cushion which occupies two-thirds of the space in the trough formed by the test piece when positioned in the apparatus.

5.12.2.6 Metallic plate electrode, carried by a spring, to make contact with the top of the brass turnings and which, when resting on the turnings or the roll of absorbent cloth applies a load of 1 N to 2 N.

5.12.2.7 Suitable electric circuit, which gives a signal when the electrical resistance between the plate electrode and the water in the tank decreases below a fixed value, thus indicating that penetration of water through the test piece has occurred.

5.12.2.8 Absorbent cloth, used to absorb water transmitted to the interior of the trough formed by the test piece.

A suitable cloth consists of a rectangle of towelling-type textile of approximately 120 mm × 40 mm with a mass of approximately 300 g/m^2.

NOTE The absorbency of the material may not be optimal when new. It is therefore advisable to wash the cloths before their first use.

5.12.2.9 Stopwatch.

5.12.2.10 Balance, capable of weighing to 0,001 g.

5.12.3 Preparation of test piece

Cut from the upper a rectangle of 75 mm × 60 mm. Buff the wear surface lightly by rubbing with a grade 180 emery paper and condition for 48 h at (20 ± 2) °C and (65 ± 5) % RH.

5.12.4 Procedure

Adjust the apparatus to give an amplitude of 3 mm (7,5 % compression of the test piece).

Weigh the test piece to the nearest 0,001 g and record its mass, m_1.

Fix the test piece in the apparatus, with the wear surface outside, as follows.

With the two cylinders (5.12.2.1) at their maximum distance apart, wrap the test piece round their adjacent ends so that it forms a trough whose upper edges, formed by the shorter sides of the test piece, are horizontal and at the same level. Keep the test piece between the cylinders under slight tension to remove folds and with approximately the same length (about 10 mm) overlapping on each cylinder, clamp it using the ring clamps (5.12.2.3). The inner edges of the two ring clamps shall lie as nearly as possible in the planes of the adjacent ends of the cylinders, so that the length of the trough is the same as the free length of the test piece between the clamps.

Place the brass turnings (5.12.2.5) into the trough, lower the plate electrode (5.12.2.6) to make contact with them and connect the electric circuit (5.12.2.7).

Raise the level of water in the tank until the water lies 10 mm below the top of the cylinders.

Start the motor (5.12.2.2) and measure the time interval until water first penetrates through the test piece, as indicated by a signal from the electric circuit.

After 60 min from the start of the test, stop the motor and remove the plate electrode and brass turnings. Remove the test piece, blotting lightly to remove adhering moisture, and reweigh, recording its mass m_2.

Replace the test piece. Weigh the absorbent cloth (5.12.2.8), recording its mass M_1, roll it up to form a cylinder of 40 mm length and immediately place it in the trough formed by the test piece. Replace the plate electrode (5.12.2.6) so that it rests on the cloth and restart the motor.

After a further 30 min, stop the motor, remove the cloth, if necessary mopping up any surplus water within the trough, and reweigh, recording its mass M_2.

5.12.5 Calculation and expression of results

5.12.5.1 Water penetration

Calculate the water penetration, P_w, in grams, from the equation:

$$P_w = M_2 - M_1$$

where

M_1 is the initial mass of the absorbent cloth, in grams;

M_2 is the final mass of the absorbent cloth, in grams.

5.12.5.2 Water absorption

Calculate the water absorption, A_w, as a percentage by mass, from the equation:

$$A_w = \frac{m_2 - m_1}{m_1} \times 100\,\%$$

where

m_1 is the initial mass of the test piece, in grams;

m_2 is the final mass of the test piece, in grams.

5.13 Water vapour permeability and water vapour coefficient

5.13.1 Determination of water vapour permeability

5.13.1.1 Principle

The test piece is fixed over the opening of a jar which contains a quantity of solid desiccant. This unit is placed in a strong current of air in a conditioned atmosphere.

The air inside the container is constantly agitated by the desiccant which is kept in movement by the rotation of the jar.

The jar is weighed in order to determine the mass of moisture that has passed through the test piece and been absorbed by the desiccant.

5.13.1.2 Apparatus

5.13.1.2.1 Jars or bottles, fitted with a screw top with a circular opening whose diameter is equal to the diameter of the neck of the jar (approximately 30 mm) (see figure 26).

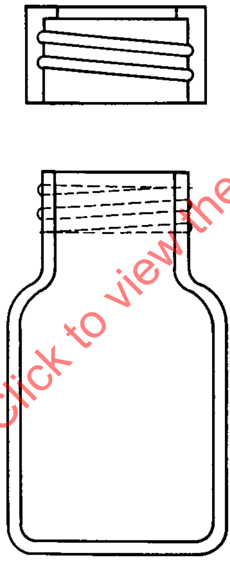


Figure 26 — Jar to be used in the water vapour permeability test

5.13.1.2.2 Holder, in the form of a disc which is rotated at (75 ± 5) r/min by an electric motor.

The jars are placed on this disc with their axes parallel to the axle of the disc and at a distance of 67 mm from it (see figure 27).

