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SOUTH AFRICAN NATIONAL STANDARD

Personal protective equipment — Safety footwear

This national standard is the identical implementation of ISO 20345:2021, and is adopted with the permission of the International Organization for Standardization.

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This document references other documents normatively.

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INTERNATIONAL STANDARD

ISO 20345

Third edition
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Personal protective equipment — Safety footwear

Équipement de protection individuelle — Chaussures de sécurité

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Table of changes

Change No.	Date	Scope

National foreword

This South African standard was prepared by National Committee SABS/TC 1194/SC 01, *Personal safety – Foot protection*, in accordance with procedures of the South African Bureau of Standards, in compliance with annex 3 of the WTO/TBT agreement.

This document was approved for publication in October 2023.

This document supersedes SANS 20345:2014 (edition 2).

This document is referenced in section 13(1)(a) of the National Regulator for Compulsory Specifications Act, 2008 (Act No. 5 of 2008) in respect of technical standards for Personal protective equipment: Safety footwear (Compulsory specification – VC 9002) published by Government gazette No. 34395 of 01 July 2011.

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Contents

Page

Foreword v

1 Scope 1

2 Normative references 1

3 Terms and definitions 1

4 Classification and designs 8

5 Basic requirements for safety footwear 9
5.1 General 9
5.2 Design 12
5.2.1 General 12
5.2.2 Height of upper 12
5.2.3 Heel area 12
5.3 Whole footwear 13
5.3.1 Constructional performance 13
5.3.2 Toe protection 13
5.3.3 Leak proofness 15
5.3.4 Specific ergonomic features 15
5.3.5 Slip resistance 15
5.3.6 Innocuousness 16
5.3.7 Seam strength 16
5.4 Upper 16
5.4.1 General 16
5.4.2 Thickness 17
5.4.3 Tear strength 17
5.4.4 Tensile properties 18
5.4.5 Flexing resistance 18
5.4.6 Water vapour permeability and coefficient 18
5.4.7 Resistance to hydrolysis 18
5.5 Lining 19
5.5.1 General 19
5.5.2 Tear strength 19
5.5.3 Abrasion resistance 19
5.5.4 Water vapour permeability and coefficient 19
5.6 Tongue 19
5.6.1 General 19
5.6.2 Tear strength 20
5.7 Insole, insock and footbed 20
5.7.1 Thickness 20
5.7.2 Water permeability 20
5.7.3 Water absorption and desorption 20
5.7.4 Abrasion resistance 20
5.8 Outsole 20
5.8.1 General 20
5.8.2 Design 21
5.8.3 Tear strength 21
5.8.4 Abrasion resistance 21
5.8.5 Flexing resistance 22
5.8.6 Resistance to hydrolysis 22
5.8.7 Interlayer bond strength 22

6 Additional requirements for safety footwear 22
6.1 General 22
6.2 Whole footwear 24
6.2.1 Perforation resistance 24

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6.2.2 Electrical properties 26
6.2.3 Resistance to inimical environments 26
6.2.4 Energy absorption of seat region 26
6.2.5 Water resistance 27
6.2.6 Metatarsal protection 27
6.2.7 Ankle protection 27
6.2.8 Cut resistance 28
6.2.9 Scuff cap abrasion 28
6.2.10 Slip resistance 28
6.3 Upper — Water penetration and absorption 29
6.4 Outsole 29
6.4.1 Resistance to hot contact 29
6.4.2 Resistance to fuel oil 29
6.4.3 Ladder grip 29

7 Marking 29

8 Manufacturer's instructions and information 31
8.1 General 31
8.2 Electrical properties 31
8.2.1 Partially conductive footwear 31
8.2.2 Antistatic footwear 32
8.3 Insocks 33
8.4 Perforation resistance 33
8.5 Date of obsolescence 33

Annex A (normative) **Customized safety footwear (safety footwear adapted to fit an individual user or a single unit to fit an individual user)** **34**

Annex B (informative) **Assessment of the footwear by the wearer** **38**

Annex C (informative) **Slip resistance** **40**

Bibliography **43**

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

ISO 20345 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 161, *Foot and leg protectors*, in collaboration with Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 3, *Foot protection*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 20345:2011), which has been technically revised. The main changes compared to the previous edition are as follows:

— revision of the terms and definitions in Clause 3;

— Figure 1 to Figure 4 revised;

— Tables 1, 2 and 3 revised;

— heel area defined (5.2.3);

— toe protection, depending on ISO 22568-1 and ISO 22568-2, exchanging EN 12568:2010;

— requirement on slip resistance revised (5.3.5 and 6.2.10); marking "SRA, SRB and SRC" deleted; marking "SR" and "Ø" introduced;

— pH value and chromium VI tests added in 5.3.6; former separate clauses under upper, lining, tongue and insole/insock deleted;

— requirement for seam strength of hybrid footwear added (5.3.7);

— requirement for upper materials not fulfilling WVP explained (5.4.6);

— abrasion of insoles revised (5.7.4);

— outsole requirements revised (5.8);

