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Foot and leg protectors — Requirements and test methods for footwear components —

Part 3: Metallic perforation resistant inserts

Protecteurs du pied et de la jambe — Exigences et méthodes d'essais pour les composants de chaussure —

Partie 3: Inserts anti-perforation métalliques

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Foreword

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

A list of all parts in the ISO 22568 series can be found on the ISO website.

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

Introduction

ISO 20345, ISO 20346 and ISO 20347 are related 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 On introducing these standards all national standards relating to metallic perforation resistant inserts were withdrawn leaving the manufacturers of these items with no means of demonstrating the performance of their products. This document has been prepared to allow manufacturers to demonstrate the performance level of the metallic perforation resistant inserts before being inserted into the footwear.

Metallic perforation resistant inserts and materials complying with the requirements of this document are suitable components of "PPE footwear".

Foot and leg protectors — Requirements and test methods for footwear components —

Part 3:
Metallic perforation resistant inserts

1 Scope

This document specifies requirements and test methods for the metallic perforation resistant inserts with resistance against mechanical perforation, intended to function as components of PPE footwear (e.g. as described by ISO 20345, ISO 20346 and ISO 20347).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 20345, *Personal protective equipment — Safety footwear*

ISO 20346, *Personal protective equipment — Protective footwear*

ISO 20347, *Personal protective equipment — Occupational footwear*

3 Terms and definitions

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

3.1
metallic perforation resistant insert
metallic footwear component placed (or intended to be placed) in the sole complex in order to provide protection against mechanical perforation

4 Requirements for metallic perforation resistant insert

4.1 General

Perforation resistant material shall be tested in accordance with this document, 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 document, 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.

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

— statistical method, e.g. that given in ISO 5725-2[1];

— mathematical method, e.g. that given in ISO/IEC Guide 98-3[2];

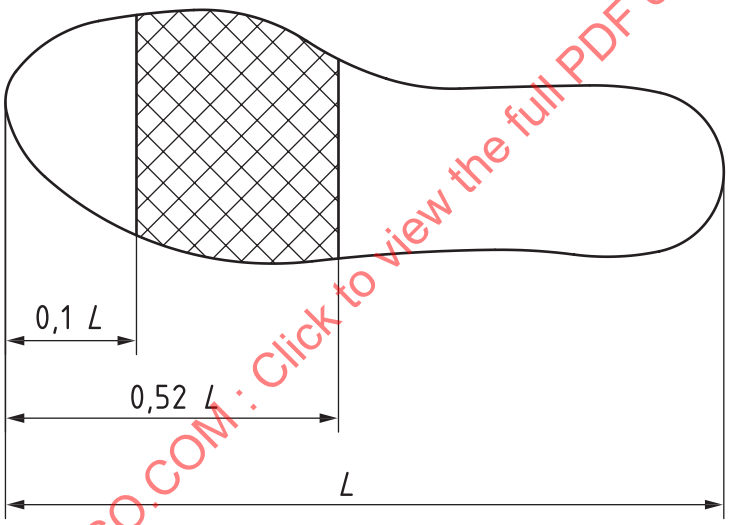
— uncertainty and conformity assessment as given in ISO/IEC Guide 98-4[3];

— JCGM 100:2008[4].

Table 1 — Summary of requirements and number of samples

Property	Subclause	Number of samples
Resistance to nail perforation	4.2.	Metallic material: 1 sample Ready –shaped inserts: 1 sample
Flexing resistance	4.3	Metallic plate: 1 sample Ready –shaped inserts: 2 different sizes
Corrosion resistance	4.4	Metallic plate: 1 sample Ready –shaped inserts: 1 sample
NOTE 2 For details, see 4.2 to 4.4.		

Metal perforation 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 3 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 1).



Key

L overall length of the metal insert

Figure 1 — Designation of the area of metal perforation resistant inserts in which no holes are permitted

4.2 Resistance to nail perforation

When the metallic perforation resistant inserts are tested in accordance with the applicable method described in 5.1, all the results reported as described in 5.1.3 shall be equal or greater than 1 100 N.

4.3 Flexing resistance

When tested in accordance with the method described in 5.2, the metallic perforation resistant inserts shall exhibit no visible signs of cracking, disintegration or delamination after having been subjected to 1×10^6 (one million) flexion cycles.

4.4 Corrosion resistance

Both before and after testing in accordance with the method described in 5.3, the metallic perforation resistant inserts shall exhibit not more than three areas of corrosion, none of which shall measure more than 2 mm in any direction.