Dimensions in millimetres

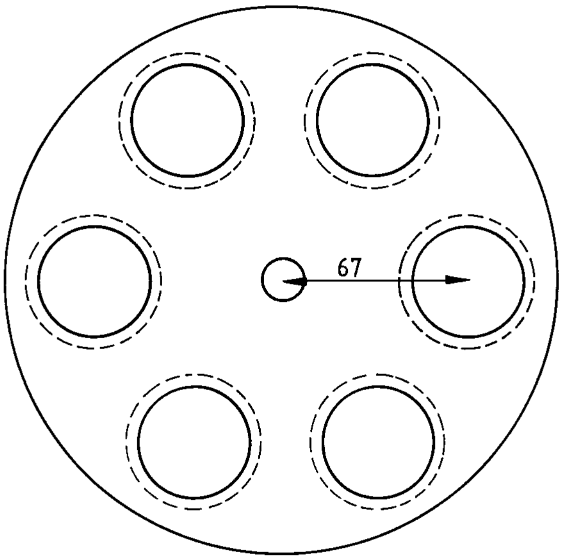


Figure 27 — Holder for jars used in the water vapour permeability test

5.13.1.2.3 Fan, mounted in front of the mouths of the jars and consisting of three flat blades in planes that are inclined at 120° to one another.

The planes of the blades pass through the prolongation of the axle of the disc. The blades are of dimensions approximately 90 mm by 75 mm, and the 90 mm long side of each blade nearest the mouths of the jars passes them at a distance of no more than 15 mm. The fan is driven by the motor at (1 400 ± 100) r/min. The apparatus is used in a conditioning atmosphere [(20 ± 2) °C, (65 ± 5) % RH] (see figure 28).

Dimensions in millimetres

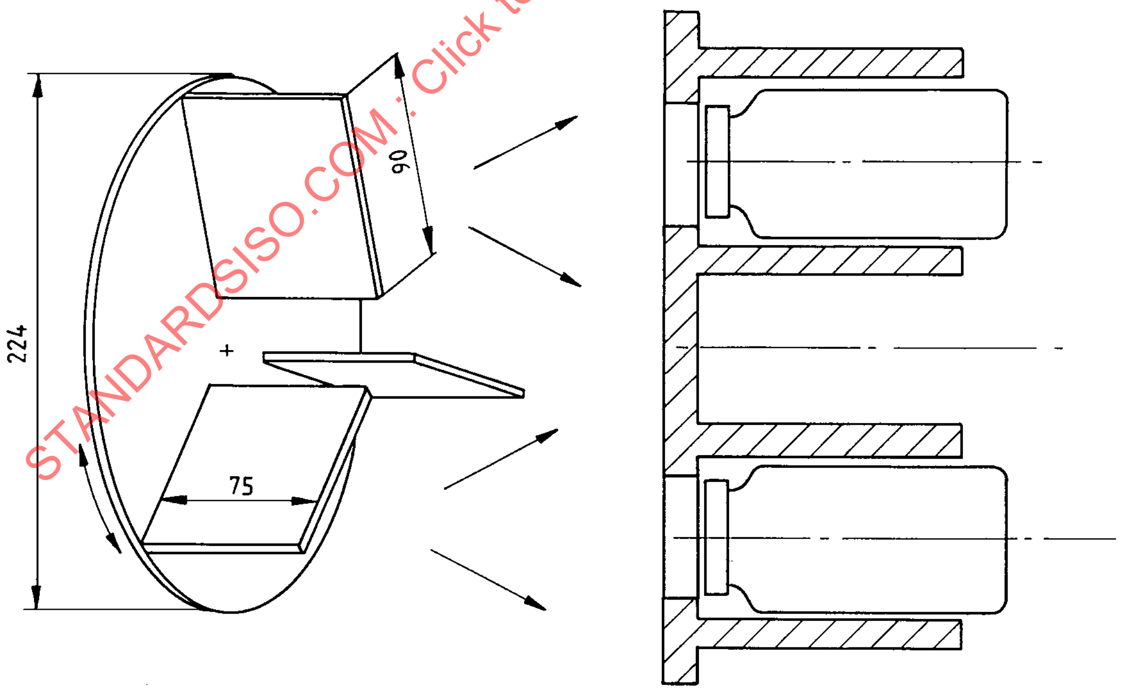


Figure 28 — Schematic diagram of apparatus to be used in the water vapour permeability test

5.13.1.2.4 Silica gel desiccant, freshly regenerated by at least 16 h in a ventilated oven at (125 ± 5) °C then cooled to ambient temperature in a hermetically sealed vessel.

The granular size of the crystals shall be such that they shall not pass through a 2 mm sieve.

The silica gel shall be sieved before regeneration in order to eliminate small particles and dust. At regeneration, the specified temperature should not be exceeded due to the risk of reducing the absorptive capacity of the gel. The ventilation of the oven by use of a fan is not necessary but the oven should not be sealed; it should allow continuous exchange of the air inside the oven with that outside. The gel shall not be used whilst it is warmer than the test piece and, since it cools slowly in a closed vessel, a long cooling time is needed.

5.13.1.2.5 Balance, capable of weighing to 0,001 g.

5.13.1.2.6 Stopwatch.

5.13.1.2.7 Instrument, capable of measuring to the nearest 0,1 mm the internal diameter of the neck of the jars.

5.13.1.3 Preparation of test piece

Cut a test sample of dimensions 70 mm × 45 mm.