— outsole thickness revised (5.8.2.1);

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- flexing resistance of outsole clarified (5.8.5);
- perforation resistant insert, depending on ISO 22568-3 and ISO 22568-4, exchanging EN 12568:2010;
- tolerance added (6.2.3.1);
- former Annex A Hybrid footwear included in the general text (Table 2, 5.4.1.2);
- optional requirement of metatarsal protection revised (6.2.6);
- optional requirement on ankle protection clarified (6.2.7);
- optional requirement for "SC" scuff cap abrasion added (6.2.9);
- water penetration and absorption, symbol "WRU" deleted, symbol "WPA" introduced;
- optional requirement for "LG" Ladder grip of outsoles added (6.4.3);
- marking revised (Table 16 and Table 20);
- two new categories added, S6 and S7 (Table 20);
- information on obsolescence date added (8.5);
- Annex A with requirements for customized safety footwear added;
- Annex B added;
- Annex C added;
- requirement for electrically insulating footwear (EN 50321) deleted.

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.

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Personal protective equipment — Safety footwear

1 Scope

This document specifies basic and additional (optional) requirements for safety footwear used for general purpose. It includes, for example, mechanical risks, slip resistance, thermal risks, ergonomic behaviour. It also specifies requirements for safety footwear equipped with customized insocks, customized safety footwear or individual manufactured customized safety footwear. This standard does not cover the property of high visibility because of interaction with the clothing (e.g. trousers cover the footwear) and work area conditions (e.g. dirt, mud).

Special risks are covered by complementary job-related standards (e.g. footwear for firefighters, electrical insulating footwear, protection against chain saw injuries, protection against chemicals and molten metal splash, protection for motorcycle riders).

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 20344:2021, *Personal protective equipment — Test methods for footwear*

ISO 22568-1:2019, *Foot and leg protectors — Requirements and test methods for footwear components — Part 1: Metallic toecaps*

ISO 22568-2:2019, *Foot and leg protectors — Requirements and test methods for footwear component — Part 2: Non-metallic toecaps*

EN 13832-3:2018, *Footwear protecting against chemicals — Part 3: Requirements for footwear highly resistant to chemicals under laboratory conditions*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 https://www.electropedia.org/

Note 1 to entry The component parts of footwear are illustrated in Figure 1, Figure 2 and Figure 3.

Note 2 to entry Further terms and definitions can be found in ISO 19952[4].

3.1
safety footwear
footwear incorporating safety features to protect the wearer from injuries that could arise through accidents

Note 1 to entry: Items of safety footwear are fitted with toecaps designed to give protection against impact of at least 200 J and against compression at least 15 kN.

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3.2
upper
part or parts of a footwear that cover the toes, the top of the foot, the sides of the foot, and optionally the back of the heel; it is attached to the outsole of a footwear

3.3
leather
hide or skin tanned to be imperishable

3.3.1
leather split
flesh or middle part of a hide or skin, obtained by splitting a *thick leather* (3.3), which is tanned to be imperishable

3.4
rubber
type of elastic *polymeric material* (3.5) which can be vulcanized

3.5
polymeric material
large molecules composed of repeating structural units (monomers) typically connected by chemical bond

EXAMPLE Polyurethane (PU) or polyvinylchloride (PVC).

3.6
insole
non-removable component used to form the base of the shoe to which the *upper* (3.2) is usually attached during lasting

3.7
insock
removable or non-removable footwear component used to cover completely the *insole* (3.6)

3.7.1
seat sock
removable or non-removable footwear component used to cover the *insole* (3.6) in the heel area

3.7.2
footbed
insock (3.7) designed according to the sole of the foot with or without the aim of correcting the posture

Note 1 to entry: "Non-removable" means that the component cannot be removed without any damage.

Note 2 to entry: "Removable" means that the component can be removed, but the safety features are only maintained when it is placed into the footwear while wearing.

3.8
lining
material covering the inner surface of the footwear

Note 1 to entry: The wearer's foot is in direct contact with the lining.

Note 2 to entry: Where an upper is split at the forepart 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.

3.9
cleat
protruding part of the outer surface of the *outsole* (3.10)

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3.10
outsole
outermost part to provide footwear with the necessary traction and protection from the floor surfaces it will be in contact with

3.10.1
rigid outsole
outsole, which can be bent less than an angle of 45° under a load of 30 N

Note 1 to entry: According to ISO 20344:2021, 8.5.

3.10.2
multi-layer outsole
made up of two or more material layers completely covering the entire surface; a tread cover of less than 0,5 mm is not considered a layer

3.11
perforation-resistant insert
component, placed in the outsole complex or used as an *insole* (3.6) simultaneously in order to provide protection against perforation

3.12
safety toecap
component, placed in the footwear to protect the toes of the wearer from impacts and compression

3.13
scuff cap
abrasion resistant material or component to protect against scuff of the upper external toe region during kneeling activities

3.14
heel area
counter (stiffener) area, rear part of the footwear

3.15
partially conductive footwear
footwear with low electrical resistance between the wearer and the ground, able to dissipate static electricity

3.16
antistatic footwear
footwear maintaining some electrical resistance between the wearer and the ground, able to dissipate some static electricity

3.17
fuel oil
aliphatic hydrocarbon constituent of petroleum

3.18
customized safety footwear
covering all individual customized footwear and other specific conditions of a foot

Note 1 to entry: Customized safety Footwear integrate in their design the recipient's own physiognomy and the specific arrangements aimed at modifying, correcting, compensating, curing, preventing, relieving a pathology, e.g. overweight, diabetes, hyperhidrosis, misalignments etc.