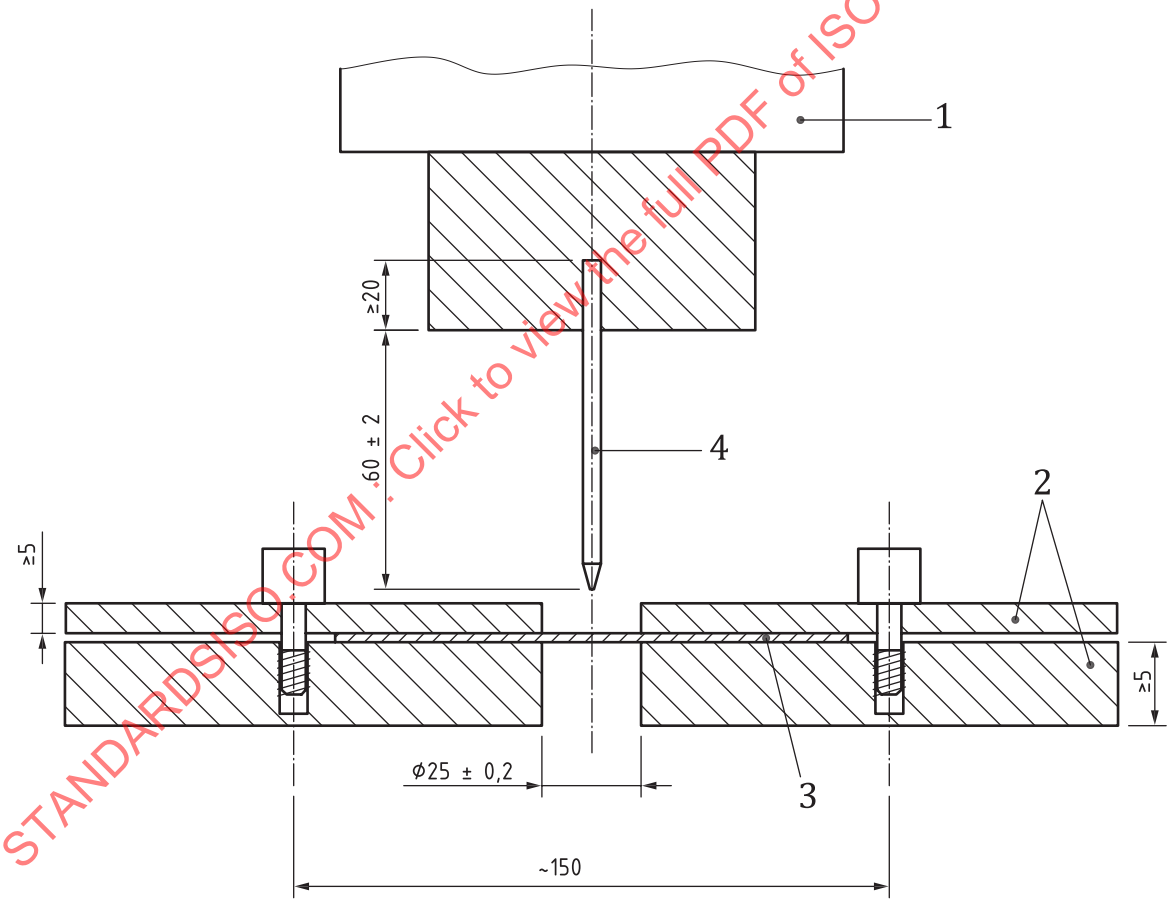
5 Test methods for the metallic perforation resistant inserts

5.1 Determination of perforation resistance

5.1.1 Apparatus

5.1.1.1 Test equipment, capable of measuring a compressive force up to at least 2 000 N, fitted with a pressure plate (5.1.1.2), in which a test nail (5.1.1.3) is fixed, and a parallel plate with a circular opening of diameter (25 ± 0,2) mm. The axes of this opening and the test nail shall be coincident (see Figure 2).

Dimensions in millimetres



Key

1	pressure platen	3	test piece
2	plates	4	nail

Figure 2 — Apparatus for perforation resistance test of metallic perforation resistant insert (example)

5.1.1.2 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 2).

This device is fixed in the compression test machine. The test nail is fixed in the 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 when the machine runs.

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

5.1.1.3 Test nail, with

— a shape conical, angle of (30 ± 2)°,

— a diameter of (4,50 ± 0,05) mm,

— with a truncated end of diameter of (1 ± 0,02) mm,

— a length ≥80 mm,

— a protruding length of (60 ± 2) mm, and

— with steel of hardness HRC ≥ 60 proven to be suitable for the nail.

See Figure 3.

The test nail should be examined after 125 perforations for its ongoing dimensional conformity to Figure 3; 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.

5.1.2 Test sample

Ready-shaped inserts can be used directly.

Unshaped metallic plates shall be greater than 40 mm × 40 mm.