Carry out 20 000 cycles of flexing using the method described in annex A.

Cut a circular test piece of diameter 34 mm centrally about the point at which the flexing creases meet.

5.13.1.4 Procedure

Carry out the test in a strong current of air, produced by the fan (5.13.1.2.3).

Half fill a jar with freshly regenerated silica gel (5.13.1.2.4). Fix the test piece over the opening of the jar (5.13.1.2.1) by means of the screw top with the side facing the foot pointing outwards. Place the jar in the holder (5.13.1.2.2) and switch on its motor (5.13.1.2.2).

Measure the internal diameter of the neck of a second jar (to the nearest 0,1 mm) in two directions perpendicular to each other, and calculate the average diameter in millimetres.

If it is necessary to seal the junction between the test piece and the neck of the jar, warm the second bottle and apply a thin layer of wax to the flat end surface of the neck.

After more than 16 h but less than 24 h stop the motor (5.13.1.2.2), and remove the first jar. Half fill the second jar with freshly regenerated silica gel and immediately remove the test piece from the first jar and place it onto the second (with the same side facing outwards).

If the opening of the jar has been coated with wax, warm the jar to around 50 °C before introducing the silica gel and fixing the test piece.

As quickly as possible, weigh the second jar with the test piece and silica gel, mass m_1, noting the time. Place the jar in the holder and switch on its motor.

After no less than 7 h and no more than 16 h stop the motor (5.13.1.2.2) and reweigh the jar, mass m_2, noting once again the time.

5.13.1.5 Calculation and expression of results

Calculate the water vapour permeability from the equation:

$$\mu_V = \frac{7\,639\,m}{d^2 t}$$

where

μ_V is the water vapour permeability, in milligrams per square centimetre per hour;

m is the increase in mass of the jar ($m_2 - m_1$), in milligrams;

d is the average diameter of the neck of the jar, in millimetres;

t is the time between the first and second weighings, in minutes.

5.13.2 Determination of water vapour absorption

5.13.2.1 Principle

An impermeable material and the test piece are clamped over the opening of a metal container, which holds 50 ml of water, for the duration of the test.

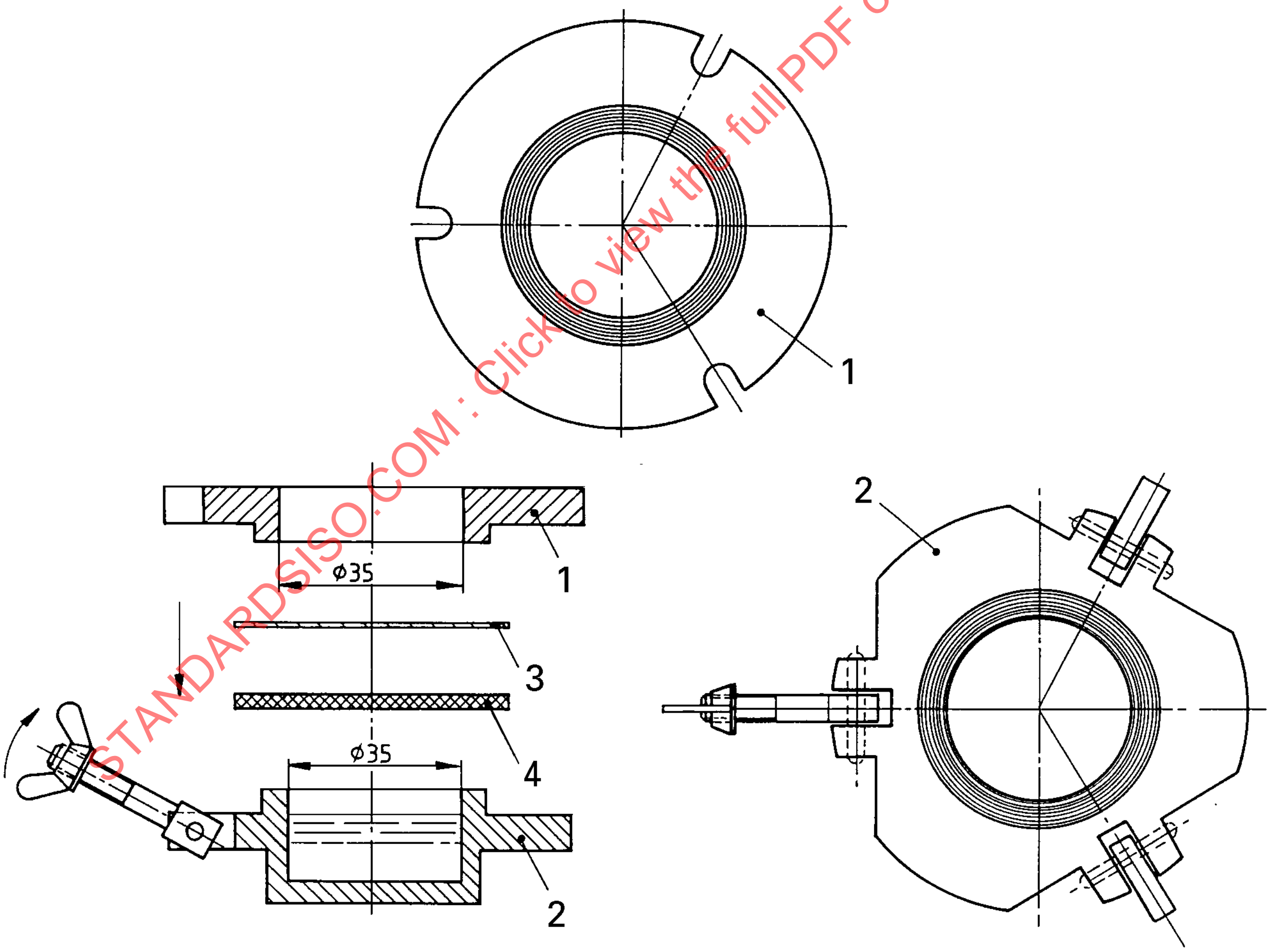
Water absorption of the test piece is determined by its difference in mass before and after the test.

