BRITISH STANDARD

BS EN 12568:2010

Foot and leg protectors — Requirements and test methods for toecaps and penetration resistant inserts

ICS 13.340.50

BSI British Standards

National foreword

This British Standard is the UK implementation of EN 12568:2010. It supersedes BS EN 12568:1998 which is withdrawn.

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

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

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Foot and leg protectors - Requirements and test methods for toecaps and penetration resistant inserts

Protecteurs du pied et de la jambe - Exigences et méthodes d'essais des embouts et des inserts anti-perforation

Fuß- und Beinschutz - Anforderungen und Prüfverfahren für durchtrittsichere Einlagen und Zehenkappen

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Foreword

This document (EN 12568:2010) has been prepared by Technical Committee CEN/TC 161 “Foot and leg protectors”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2010, and conflicting national standards shall be withdrawn at the latest by November 2010.

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Introduction

EN ISO 20345, EN ISO 20346 and EN ISO 20347 relate to safety, protective and occupational footwear which define the performance and required properties of the footwear. On introducing these standards all national standards relating to safety toecaps and penetration resistant inserts were withdrawn leaving the manufacturers of these items with no means of demonstrating the performance of their products. This European Standard has been prepared to allow manufacturers to demonstrate the performance level of the toecaps and penetration resistant inserts before being inserted into the footwear.

1 Scope

This European Standard specifies requirements and test methods for toe caps and inserts with resistance against mechanical penetration, intended to function as components of PPE footwear (e.g. as described by EN ISO 20345, EN ISO 20346 and EN ISO 20347).

2 Normative references

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

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 20345:2004, EN ISO 20346:2004 and EN ISO 20347:2004 and the following apply.

3.1
internal toe cap
toe cap intended to be incorporated underneath the upper of footwear intended to provide protection against mechanical impact and compression

3.2
external toe cap
toe cap intended to be incorporated on top of the footwear upper forepart intended to provide protection against mechanical impact and compression

3.3
penetration resistant insert
footwear component placed (or intended to be placed) in the sole complex in order to provide protection against mechanical penetration

4 Requirements for toe caps

4.1 General

Table 1 — Summary of requirements for toecaps and number of tests

Property	Subclause	Metal toe cap	Non-metal toecap	Number of tests for type approval
Finishing	4.2.1	X	X	1 sample each size right and left
Internal length	4.2.2.1	X	X	1 sample each size right and left
Width of flange	4.2.2.2	X	X	1 sample each size right and left
Impact resistance	4.2.3	X	X	1 sample each size right and left
Compression resistance	4.2.4	X	X	1 sample each size right and left
Corrosion resistance	4.3	X	-	3 samples of different sizes
Impact resistance after five environmental treatments	4.4	-	X	2 samples for each treatment [a]
"X" means "Test shall be carried out"; "-" means "Test need not be carried out". NOTE 1 For details, see 4.2 to 4.4. NOTE 2 "Worst performing" sample is where the smallest gap between required and measured clearance has been found.				
[a] Select worst performing sample sizes of test 4.2.3.				

Each single test result shall comply with the applicable requirement, otherwise the overall result of the whole lot is deemed to be "fail". In case of different single results obtained with the same test on equal samples, the worst value shall be stated as test result ("worst case principle" to be applied).

4.2 Requirements for all types of toe caps

4.2.1 Finishing

Toe caps shall be finished so as to be free from surface marks or defects and shall be free from burrs and sharp edges and defects of splitting or delaminating between material layers.

4.2.2 Dimensions

4.2.2.1 Internal length

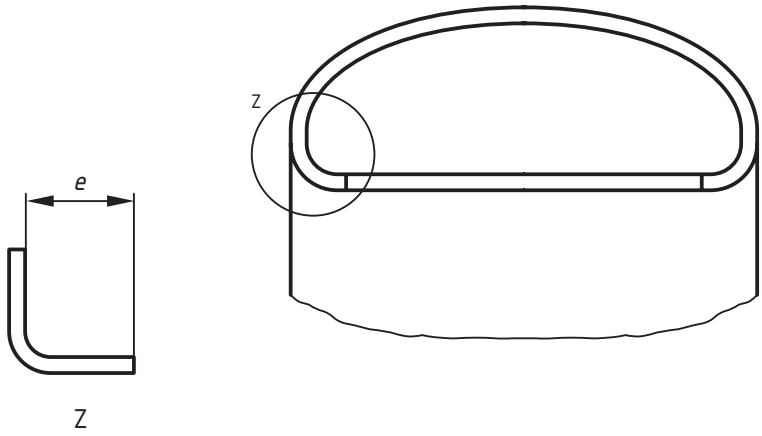
When measured in accordance with the method described in 5.2.1, the internal length of toe caps shall be not less than the appropriate value given in Table 2.

Table 2 — Minimum internal length of toe caps

Toe cap number	**5 and below**	**6**	**7**	**8**	**9**	**10 and above**
Minimum internal length in millimetres	34	36	38	39	40	42
NOTE The above numbering system for toecaps is not identical to any numbering system for footwear.						

4.2.2.2 Width of flange

If toe caps are formed with a flange, the inside width of the flange (*e*) shall be not greater than 10 mm, as shown in Figure 1.



Key

e Width of the toe cap flange

Figure 1 — Illustration of width "e" of the toe cap flange

4.2.3 Impact resistance

When toe caps are tested in accordance with the method described in 5.2.2 at an energy level of either (100 ± 2) J (toe caps intended for protective footwear), or (200 ± 4) J (toe caps intended for safety footwear), the clearance under the cap at the moment of impact shall be not less than the appropriate value given in Table 3. In addition the toe cap shall not develop sharp edges or any cracks passing through the material (i.e. through which light can be seen).

4.2.4 Compression resistance

When toe caps are tested in accordance with the method described in 5.2.3, the clearance under the toe cap at a compression load of either (10 ± 0,1) kN (toe caps intended for protective footwear) or (15 ± 0,15) kN (toe caps intended for safety footwear) shall not be less than the appropriate value given in Table 3. In addition the toe cap shall not develop sharp edges or any cracks passing through the material (i.e. through which light can be seen).

NOTE The provisions of 4.2, 4.3 and 4.4 do not exclude a toe cap design incorporating perforations.

Table 3 — Minimum clearance under toe caps at impact and compression

Toe cap number	5 and below	6	7	8	9	10 and above
Internal toe cap minimum clearance (mm)	19,5	20,0	20,5	21,0	21,5	22,0
External toe cap minimum clearance (mm)	24,5	25,0	25,5	26,0	26,5	27,0

4.3 Special requirements for metal toe caps − Corrosion resistance

Both before and after testing metal toe caps in accordance with the method described in 5.3, they shall exhibit not more than three areas of corrosion, none of which shall measure more than 2 mm in any direction.