5.1.3 Test procedure

5.1.3.1 For ready-shaped inserts

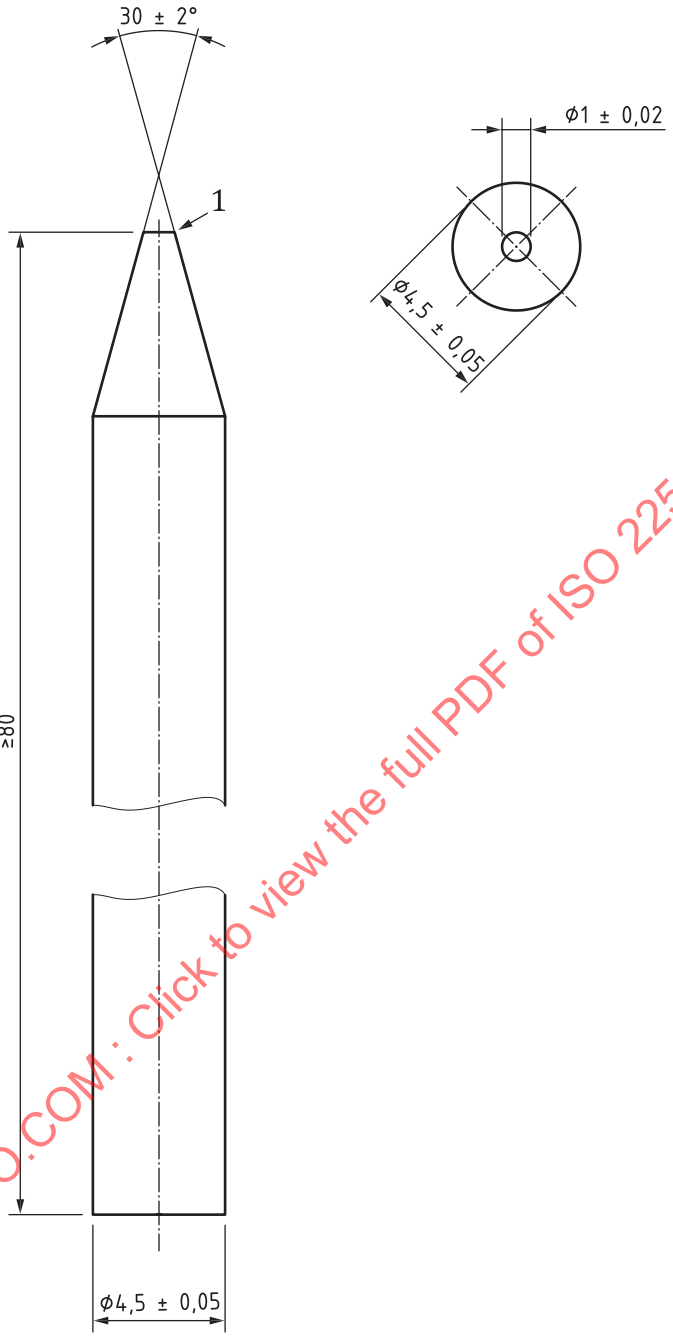
Place the test piece on the clamping device in such a way that the steel nail can perforate it. Press the nail against the test piece at a speed of (10 ± 3) mm/min.

Record the maximum force in Newton and stop the test after the first decrease of the perforation force.

Carry out the test at 3 different points on the test piece with a minimum distance of 30 mm between any two perforation points. The test point shall be at least 20 mm away from any edge of the sample.

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

Dimensions in millimetres



Key

1 truncated tip

Figure 3 — Test nail for perforation resistance test

5.1.3.2 Metallic plate

Place the test piece on the clamping device in such a way that the steel nail can perforate it. Press the nail against the test piece at a speed of (10 ± 3) mm/min until the tip has perforated completely and measure the maximum force.

Carry out the test at three different points on the test piece with a minimum distance of 30 mm between any two perforation points. The test point shall be at least 20 mm away from any edge of the sample.

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

5.1.4 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 22568-3:2019;

b) a full description of the samples tested including commercial sizes, styles, codes, colours, nature, etc.;

c) results according to 5.1.3;

d) any deviation by agreement and otherwise from the present test method.

5.2 Determination of flexing resistance

5.2.1 Apparatus

Flexing apparatus, comprising a suitable flexing guide (e.g. a pair of bars) to move the free end of the metallic perforation resistant 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 4). In order to accommodate all sizes of metallic perforation resistant inserts, the flexing line can be shifted by up to 10 mm in the direction of the heel (see the shaded region in Figure 5). The apparatus shall be suitable to perform the flex test at a frequency of (16 ± 1) Hz.

5.2.2 Sampling

5.2.2.1 Number of test pieces

In case of ready-shaped metallic perforation resistant inserts, samples of two different sizes shall be tested. One right and one left insert shall be tested.