5.13.2.2 Apparatus

5.13.2.2.1 Circular metal container, of volume 100 cm^3 and an upper ring, between which the impermeable material and the test piece are clamped (see figure 29).

The container and the ring have an internal diameter of 3,5 cm which correspond to a test area of approximately 10 cm^2. The upper ring is clamped to the apparatus with three hinged bolts equipped with wing nuts.

Dimensions in millimetres



Key

1 Top

2 Bottom

3 Seal

4 Specimen

Figure 29 — Apparatus for determination of the water vapour absorption

5.13.2.2.2 Balance, capable of weighing to the nearest 0,001 g.

5.13.2.2.3 Stopwatch.

5.13.2.3 Preparation of test piece

Cut a test piece of 4,3 cm diameter.

5.13.2.4 Procedure

Carry out the test in a conditioning atmosphere of (20 ± 2) °C and (65 ± 5) % RH.

Weigh the conditioned test piece and record its mass, m_1.

Place 50 ml of water into the container and place the test piece over the container with the side facing the foot downwards. Place the rubber or metal disc and the upper ring over the test piece and screw down firmly. Ensure that no water laps against the bottom of the test piece.

Remove the test piece after 8 h and weigh immediately, recording its mass, m_2.

5.13.2.5 Calculation and expression of results

Calculate the water vapour absorption, A_V, from the equation:

$$A_V = \frac{m_2 - m_1}{a}$$

where

A_V is the water vapour absorption, in milligrams per square centimetre;

m_1 is the initial mass of the test piece, in milligrams;

m_2 is the final mass of the test piece, in milligrams;

a is the test surface area, in square centimetres.

Round the result to the nearest 0,1 mg/cm^2.

5.13.3 Determination of water vapour coefficient

Calculate the water vapour coefficient, C_V, from the following equation:

$$C_V = 8\,\mu_V + A_V$$

where

C_V is the water vapour coefficient in milligrams per square centimetre;

μ_V is the water vapour permeability, in milligrams per square centimetre per hour;

A_V is the water vapour absorption in milligrams per square centimetre.

Round the result to the nearest 0,1 mg/cm^2.

5.14 Abrasion resistance of lining

5.14.1 Principle

Circular test pieces are abraded on a reference abradant under known pressure with a cyclic planar motion in the form of a Lissajous figure which is the resultant of two simple harmonic motions at right angles to each other. The resistance to abrasion is assessed by subjecting the test piece to a defined number of cycles at which point it shall not exhibit any holes.

5.14.2 Apparatus

5.14.2.1 Abrasion machine[4] of the type described in reference [2] of annex D, and fulfilling the following requirements:

— Rotational speed of each of the outer pegs	47,5 r/min ± 5 r/min
— Drive ratio of outer pegs : inner pegs	32 : 30
— Dimensions of the Lissajous figure	60 mm ± 1 mm
— Symmetry of Lissajous figure	curves shall be parallel and evenly spaced
— Face diameter of specimen holder insert	28,65 mm ± 0,25 mm
— Combined mass of specimen holder, spindle and weight	795 g ± 7 g
— Parallelism of plate and abrading tables	± 0,05 mm
— Circumferential parallelism	± 0,05 mm
— Diameter of abradant base	$140\ ^{+1}_{-2}$ mm

The test-piece holders and abrading tables shall be plane and parallel over their entire surfaces. The drive from the motor to the machine shall be connected to a counter and switch so that the revolutions of the outer pegs are indicated and the machine may be stopped after a predetermined number of cycles has been measured by the counter.

5.14.2.2 Reference abradant[4] consisting of a crossbred worsted-spun, plain-woven fabric, complying with table 12.

The reference abradant is mounted on the abrading tables of the machine over a piece of felt. The felt shall be woven felt of mass per unit area (750 ± 50) g/m^2 and (3 ± 0,5) mm thick, and need not be renewed until damaged or soiled on both sides or until approximately 100 h of testing have been completed.