4.4 Special requirements for non-metal toe caps − Stability against ageing and environmental influence

When non-metal toe caps are subject to each single one of the treatments described in 5.4 and thereafter tested in accordance with the method described in 5.2.2 at an energy level of either (100 ± 2) J (caps intended for protective footwear) or (200 ± 4) J (caps intended for safety footwear), the clearance under the cap at the moment of impact shall be not less than the appropriate value given in Table 3. In addition, the toe cap shall not develop sharp edges or any cracks passing through the material (i.e. through which light can be seen).

5 Test methods for toe caps

5.1 General

One pair of samples of each size shall be tested. Exceptions are made for some properties, as specified in Table 1. Where repetitions lead to different results on equal samples, the worst value shall be reported as test result.

If samples of only one size are available, two pairs shall be tested.

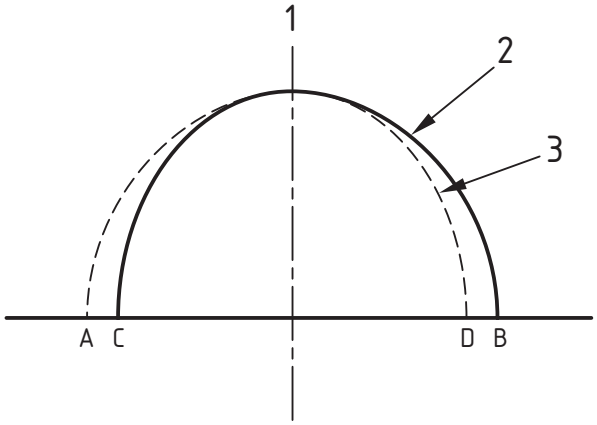
Each one of the environmental treatments of 5.4 shall be applied to new samples.

5.2 Test methods for all types of toe caps

5.2.1 Determination of internal toe cap length

5.2.1.1 Determination of the test axis

Position the left toe cap with its rear edge in line with a base line and draw its outline. Repeat the exercise with the right toe cap of the pair, positioning it at the same base line in such a manner that the outlines at the toe end of the toe caps coincide (see Figure 2).



Key

1 Test axis
2 Right cap
3 Left cap
A, B, C, D Points where the outlines of the right and left toe caps intersect on the base line

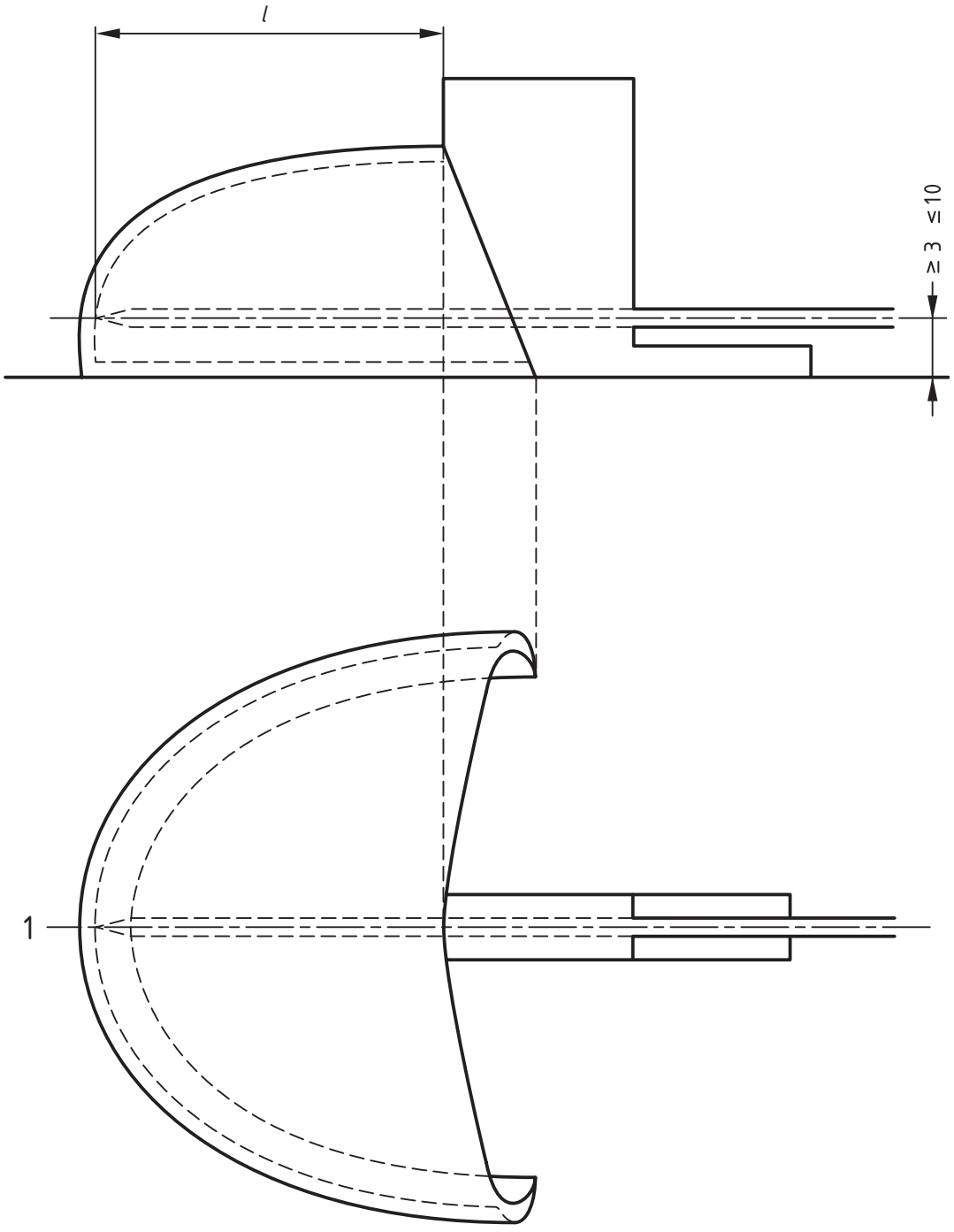
Figure 2 — Determination of test axis (schematic illustration)

Mark the four points A, B, C and D where the outlines of the right and left toe caps intersect on the base line. Construct the perpendicular from the base line at the mid point of AB or CD. This constitutes the test axis of both toe caps.

