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

Part 4:
Non-metallic perforation resistant inserts

Protecteurs du pied et de la jambe — Exigences et méthodes d'essais pour les composants de chaussure — Partie 4: Inserts anti-perforation non métalliques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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.

This second edition cancels and replaces the first edition (ISO 22568-4: 2019), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Table 2, changes in the type names from X and Y to PL and PS, new requirements ("tent effect" and minimum value of 950N)
- New nail see Figure B.1 (conical shape instead of pyramidal)
- 3.2 new definition
- Figure B.3 new dimension of the nail
- The annex C and the reference material have been deleted.

Introduction

ISO DIS 20345:2020, ISO DIS 20346:2021 and ISO DIS 20347:2021 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 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 type of the perforation resistant inserts before being inserted into the footwear.

Non-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 4:
Non-metallic perforation resistant inserts

1 Scope

This document specifies requirements and test methods for the non-metallic inserts with resistance against mechanical perforation, intended to function as components of PPE footwear (e.g. as described by ISO DIS 20345:2020, ISO DIS 20346 :2021and ISO DIS 20347:2020).

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.

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ISO 105-E04:2013, *Textiles — Tests for colour fastness — Part E04: Colour fastness to perspiration*

ISO/DIS 20344:2020, *Personal protective equipment — Test methods for footwear*

ISO/DIS 20345:2020, *Personal protective equipment — Safety footwear*

ISO/DIS 20346:2020, *Personal protective equipment — Protective footwear*

ISO/DIS 20347:2020, *Personal protective equipment — Occupational footwear*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO DIS 20345:2020, ISO DIS 20346:2020 and ISO DIS 20347:2020 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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

3.2
"tent effect"
separation between the layers of the test piece during the testing procedure given procedure of Annex A

4 Requirements for non-metallic perforation resistant inserts

4.1 General

Depending on the footwear construction, the non-metallic perforation resistant inserts could be in contact with the wearer foot, therefore the requirements of ISO DIS 20345:2020, ISO DIS 20346:2020 and ISO DIS 20347:2020 should be taken into account (for example abrasion resistance, water absorption, innocuousness).

Perforation resistant material can 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 non-metallic perforation resistant 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.

Table 1 — Summary of requirements and number of samples

Property	Subclause	Number of samples	Status
Resistance to nail perforation	4.2	Non-metallic material: 1 sample Ready –shaped inserts: 1 sample	mandatory
Flexing resistance	4.3	Non-metallic material: 1 sample Ready – shaped inserts: 2 different sizes	mandatory
Stability against ageing and environmental influence	4.4	Non-metallic material: 1 sample for each test Ready –shaped inserts: 1 sample for each test	mandatory
Electrical resistance	4.5	Non-metallic material: 1 sample	optional
NOTE For details, see 4.2 to 4.5.			

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

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

— a mathematical method, e.g. that given in ISO/IEC Guide 98-3[4];

— uncertainty and conformity assessment as given in ISO/IEC Guide 98-4[5];

— JCGM 100:2008[6].

4.2 Resistance to nail perforation

When the non-metallic perforation resistant inserts are tested in accordance with the applicable methods described in 5.1, they shall meet one of the two types given in Table 2.

Table 2 — Minimum requirements for the perforation force

Types	Test method	Requirements
Type PL	See 5.1.1	Perforation test (see A.4); the four results reported shall be "pass" with a force of 1100N No "tent effect" shall occur
Type PS	See 5.1.2	Perforation force (B.4) the average value reported shall be greater or equal to 1 100 N No single value shall be lower than 950N
NOTE This property has two types in term of the protection afforded. This covers the degree of risk or hazard that a user will face in terms of the type of working places. Type PS offers more appropriate protection from smaller diameter and sharper objects than type PL		

4.3 Flexing resistance

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

4.4 Stability against ageing and environmental influence

When subjected to each single one of the 4 treatments described in 5.3 and tested in accordance with the method described in 5.1, the non-metallic perforation resistant insert shall conform to the requirements of 4.2.

4.5 Electrical resistance

This property is optional and frequently requested when the non-metallic perforation resistant inserts are supposed to be used in a footwear with electrical properties (ISO DIS 20345:2020, 6.2.2.1 and 6.2.2.2).

The results of this test, see 5.4, is given as an information, this document does not fix requirements.

5 Test methods for the non-metallic perforation tests

5.1 Determination of perforation resistance

5.1.1 Method PL: with conical nail 4,5 mm diameter

The test method described in Annex A shall be used.

5.1.2 Method PS: with conical nail 3.0 mm diameter

The test method described in Annex B shall be used.