Table 12 — Reference abradant

	Warp	Weft
Yarn linear density	R63 tex/2	R74 tex/2
Threads per cm	17	12
Singles twist, turns per metre	(540 ± 20) 'Z'[1)]	(500 ± 20) 'Z'[1)]
Two-fold twist, turns per metre	(450 ± 20) 'S'[1)]	(350 ± 20) 'S'[1)]
Fibre diameter, m	27,5 ± 2,0	29,0 ± 2,0
Mass per unit area of fabric, min., g/m^2	195	
Oil content, %	0,9 ± 0,2	
1) For details concerning 'Z' and 'S' twist directions, see ISO 2:1973, *Textiles — Designation of the direction of twist in yarns and related products.*		

4) Information on the availability of a suitable abrasion machine, reference abradant, felt and polyetherurethane foam may be obtained from the Secretariat of ISO/TC 94/SC 3 at the British Standards Institution, 389 Chiswick High Road, London W4 AL, UK.

5.14.2.3 Backing, for test pieces having a mass per unit area less than 500 g/m^2, consisting of polyetherurethane foam[4] (3 ± 1) mm thick, of density (30 ± 1) kg/m^3 and indentation hardness (5,8 ± 0,8) kPa, cut to the same size as the test piece.

Backings shall be renewed with every test.

5.14.2.4 Fabric punch or press cutter, to produce a test piece to fit the holder, having a diameter of 38 mm.

5.14.2.5 Weight, of mass (2,5 ± 0,5) kg and diameter (120 ± 10) mm.

5.14.2.6 Balance, capable of weighing to the nearest 0,001 g.

5.14.3 Test conditions

During conditioning and testing, the temperature and moisture content shall be maintained at (20 ± 2) °C and (65 ± 5) % RH.

5.14.4 Preparation of test pieces and materials

Using the fabric punch (5.14.2.4), cut four circular test pieces from the lining, two for the dry test and two for the wet test. Expose the test pieces and materials to the standard atmosphere for at least 24 h.

5.14.5 Procedure

5.14.5.1 General

Check that the top plate and abrading tables are parallel. Insert a dial gauge through the spindle bearing and move the top plate by turning the drive shaft by hand. The needle movement of the dial gauge shall be within ± 0,05 mm over the whole surface of an abrading table. If machines are being used in which the test-piece holders are connected to the weights by spindles, assemble each empty test-piece holder and place each one in position on the appropriate abrading table and insert the spindles. Use a feeler gauge to check for any gap between the face of the holder insert and the table. The gap shall not be greater than 0,05 mm. Rock the spindle from side to side and recheck with the feeler gauge. To avoid damaging abrading tables and metal inserts, do not run the machine with metal inserts in contact with the uncovered abrading table.

5.14.5.2 Mounting test pieces

Remove the outer ring of a test-piece holder together with the accompanying metal insert. Insert the test piece centrally into the outer ring so that the face to be abraded shows through the hole.

For test pieces of fabric having a mass per unit area less than 500 g/m^2, insert a disc of polyetherurethane foam (5.14.2.3) having the same diameter as the test piece. Use a new backing for each test. Place the metal insert carefully into the outer ring with its raised surface next to the test piece. Complete the assembly of the test-piece holder by screwing on the back plate whilst pressing the face of the test piece firmly against a hard flat surface to prevent wrinkling. Check that no wrinkling has occurred. Repeat for the remaining test pieces.

5.14.5.3 Preparation of abradant and backer for the wet test

Thoroughly wet the fabric abradant and felt backer by one of the following methods:

a) soak overnight;

b) agitate thoroughly in water;

c) wet with a high pressure water jet.

Allow excessive water to drain and mount them in accordance with 5.14.5.4.

Rewet the abradant fabric and felt at 6 400 cycles by gradually pouring on up to 30 ml of water and lightly rubbing it with the fingertips. Place the weight (5.14.2.5) on the fabric and leave for a few seconds to squeeze out excess water.

5.14.5.4 Mounting abradant

Mount a new piece of the reference abradant (5.14.2.2) on each table with a piece of felt of the same dimensions beneath the reference abradant. Flatten the reference abradant by placing the weight (5.14.2.5) on its surface, and then position and tighten up the retaining frame evenly. Make sure that the reference abradant is held in place firmly and that there are no tucks or ridges.

5.14.5.5 Mounting test-piece holders

Mount the test-piece holders in the abrasion machine (5.14.2.1).

Every time a holder is taken from the machine to check the test piece, re-tighten the holder before it is replaced on the machine.

5.14.6 Method of assessment

Continue the test until either a hole forms in the test piece or 25 600 cycles have been performed for the dry sample (12 800 cycles for the wet test). If the fabric has a pile, only holes in the base fabric need to be taken account of.

5.15 Water absorption and water desorption of insole

5.15.1 Preparation of test piece

Take a test piece of dimensions (50 ± 1) mm × (50 ± 1) mm from the insole and condition for 24 h at (20 ± 2) °C and (65 ± 5) % RH.

5.15.2 Procedure

5.15.2.1 Water absorption

Weigh the test piece to the nearest 0,01 g, and record its mass, m_0.

Place the test piece in distilled water at (20 ± 2) °C for 8 h. Then remove it, dry off any drops of water still adhering to it using filter paper and reweigh it, recording its mass m_F.