5.2.1.2 Procedure

Place the toe cap, open side down, on a flat surface. With an appropriate gauge, measure the internal length *l*, along the test axis from the front inside to the vertical projection of the back edge between 3 mm and 10 mm above and parallel to the surface upon which the toe cap rests, taking the longest distance as the length *l* (see Figure 3).

Dimensions in millimetres



Key

1 Test axis

l Internal length of the toe cap

Figure 3 — Measurement of internal toe cap length

5.2.2 Determination of impact resistance

5.2.2.1 Apparatus

5.2.2.1.1 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 4) shall be made of steel with Rockwell hardness min. 60 HRC and shall consist of a wedge at least 60 mm long, the rectangular faces of which are at least 40 mm in height and 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 ± 2° to the base of the clamping device.

The base of the apparatus shall be of compact design, avoiding elastic structures as far as possible. It shall have a mass of at least 600 kg and 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 large and rigid to support the test equipment. Provision shall be made for a mechanism to catch the striker after the first impact so that the test specimen will be hit only once.

Dimensions in millimetres

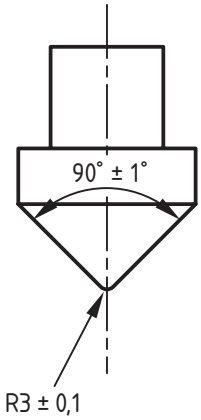
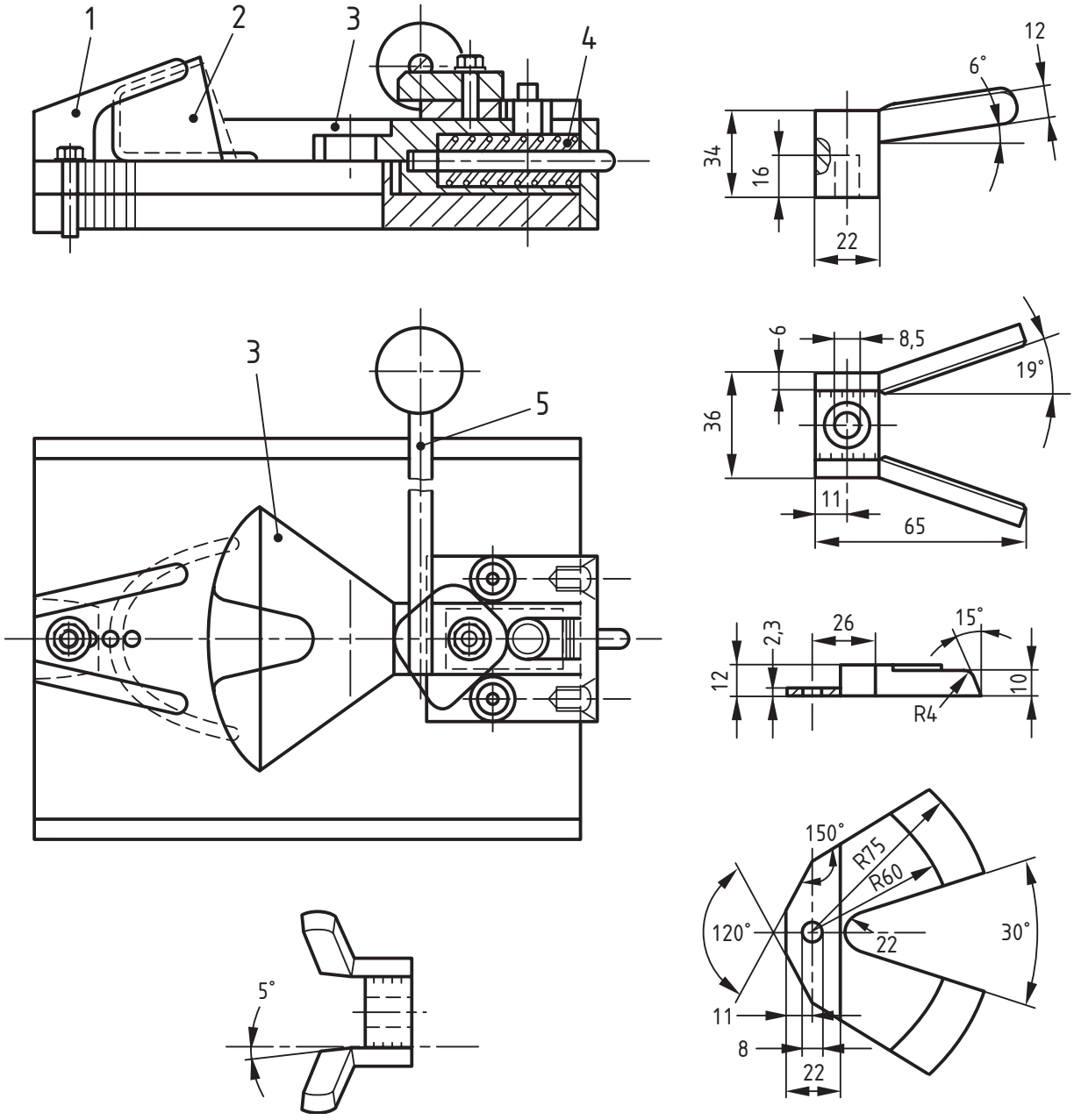


Figure 4 — Impact striker

5.2.2.1.2 Clamping device, consisting of a steel platen at least 19 mm thick and 150 mm × 150 mm in area and of minimum hardness 60 HRC with provision for lightly clamping a toe cap in a way which will not restrict any lateral deformation of the cap during the impact test.

An example of a suitable clamping device is shown in Figure 5.

Dimensions in millimetres



Key

1 Forked clamp
2 Toe cap
3 Radiused plate
4 Spring
5 Clamping handle

Figure 5 — Example of suitable design of toe cap clamp

The toe cap shall be held in position at the front end with a forked clamp which is fixed with a screw into one of the threaded holes, depending on the size of the toe cap.

The toe cap shall be held at the rear end with a curved plate which is screwed to a sliding rail. The radiused plate lies over the flange at the back edges of the cap and pushes the cap against the forked clamp with a load of 100 N to 200 N.

The sliding rail is sprung such that when the toe cap is hit by the striker it can move back along its axis against the spring. To change the toe cap the curved plate is retracted by releasing the clamping handle.

5.2.2.1.3 Cylinders of modelling clay, with a diameter (25 ± 2) mm; the height shall be (28 ± 2) mm for toe caps up to and including size 5, and (30 ± 2) mm for toe caps above size 5.

5.2.2.1.4 Dial gauge, with an accuracy of 0,1 mm, working in a vertical sense, with a flat base to place the clay cylinder on, and a hemispherical upper sensor of (3,0 ± 0,2) mm radius exerting a vertical force of not greater than 250 mN.