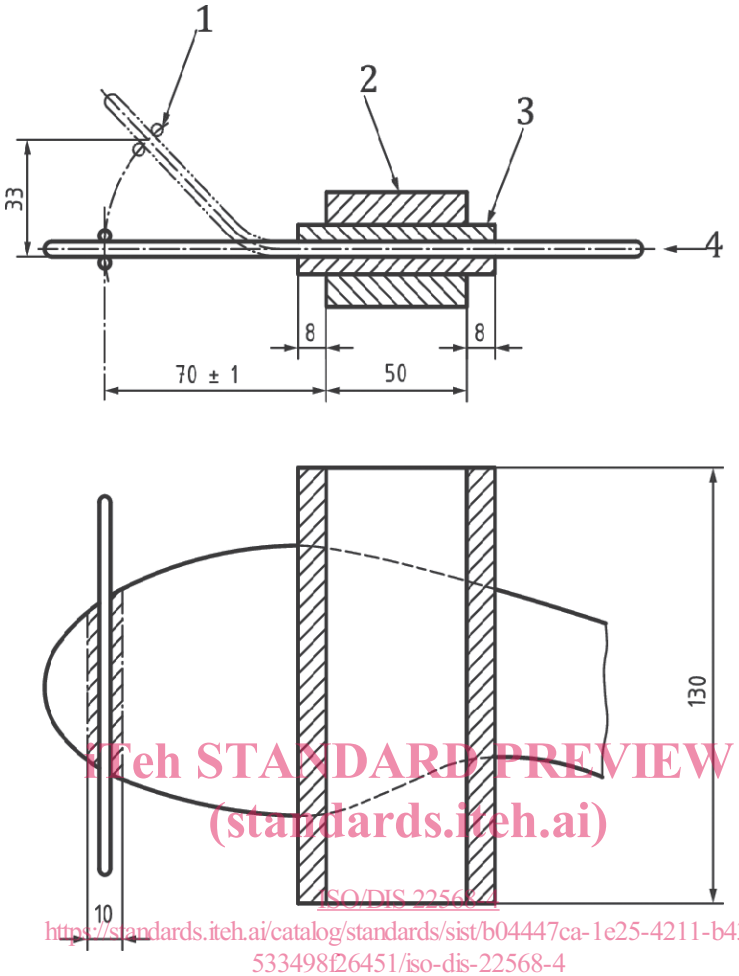
5.2 Determination of flexing resistance

5.2.1 Apparatus

Flexing apparatus, comprising a suitable flexing guide (e.g. a pair of bars) to move the free end of the non-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 1).

Dimensions in millimetres



Key

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

Figure 1 — Example of details of a suitable construction of a flexing apparatus for non-metallic perforation resistant inserts

5.2.2 Sampling

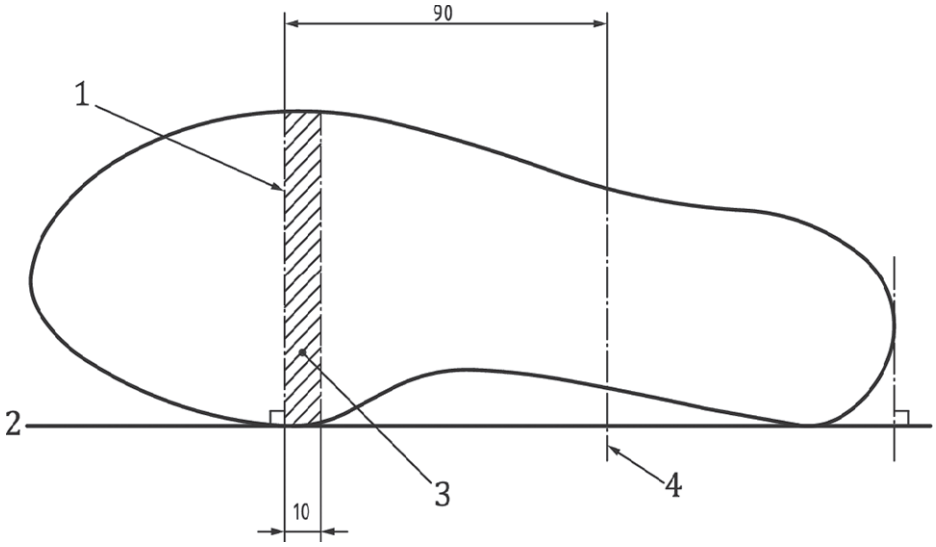
5.2.2.1 Number of test pieces

In case of ready-shaped non-metallic perforation resistant inserts, samples of two different sizes shall be tested. For unshaped material cut out two suitable test pieces, giving them a shape similar to a typical insole of approximate size 41 – 42 (Paris Point).

5.2.2.2 Determination of the flexing line

Lay the non-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 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 2).

Dimensions in millimetres



Key

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

Figure 2 — Flexing line for non-metallic perforation resistant inserts

5.2.2.3 Preparation of test piece

If necessary, cut off the heel part of the non-metallic perforation resistant insert at a distance of at least 90 mm from the flexing line (see Figure 2 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 non-metallic perforation resistant inserts, the two results for the two different sizes shall be reported.

In case of unshaped material, the 2 results shall be reported.

5.2.5 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 22568-4:2021;

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

c) the results of the visual examination;

d) description of any change of the test piece (for example delamination);

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