Calculate the water absorption, A_W, as a percentage by mass using the following equation:

$$A_W = \frac{m_F - m_0}{m_0} \times 100\,\%$$

where

m_0 is the initial mass of the test piece, i.e. in the dry condition, in grams;

m_F is the final mass of the test piece, i.e. in the wet condition, in grams.

Report the water absorption to the nearest 1 %.

5.15.2.2 Water desorption

On completion of the test specified in 5.15.2.1, condition the test piece for 16 h at (20 ± 2) °C and (65 ± 5) % RH and then reweigh it, recording its mass m_R.

Calculate the water desorption, D_W, as a percentage by mass using the following equation:

$$D_W = \frac{m_F - m_R}{m_F - m_0} \times 100\,\%$$

where

m_0 is the initial mass of the test piece, i.e. in the dry condition, in grams;

m_F is the final mass of the test piece, i.e. in the wet condition, in grams;

m_R is the mass of the reconditioned test piece, in grams.

Report the water desorption to the nearest 1 %.

5.16 Abrasion resistance of insole

5.16.1 Principle

The test piece is rubbed with pieces of wet, white wool felt, under a given pressure, with a number of to-and-fro motion cycles. The test is carried out on conditioned insole material, and abrasion damage is assessed visually.

5.16.2 Apparatus[5)]

5.16.2.1 Test equipment, incorporating the following features:

a) carriage, with a horizontal, completely planar metal platform, a holder for fastening the material leaving 80 mm freely exposed and a device which allows the test piece to be maintained under a slight tension in the direction of the rubbing;

b) finger, of mass 500 g, removable but able to be fixed firmly, with a base of 15 mm × 15 mm, a device for attaching pieces of wool felt (5.16.2.2) to the base, an additional mass of 500 g, and a means of guiding the finger when fully loaded (total mass 1 kg) flat on the test piece;

c) means for driving the carriage to-and-fro, with an amplitude of 35 mm and a frequency of (40 ± 2) cycles/min.

NOTE The following items are convenient, but not essential, parts of the equipment:

— means to move the finger at right angles to the direction of rubbing, so that two or three tracks may be used for rubbing on one test piece;

— means for pre-selecting a given number of cycles.

5.16.2.2 Abradant pads, comprising square pieces of wool felt, 15 mm × 15 mm, punched out of a sheet of pure white wool felt with the following specification:

a) mass per unit area of (1 750 ± 100) g/m^2;

b) mean water uptake of (1,0 ± 0,1) ml;

c) pH of 5,5 to 7,0 for an extract prepared by shaking 5 g of ground felt with 100 ml distilled water for 2 h in a polyethylene bottle.

5.16.3 Preparation of test piece

Cut a rectangle of minimum dimensions 120 mm × 20 mm.

5.16.4 Preparation of abradant pads

Condition the abradant pads (5.16.2.2) at (20 ± 2) °C and (65 ± 5) % RH for 48 h and then weigh.

For each test piece, place four abradant pads in distilled water, heat to boiling and allow to boil gently until they sink. Then decant the hot water and replace with cold, distilled water, until the pads have reached room temperature.

5) Information on the availability of suitable apparatus may be obtained from the Secretariat of ISO/TC94/SC3 at the British Standards Institution, 389 Chiswick High Road, London W4 AL, UK.

Before use, take each pad from the water and squeeze or wipe it against the rim of a beaker so that it no longer drips.

Verify that the water uptake of each pad is (1,0 ± 0,1) ml, by weighing.

The pads shall not be allowed to soak in water for more than 24 h before use.

5.16.5 Procedure

Fasten the test piece on to the apparatus and apply a slight tension to hold it flat.

Attach a wet pad to the finger and place the finger 5 mm from one edge of the test piece. Attach the additional mass of 500 g to the finger. Carry out 100 cycles, lift the finger, and examine the test area for abrasion damage.

Replace the pad with a fresh one and carry out a further 100 cycles.

Replace the pad every 100 cycles and stop the test at the first indication of surface tearing or after 400 cycles, whichever occurs first.

5.16.6 Method of assessment

Examine the abraded surface of the test piece visually and note any surface tearing.

5.17 Flexing resistance of outsole

5.17.1 Apparatus

5.17.1.1 Testing device, as illustrated in figure 30.

The test piece is guided in such a way that on one side it can be bent at an angle of 90° about a mandrel with a radius of 15 mm.