5.2.2.2 Procedure

Determine the test axis as described in 5.2.1.1.

Use the toe cap as the test piece.

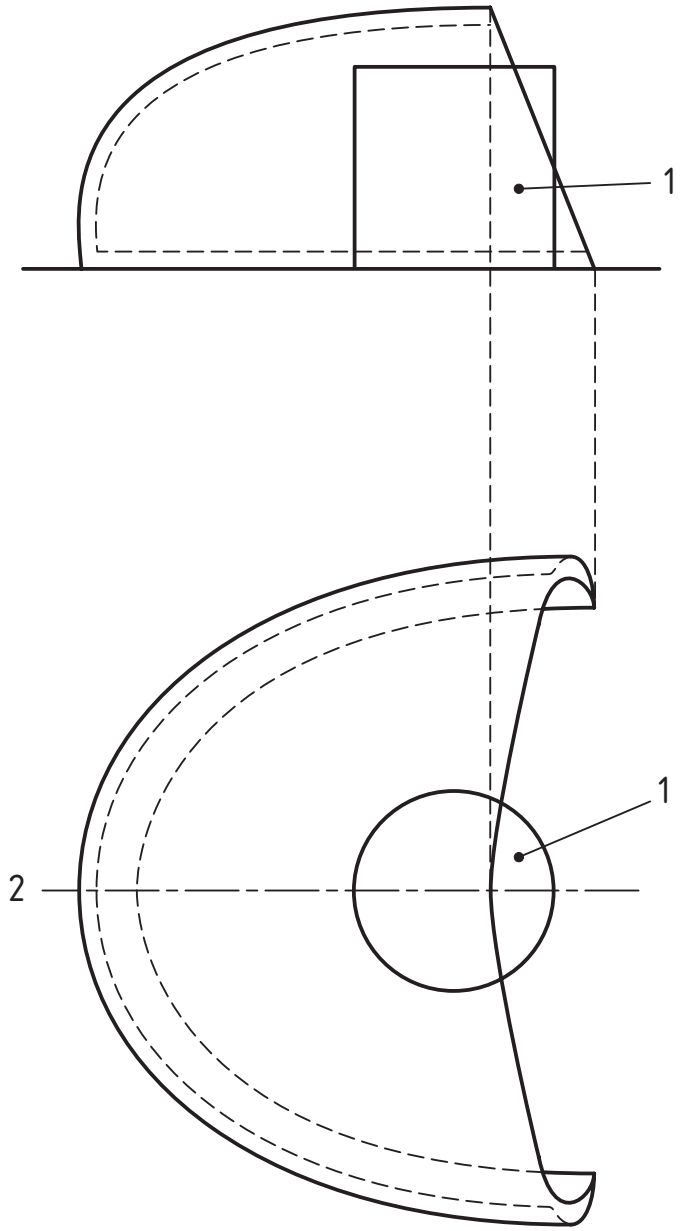
Hold the test piece in the clamping device (5.2.2.1.2) so that when the striker hits it, the striker will project over the front and back of the toe cap.

Position a cylinder (5.2.2.1.3) under the rear upper edge of the test piece in such a way that approximately ⅔ of its diameter is within the test piece and ⅓ of its diameter is protruding behind the rear edge and the centre of the cylinder matches the test axis as closely as possible (see Figure 6). At the time of the test, the temperature of the modelling clay shall be between 18 °C and 25 °C.

Allow the striker to drop onto the test axis from the appropriate height to give an impact energy of (200 ± 4) J for toe caps designed for safety footwear or (100 ± 2) J for toe caps to be used in protective footwear.

Measure, to the nearest 0,5 mm, the lowest height to which the cylinder has been compressed, using the dial gauge (5.2.2.1.4). This value is the clearance at the moment of impact.

The number of tests to be performed is stated in Table 1. If only one size is available (e.g. prototype), two pairs of samples shall be tested.



Key

1 Modelling clay cylinder
2 Test axis

Figure 6 — Position of cylinder for impact or compression testing of toe caps

5.2.3 Determination of compression resistance

5.2.3.1 Equipment

5.2.3.1.1 Compression testing machine, capable of subjecting the test piece to a force of at least 20 kN (to a tolerance of ± 1 %) between two plain platens, by moving one of those at a speed of (5 ± 2) mm/min.

Both platens shall cover at least an area of diameter 150 mm, shall have a minimum hardness of 60 HRC and shall remain parallel during the application of the load. Any effect of eccentrically applied forces to the measurement shall be excluded as far as possible.

5.2.3.1.2 Cylinders, as described for the impact test (see 5.2.2.1.3).

5.2.3.1.3 Dial gauge, as described for the impact test (see 5.2.2.1.4).

5.2.3.2 Procedure

Determine the test axis as described previously (see 5.2.1.1).

Use the toe cap as the test piece.

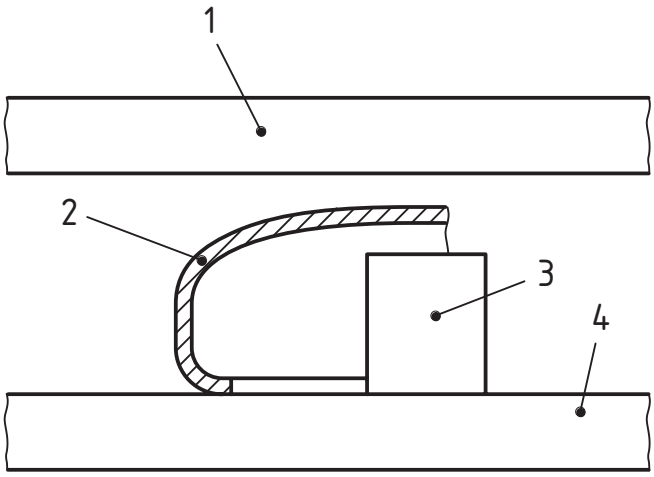
Position the test piece between the platens of the compression machine (5.2.3.1.1). A cylinder (5.2.3.1.2) is positioned under the rear upper edge of the test piece in a way that approximately ⅔ of its diameter is within the test piece and ⅓ is protruding behind the rear edge and the centre of the cylinder matches the test axis as closely as possible (see Figure 6). At the time of the test, the temperature of the modelling clay shall be between 18 °C and 25 °C.

Compress the test specimen to a load of either (15 ± 0,1) kN for toe caps to be used for safety footwear or (10 ± 0,1) kN for toe caps to be used for protective footwear (see Figure 7).

Reduce the load, remove the cylinder and measure, to the nearest 0,5 mm, the lowest height to which the cylinder has been compressed, using the dial gauge described in 5.2.3.1.3.