For unshaped material, sample shall be cut using a mechanical punch or press. Cut out two suitable test pieces, giving them a shape similar to a typical insole of approximate size 41 – 42 (Paris Point).

The cutting can affect the results, no burring shall be present on the sample edge

5.2.2.2 Determination of the flexing line

Lay the metallic perforation resistant insert with its inner edge against a straight line in such a way that this line is at a tangent to the metallic perforation resistant 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 metallic perforation resistant insert is clamped (see Figure 5).

5.2.2.3 Preparation of test piece

If necessary, cut off the heel part of the metallic perforation resistant insert at a distance of at least 90 mm from the flexing line (see Figure 5 and 5.2.2.2).

5.2.3 Test procedure

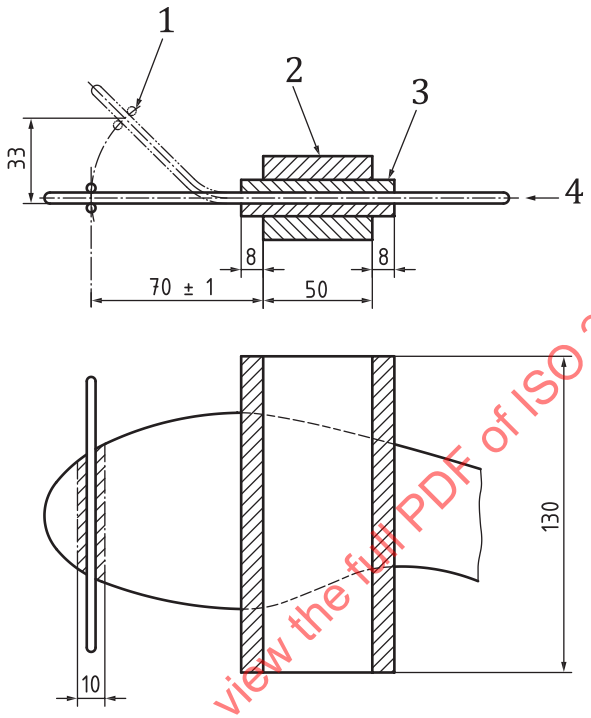
Deflect the test piece at a rate of (16 ± 1) Hz by moving the guide bar to a height of 33 mm, measured vertically above the zero position. Ensure by means of a guide that the test piece returns to the zero position after every deflection. After 1×10^6 flexes, carry out a visual examination of the test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

5.2.4 Results

For ready-shaped metallic perforation resistant inserts, the two results for the two different sizes shall be reported.

In case of unshaped material, the two results shall be reported.

Dimensions in millimetres

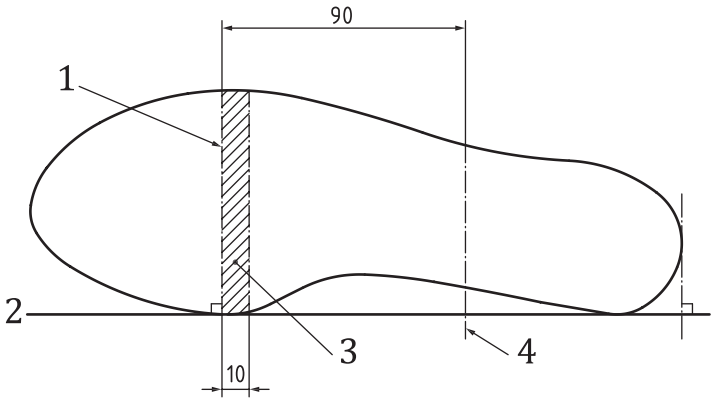


Key

1	flexing guide	3	elastic interlayer
2	clamping plates	4	test piece

Figure 4 — Example of details of a suitable construction of a flexing apparatus for metallic perforation resistant inserts

Dimensions in millimetres



Key

1	flexing line	3	flexing zone
2	base line	4	line of cut

Figure 5 — Flexing line for metallic perforation resistant inserts

5.2.5 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 22568-3:2019;

b) a full description of the samples tested including commercial styles codes, colours, nature, etc.;

c) results of the visual examination according to 5.2.4;

d) any deviation by agreement and otherwise from the present test method.

5.3 Determination of corrosion resistance

5.3.1 Preliminary examination

Examine the metallic perforation resistant insert visually for signs of corrosion.

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

5.3.2 Test procedure

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

Cut from the material or metallic perforation resistant insert samples two rectangular specimens of approximately 30 mm × 40 mm.

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 test piece to be tested over the free end of one filter paper to have a good contact with the wetted area and lay the other filter paper over the test piece so that the greatest possible area is in contact with the filter paper. Ensure that the filter paper remains saturated throughout the test, see Figure 6.

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 metal of the pool which could rust later. In case of doubt it is advised to clean the edges with emery paper.