5.17.1.2 Cutting tool, as illustrated in figure 31.

5.17.1.3 Measuring magnifier, to enable the cut growth to be measured to 0,1 mm.

5.17.2 Preparation of test piece

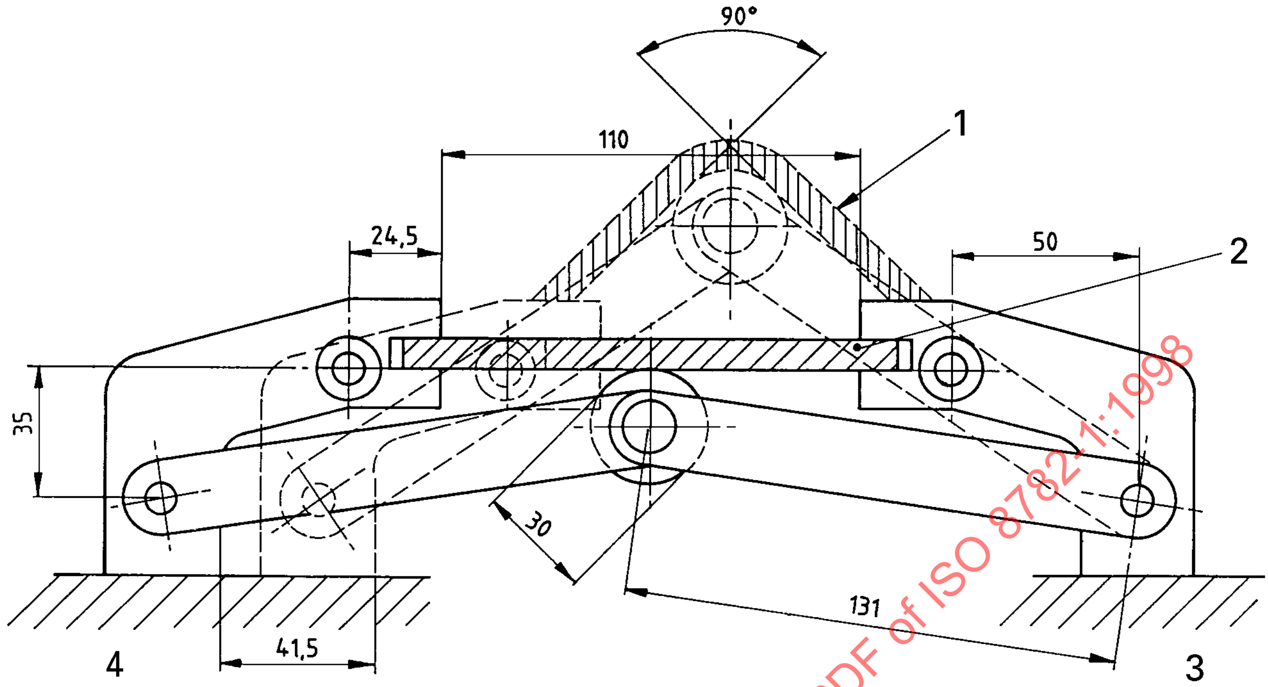
Take the bottom of the footwear, separated from the upper, as the test piece.

5.17.3 Procedure

Clamp the test specimen in the testing device (5.17.1.1) in such a way that the greatest bending stress is applied to the ball area (flexing zone). Pierce the sole between the cleats at three points along the line of maximum bending stress (twice in the edge zone of the sole 10 mm from the edge and once in the middle) using the cutting tool (5.17.1.2). Carry out 30 000 cycles starting from an extended or stretched state, with the test piece undergoing deformation at a constant stroke value between 125 cycles/min and 150 cycles/min.

After 30 000 cycles, measure the length of the cuts on the test piece surface in the secured state under the maximum bending angle using the measuring magnifier (5.17.1.3).

Dimensions in millimetres



Key

1 Test piece at maximum flex position

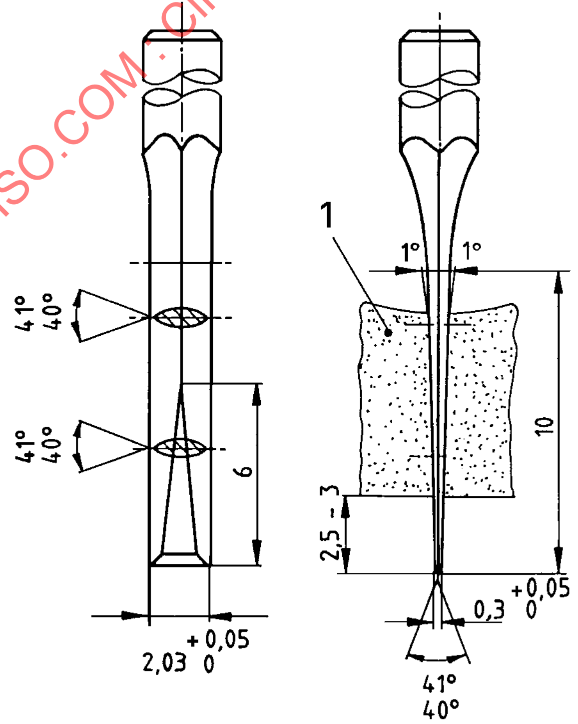
2 Test piece at null flex position

3 Fixing bearing

4 Moveable bearing

Figure 30 — Testing device for flexing resistance of outsole

Dimensions in millimetres



Key

1 Test piece

Figure 31 — Cutting tool

5.18 Resistance to hot contact

5.18.1 Apparatus

NOTE A general arrangement of the apparatus is illustrated in figure 32.

WARNING — As toxic fumes may be released from some solings during this test it is necessary to site the apparatus in a well ventilated area.

5.18.1.1 Cylindrical copper body, referred to as the bit, of mass (200 ± 20) g and with the lower end reduced to a flat square face with sides of dimension (25,5 ± 0,1) mm.