NOTE This value is the compression clearance at the moment of highest compression.

The number of tests to be performed is stated in Table 1. If only one size is available (e.g. prototype), two pairs of samples shall be tested.



Key

1 Upper platen

2 Toe cap

3 Modelling clay cylinder

4 Lower platen

Figure 7 — Apparatus for compression test

5.3 Test method for metal toe caps − Determination of corrosion resistance

5.3.1 Preliminary examination

Examine the toe cap visually inside and outside for signs of corrosion under the coating and for corrosion occurring where the coating has broken down.

Measure the longest distance across each area of corrosion and note the number of such areas.

5.3.2 Corrosion test procedure

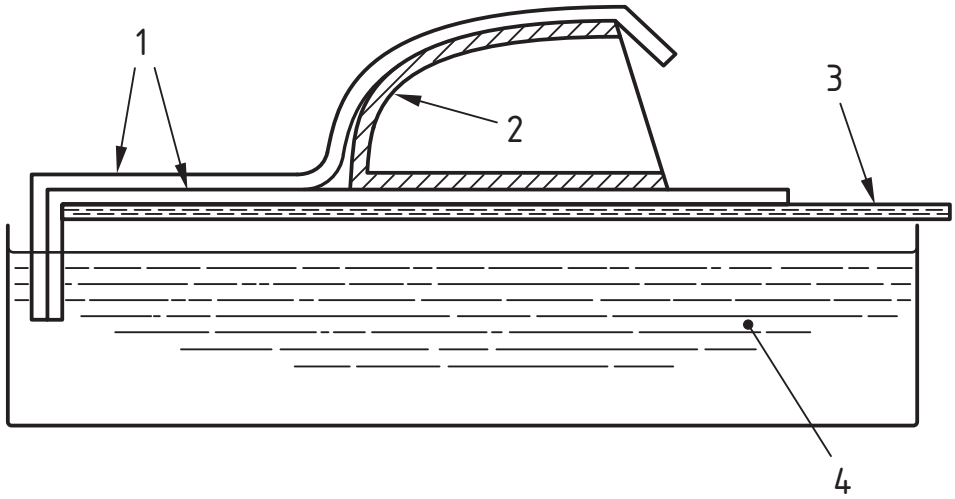
Remove any grease, silicone, wax or similar material which might be present on the surface.

Prepare at least 300 ml of a 1 % (mass fraction) aqueous solution of sodium chloride as the test solution. Pour it into a dish sized at least 100 mm × 160 mm. The depth of the solution shall be ≥ 15 mm and it shall fill the dish up to a height of ≤ 10 mm from the glass plate. Cover the dish with a glass plate leaving a small opening.

Dip two strips of white filter paper of dimensions at least 100 mm wide and 150 mm long into the test solution at one end so that the strips of filter paper become saturated with solution, the other ends being laid on the glass plate.

Lay the toe cap to be tested flange down over the free end of one filter paper so that the whole flange is in contact with the wetted area and lay the other filter paper over the toe cap so that the greatest possible area of the nose of the cap and its upper surface is in contact with the filter paper (see Figure 8). Ensure that the filter paper remains saturated throughout the test.

After 48 h remove the filter paper and examine the toe cap for signs of corrosion. Measure the longest distance across each area of corrosion and note the number of such areas.



Key

1 Filter paper
2 Toe cap
3 Glass plate
4 Sodium chloride aqueous solution

Figure 8 — Schematic view of the corrosion test on metal toe caps

5.4 Test methods for non-metal toe caps

5.4.1 General

New samples shall be used for each of the following five treatments.

5.4.2 Effect of high temperature

Place the toe cap in an oven with forced air circulation, which is maintained at (60 ± 2) °C for 4 h ± 10 min; reduce the temperature to (45 ± 2) °C for another 18 h to 20 h. Remove the sample and after 2 min ± 30 s from removing it from the oven (or from an insulating box which may be used if necessary) carry out the impact test in accordance with the method described in 5.2.2.

5.4.3 Effect of low temperature

Place the toe cap in a chamber maintained at (- 20 ± 2) °C for 4 h ± 10 min; change the temperature to (- 6 ± 2) °C for another 18 h to 20 h. Remove the sample and after 2 min ± 30 s from removing it from the chamber (or from an insulating box which may be used if necessary) carry out the impact test in accordance with the method described in 5.2.2.

5.4.4 Effect of acid

Totally immerse the toe cap in sulfuric acid solution, c(H_2SO_4) = 1 mol/l at (23 ± 2) °C for 24 h ± 15 min. Remove, wash off any excess acid with water and store at (23 ± 2) °C for (24 ± 1) h before testing it in accordance with the method described in 5.2.2.

5.4.5 Effect of alkali

Totally immerse the toe cap in sodium hydroxide solution, c(NaOH) = 1 mol/l, at (23 ± 2) °C for 24 h ± 15 min. Remove, wash off any excess alkali with water and store at (23 ± 2) °C for (24 ± 1) h before testing it in accordance with the method described in 5.2.2.

5.4.6 Effect of fuel oil

Totally immerse the toe cap in 2,2,4-trimethylpentane (iso-octane) at (23 ± 2) °C for 24 h ± 15 min. Remove, wash off any excess liquid and store at (23 ± 2) °C for (24 ± 1) h before testing it in accordance with the method described in 5.2.2.

6 Requirements for penetration resistant inserts

6.1 General

NOTE Penetration resistant material can be tested in accordance with this standard, even in an unshaped status, if it is intended to be cut and/or shaped by the footwear or sole manufacturer. When shaped inserts are tested in accordance with this standard, their suitability to fit into footwear is not assured, because the dimensional conformity to the footwear depends on the individual shape of each model of footwear.

Each single test result shall comply with the applicable requirement, otherwise the overall result of the whole lot shall be deemed to be "fail". In case of different single results obtained by the same test on equal samples, the worst value shall be stated as test result ("worst case principle" to be applied).

For number of samples and tests see also 7.1.

6.2 Requirements for all types of penetration resistant inserts

6.2.1 Resistance to nail penetration

When the inserts are tested in accordance with the applicable method described in 7.2.1 using a force of at least 1 100 N, the tip of the test nail shall not penetrate through the test piece. A "pass" result requires that the tip of the test nail does not protrude from the rear side of the test piece to be checked by visual, cinematographic or electrical detection.

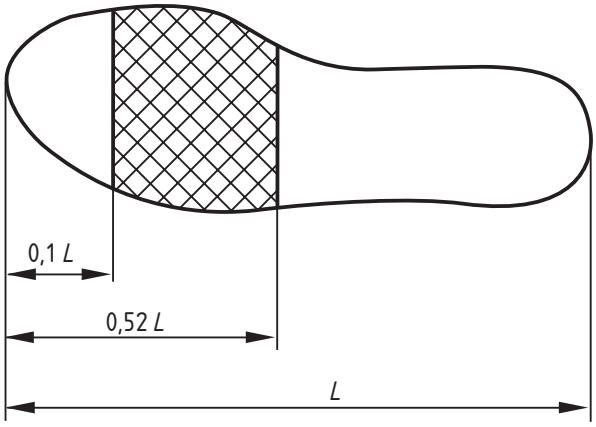
6.2.2 Flexing resistance

When tested in accordance with the method described in 7.2.2, the inserts shall exhibit no visible signs of cracking, disintegration or delamination after having been subjected to 1×10^6 (one million) flexion cycles.

6.3 Special requirements for metal penetration resistant inserts

6.3.1 Dimensions

Metal penetration resistant inserts can be flat or bended in order to better fit the individual boot design. For the needs of their positioning in the footwear, the presence of up to three holes in one insert is allowed, each of them with a diameter of not more than 3 mm. However, no holes are allowed in the area between 10 % and 52 % of the overall length of the insert, measured from its top (see Figure 9).



Key

L overall length of the metal insert

Figure 9 — Designation of area of metal penetration resistant inserts in which no holes are permitted

6.3.2 Corrosion resistance

Both before and after testing in accordance with the method described in 7.3, the inserts shall exhibit not more than three areas of corrosion, none of which shall measure more than 2 mm in any direction.

6.4 Special requirements for non-metal penetration resistant inserts − Stability against ageing and environmental influence

When subjected to each single one of the five treatments described in 7.4 and tested in accordance with the method described in 7.2.1, the inserts shall conform to the requirements of 6.2.1

NOTE The five treatments of 7.4.2 to 7.4.6 are basically the same as those of 5.4.2 to 5.4.6 for testing toe caps.

7 Test methods for penetration resistant inserts

7.1 General

Each required property shall be tested at least two or three times, as specified in Table 4. In case of ready-shaped inserts, samples of different sizes shall be used. In case of unshaped material cut out suitable test pieces, giving them a shape similar to a typical insole of approximate size 41 − 42 (Paris Point).

Where repetitions lead to different results on equal samples, the worst value shall be reported as test result.

New test pieces shall be used for each of the environmental treatments indicated in 7.4.

Table 4 — Summary of requirements for penetration resistant inserts [a]

Property	Subclause	Metal insert	Non-metal insert	Number of tests
Nail penetration resistance	6.2.1	X	X	Not less than three
Multiple flex resistance	6.2.2	X	X	Not less than two
Corrosion resistance	6.3.2	X	-	Not less than three
Nail penetration resistance after five environmental treatments	6.4	-	X	Not less than two for each treatment
[a] For all tests use samples of different sizes, if applicable.				

7.2 All types of penetration resistant inserts

7.2.1 Determination of penetration resistance

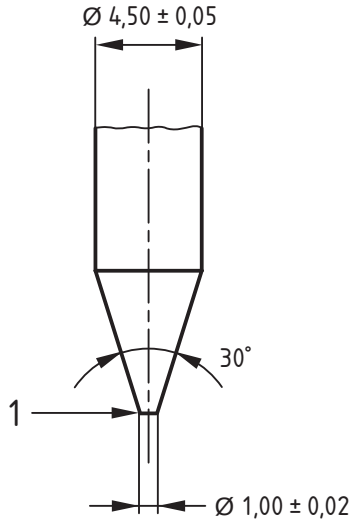
7.2.1.1 Apparatus

7.2.1.1.1 Compression machine, capable of applying a uniform speed of (10 ± 3) mm/min and of measuring compressive forces up to at least 2 kN.

7.2.1.1.2 Test nail, of diameter (4,5 ± 0,05) mm with a truncated end of the form and dimensions as shown in Figure 10.

The test nail should be examined at intervals for its ongoing conformity to Figure 10; in case of non-conformity the test nail shall be corrected or replaced. Steel of hardness HRc ≥ 60 has proven to be suitable for the nail.

Dimensions in millimetres



Key

1 Truncated tip

Figure 10 — Test nail for penetration resistance test

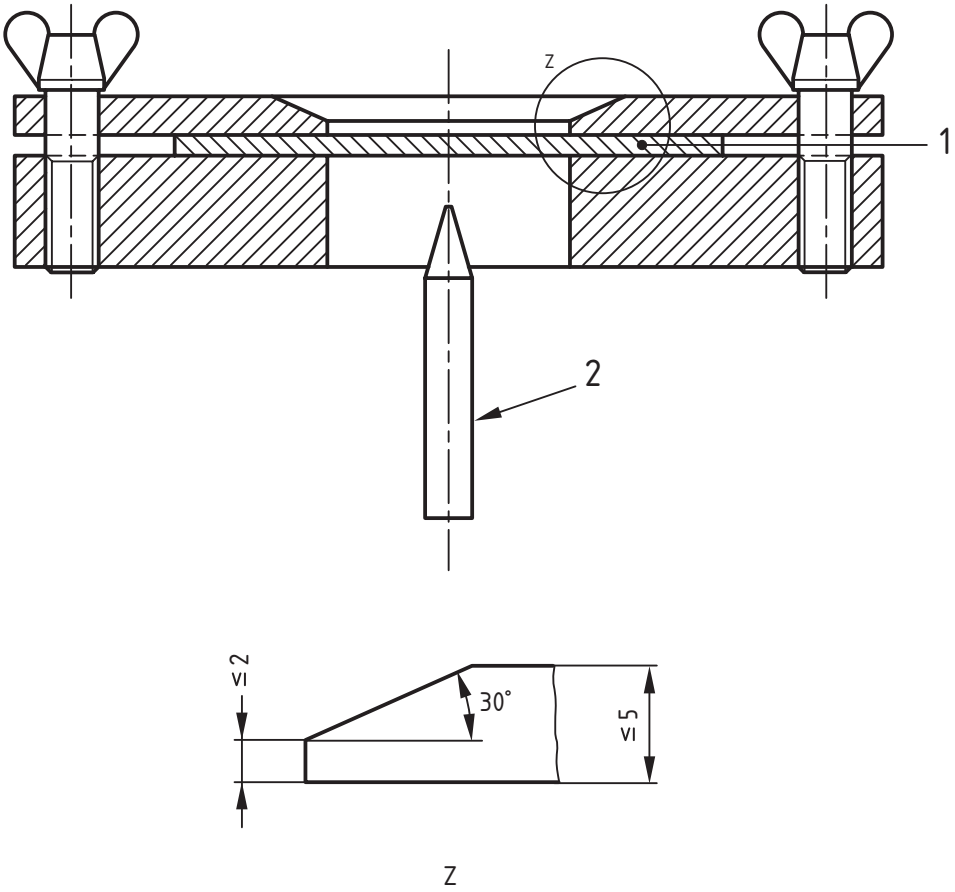
7.2.1.1.3 Clamping device.