The bit has a central longitudinal cavity of 6,5 mm diameter, extending to 4 mm from the outer working surface of the square end of the bit, to receive a temperature-measuring device. The other dimensions of the bit are shown in figure 33.

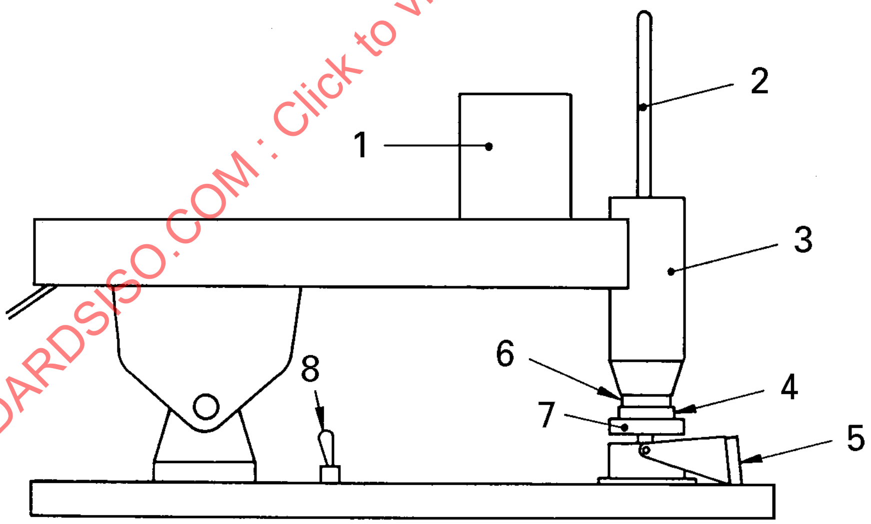
5.18.1.2 Metal heating block, of mass (530 ± 50) g, which surrounds the cylindrical part of the bit.

This heating block contains an electrical resistance heating element and a means of control (an 'on/off' switch is sufficient) to pre-heat the bit to any desired temperature up to a maximum of 400 °C. The dimensions of the heating block are shown in figure 33.

5.18.1.3 Device for measuring the internal temperature of the bit, close to its square end.

A convenient way of measuring the temperature is a mercury-in-glass thermometer reading to 400 °C.

For such a thermometer it is recommended that the small space between the thermometer bulb and the wall of the cavity be filled with a metal alloy having a melting point below 150 °C.

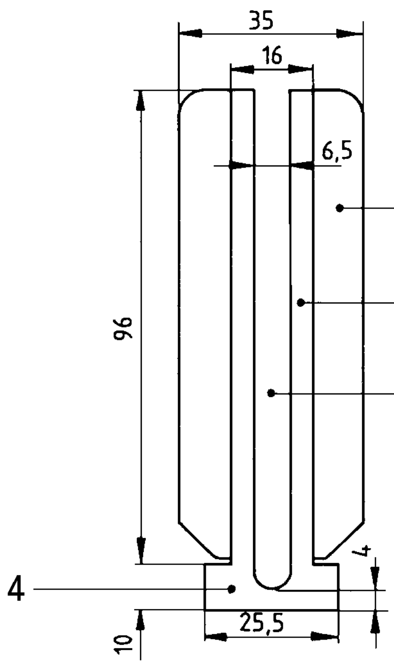


Key

1 Mass
2 0° to 400° mercury-in-glass thermometer
3 Encased heating block
4 Soling test piece
5 Hinged insulated support
6 Square end of copper bit
7 Self-aligning test-piece platform
8 On/off switch

Figure 32 — Apparatus for resistance to hot contact

Dimensions in millimetres



Key

1 Metal heating block
2 Copper bit
3 Cylindrical cavity in bit for the thermometer
4 Square end of bit

Figure 33 — Bit and heating block

5.18.1.4 Means of raising and lowering the bit, together with the heating block, to bring its face into uniform contact with the test piece, in a horizontal plane and under a uniformly distributed pressure of (20 ± 2) kPa.

5.18.1.5 Self-aligning platform, of suitable diameter, to receive the test piece and maintain uniform pressure on it.

5.18.1.6 Hinged support with thermally insulated face, on which the face of the bit rests during heating, and which can be moved aside to enable the bit to be lowered on the test piece.

5.18.1.7 Mandrel, of (10 ± 1) mm diameter.

5.18.2 Preparation of test specimen

Cut a test piece of width (30 ± 2) mm and length 70 mm (minimum) from the sole and where necessary remove the cleats.

Tests may be carried out in the waist region where there are normally no cleats. Where, however, the removal of the cleats would result in the removal of the wear layer, it is essential that the test piece be taken from the waist region.

Condition leather test pieces for 48 h at (20 ± 2) °C and (65 ± 5) % RH before testing.

5.18.3 Procedure

Switch on the heating block (5.18.1.2) with the bit resting on the insulating support and place the test piece on the platform below with its wear side uppermost. Cover the test piece with aluminium foil to prevent contamination of the heated bit, using a new piece of foil for each test. When the bit temperature has just exceeded 300 °C switch off the heating block and allow the temperature to fall to (300 ± 2) °C, with the bit still resting on its insulating support. Then move the insulating support aside and immediately place the bit centrally on the test piece, so that its sides are