A suitable clamping device consists of two rigid platens with central coaxial holes of diameter (25 ± 0,2) mm, connected by screws or other suitable means to clamp the test piece in position and prevent it from slipping during the puncture test (see Figure 11). This device is fixed to the upper traverse of the compression test

machine in a way that the test piece can be visually inspected on its upper surface opposed to the puncture. To enable visual inspection, the thickness of the upper platen shall not be more than 5 mm, with a conical shape around the centre hole as specified in Figure 11. The test nail is fixed upwards to the lower sample holder of the compression test machine so that the tip of the nail will be forced perpendicularly against the centre of the test piece (or vice versa) when the machine runs.

NOTE To prevent slipping, a special preparation of the clamping surfaces (e.g. application of emery paper) may be appropriate. Also the use of a tensile testing machine is possible if mounting the clamping device into a compression cage.

Dimensions in millimetres



Key

1 Test piece
2 Nail

Figure 11 — Schematic example of apparatus for the penetration resistance test of inserts

7.2.1.2 Preparation of test piece

Either use the complete insert as the test piece and carry out three tests upon it or cut three test pieces, of at least diameter 50 mm (metal inserts) or 75 mm (non-metal inserts) from the samples and test each separately.

7.2.1.3 Procedure

Fix the test piece firmly between the two platens (see Figure 11), applying sufficient clamping force to prevent the test piece from slipping. The distance of the point to undergo puncture from any previous puncture point and from any edge of the test piece shall be at least 25 mm (metal inserts) or 35 mm (non-metal inserts).

Run the testing machine at a speed of (10 ± 3) mm/min up to the required force of 1 100 N (see 6.2.1.), then stop the machine and carry out either the visual inspection within 10 s at an angle of (90 ± 15)° to the nail axis

or an electrical or cinematographic detection. If the opposite surface of the test piece has been penetrated, the test piece has failed the test. If separation between the layers of the test piece occurs ("tent effect") the test piece has failed the test.

NOTE The present method and its requirement lead to a pass/fail result without distinction between different levels of performance. However, in order to obtain additional information, a higher puncture force can be applied, e.g. for research needs or to compare various materials or solutions.

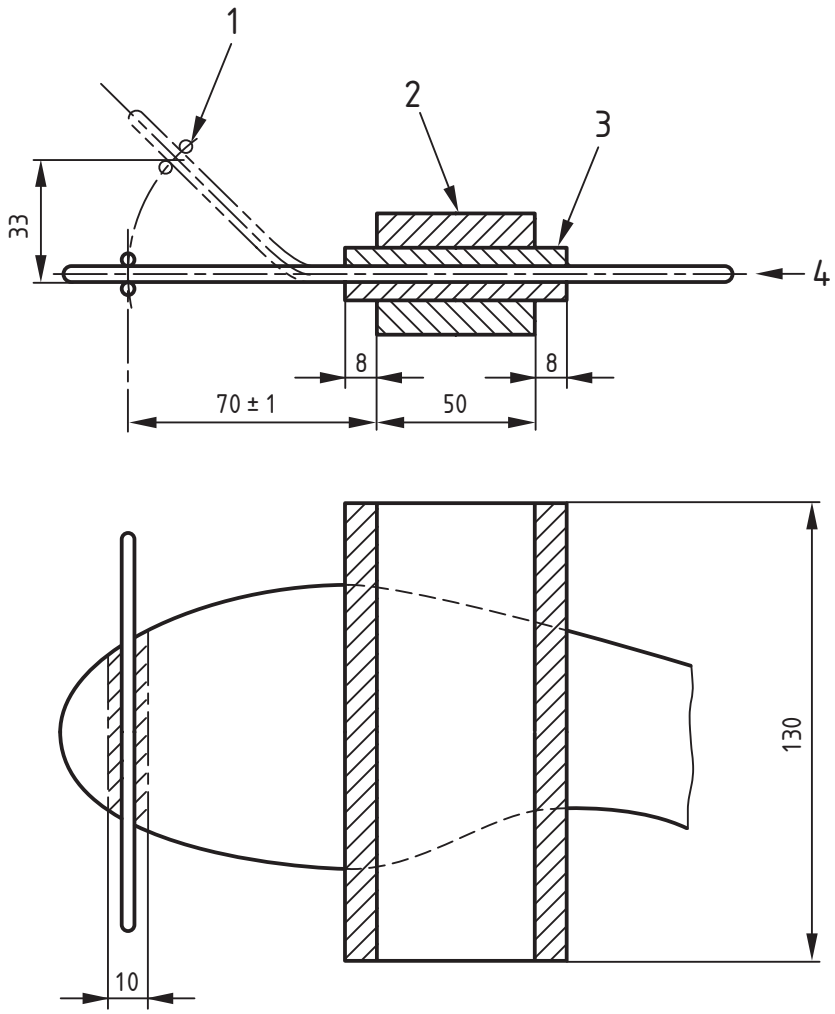
7.2.2 Determination of flexing resistance

7.2.2.1 Apparatus

7.2.2.1.1 Flexing apparatus, comprising a suitable flexing guide (e.g. a pair of bars) to move the free end of the insert through a specified distance at a defined rate and a clamping device consisting of two elastic interlayers approximately 4 mm thick and of Shore A hardness 75 ± 5 with two metal clamping plates at least 130 mm wide.

In the zero position, the guide acts at a distance of (70 ± 1) mm from the clamping plates (see Figure 12). In order to accommodate all sizes of inserts, the flexing line can be shifted by up to 10 mm in the direction of the heel (see the shaded region in Figure 13). The apparatus shall be suitable to perform the flex test at a frequency of (16 ± 1) Hz.

Dimensions in millimetres

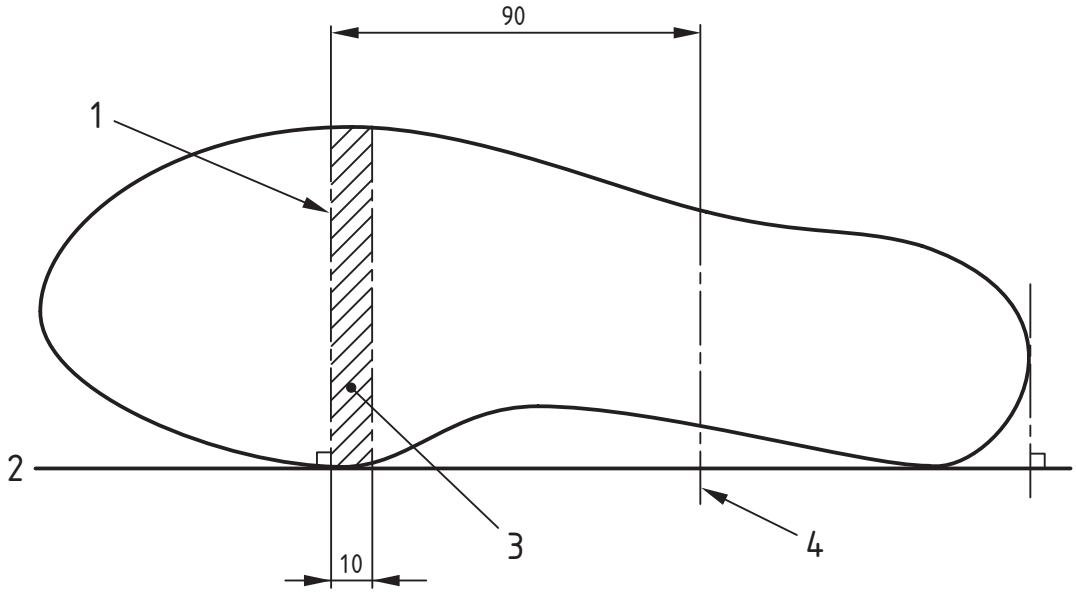


Key

1 Flexing guide 2 Clamping plates 3 Elastic interlayer 4 Test piece

Figure 12 — Example of details of a suitable construction of a flexing apparatus for penetration resistant inserts

Dimensions in millimetres



Key

1 Flexing line 2 Base line 3 Flexing zone 4 Line of cut

Figure 13 — Flexing line for inserts

7.2.2.2 Determination of the flexing line

Lay the insert with its inner edge against a straight line in such a way that this line is at a tangent to the insert in the joint and heel regions. At the tangent to the joint construct a perpendicular. This line is the flexing line at which the insert is clamped (see Figure 13).

7.2.2.3 Preparation of test piece

If necessary, cut off the heel part of the insert at a distance of at least 90 mm from the flexing line (see Figure 13 and 7.2.2.2).

7.2.2.4 Test procedure

Deflect the test piece at a rate of (16 ± 1) Hz by moving the guide bar to a height of 33 mm, measured vertically above the zero position. Ensure by means of a guide that the test piece returns to the zero position after every deflection. After 1×10^6 flexes, carry out a visual examination of the test piece.

7.3 Test method for metal penetration resistant inserts − Determination of corrosion resistance

7.3.1 Preliminary examination

Examine the insert visually for signs of corrosion.

Measure the longest distance across of each area of corrosion and note the number of such areas.

7.3.2 Test procedure

Remove any grease, silicone, wax or similar substance which might be present on the surface. Cut from the material or insert samples two rectangular specimens of approximately 30 mm × 40 mm. Test each of these

specimens in a similar way to that described in 5.3.2, placing it between the two papers wetted with the test solution and on the glass plate.

After 48 h remove the filter paper and examine the specimens for signs of corrosion. Measure the longest distance across each area of corrosion and note the number of such areas.

NOTE Pay attention to cutting without producing on the test piece traces of the tool metal which could rust later. In case of doubt it is advised to clean the edges with emery paper.

7.4 Test methods for non-metal penetration resistant inserts

7.4.1 General

New samples shall be used for each of the following five treatments.

7.4.2 Effect of high temperature

Clamp the specimen into the penetration device and place it together with the device in an oven with forced air circulation, which is maintained at (60 ± 2) °C for at least 4 h ± 10 min; reduce the temperature to (45 ± 2) °C for another 18 h to 20 h. Remove the assembly from the oven and, within 2 min ± 30 s from removing it from the oven (or from an insulating box which may be used if necessary), start performing the penetration test in accordance with the method described in 7.2.1.

7.4.3 Effect of low temperature

Clamp the specimen into the penetration device and place it together with the device in a chamber which is maintained at (- 20 ± 2) °C for at least 4 h ± 10 min. Change the temperature to (- 6 ± 2) °C for another 18 h to 20 h. Remove the assembly from the chamber and within 2 min ± 30 s from removing it from the chamber (or from an insulating box which may be used if necessary) start performing the penetration test in accordance with the method described in 7.2.1.

7.4.4 Effect of acid

Totally immerse the penetration resistant insert in sulfuric acid solution, c(H_2SO_4) = 1 mol/l, at (23 ± 2) °C for 24 h ± 15 min. Remove, wash off any excess acid with water and store at (23 ± 2) °C for (24 ± 1) h before testing it in accordance with the method described in 7.2.1.

7.4.5 Effect of alkali

Totally immerse the penetration resistant insert in sodium hydroxide solution, c(NaOH) = 1 mol/l, at (23 ± 2) °C for 24 h ± 15 min. Remove, wash off any excess alkali with water and store at (23 ± 2) °C for (24 ± 1) h before testing it in accordance with the method described in 7.2.1.

7.4.6 Effect of fuel oil

Totally immerse the penetration resistant insert in 2,2,4-trimethylpentane (octane) at (23 ± 2) °C for 24 h ± 15 min. Remove, wash off any excess liquid and store at (23 ± 2) °C for (24 ± 1) h before testing it in accordance with the method described in 7.2.1.

8 Marking

8.1 Toe Caps

Toe caps shall be clearly and permanently marked with the following information:

a) toe cap number (see Tables 2 and 3);

b) left or right;

c) manufacturer's identification mark;

d) manufacturer's type designation;

e) 1) **S** or **200 J** (toe caps designed for safety footwear);

2) **P** or **100 J** (toe caps designed for protective footwear);

f) the number of this standard.

8.2 Penetration resistant inserts

Penetration resistant inserts shall be clearly and permanently marked with the following information:

a) insert size (if applicable);

b) manufacturer's identification mark;

c) manufacturer's type designation;

d) the number of this standard.

NOTE 1 Marking by embossing is acceptable. Marking of the size is not compulsory when the material is distributed as platen, and die-cutting or otherwise shaping is performed by a third party.

NOTE 2 The toe caps and penetration resistant inserts covered by this standard are not PPE. "CE" marking would be against the provisions of the Directive 89/686/EEC and therefore is not admitted.

Bibliography

[1] Council Directive 89/686/EEC of 21 December 1989 on the approximation of the laws of the Member States relating to personal protective equipment

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