Note 2 to entry: Several types of customized safety footwear and footwear adaptions exist:

Type 1 – equipped with customized insocks

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Safety footwear (according to this document) incorporating customized insocks adapted to the wearers needs.

Type 2 – modified safety footwear

Safety footwear (according to this document) modified from its original construction to fit to an individual user.

See examples in ISO 21064:2017, 6.4[5].

Type 3 – Bespoke safety footwear

Safety footwear (according to this document) constructed as a single unit to fit an individual user.

See examples in ISO 21064:2017, 6.3.2 and 6.3.3[5].

Note 3 to entry: Adapted to fit an individual user or a single unit to fit an individual user.

Note 4 to entry: According to ISO 21064:2017, 3.2[5].

3.19
hybrid footwear
footwear that cannot be classified as footwear of class I or II

Note 1 to entry: There are two types of hybrid footwear (other than design E boots) see 3.19.1 and 3.19.2.

3.19.1
hybrid "moulded" footwear
vulcanized rubber or all moulded polymeric foot section integrally moulded around the toecap and often including the outsole, which can be unlined and usually does not incorporate an *insole* (3.6)

3.19.2
hybrid "mounted" footwear
vulcanized rubber or all moulded polymeric foot section that is manufactured separately and then constructed around a conventionally lasted *lining* (3.8)/*insole* (3.6) construction and often with a separately attached *outsole* (3.10)

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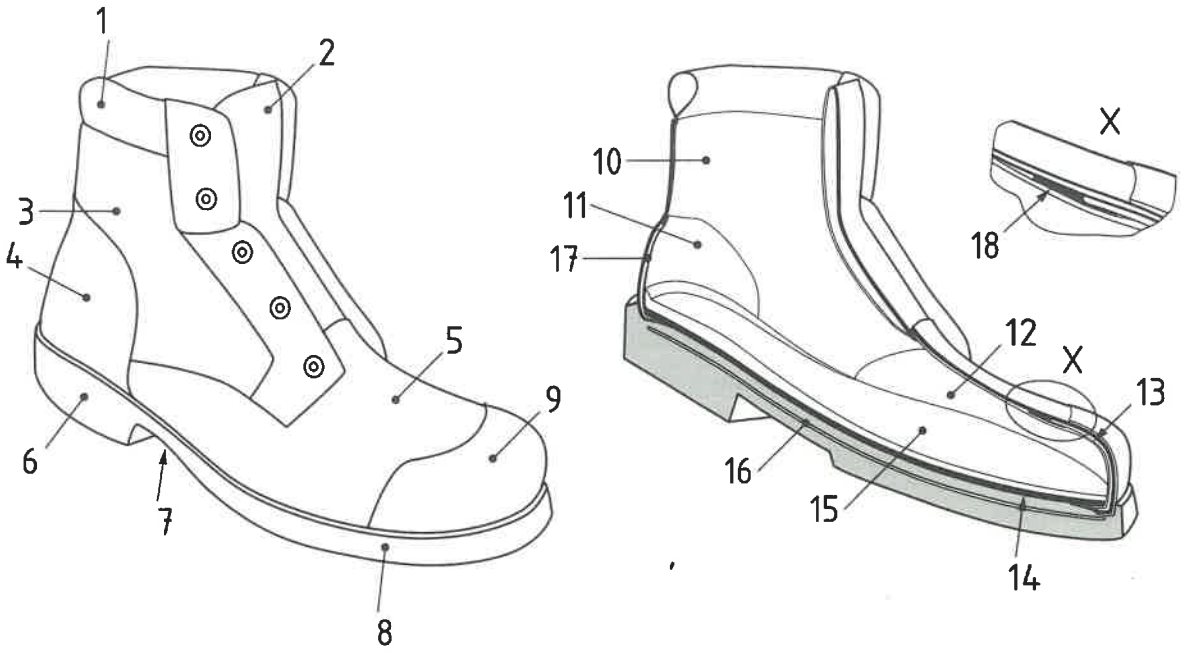

Key

1	collar	10	quarter lining
2	tongue	11	counter lining
3	upper – quarter	12	vamp lining
4	upper - counter	13	safety toecap
5	upper - vamp	14	insole
6	outsole – heel	15	insock/footbed
7	outsole – waist	16	perforation resistant insert
8	outsole – forepart	17	counter stiffener
9	scuff cap	18	toecap back edge covering

Figure 1 — Example parts of class I safety footwear

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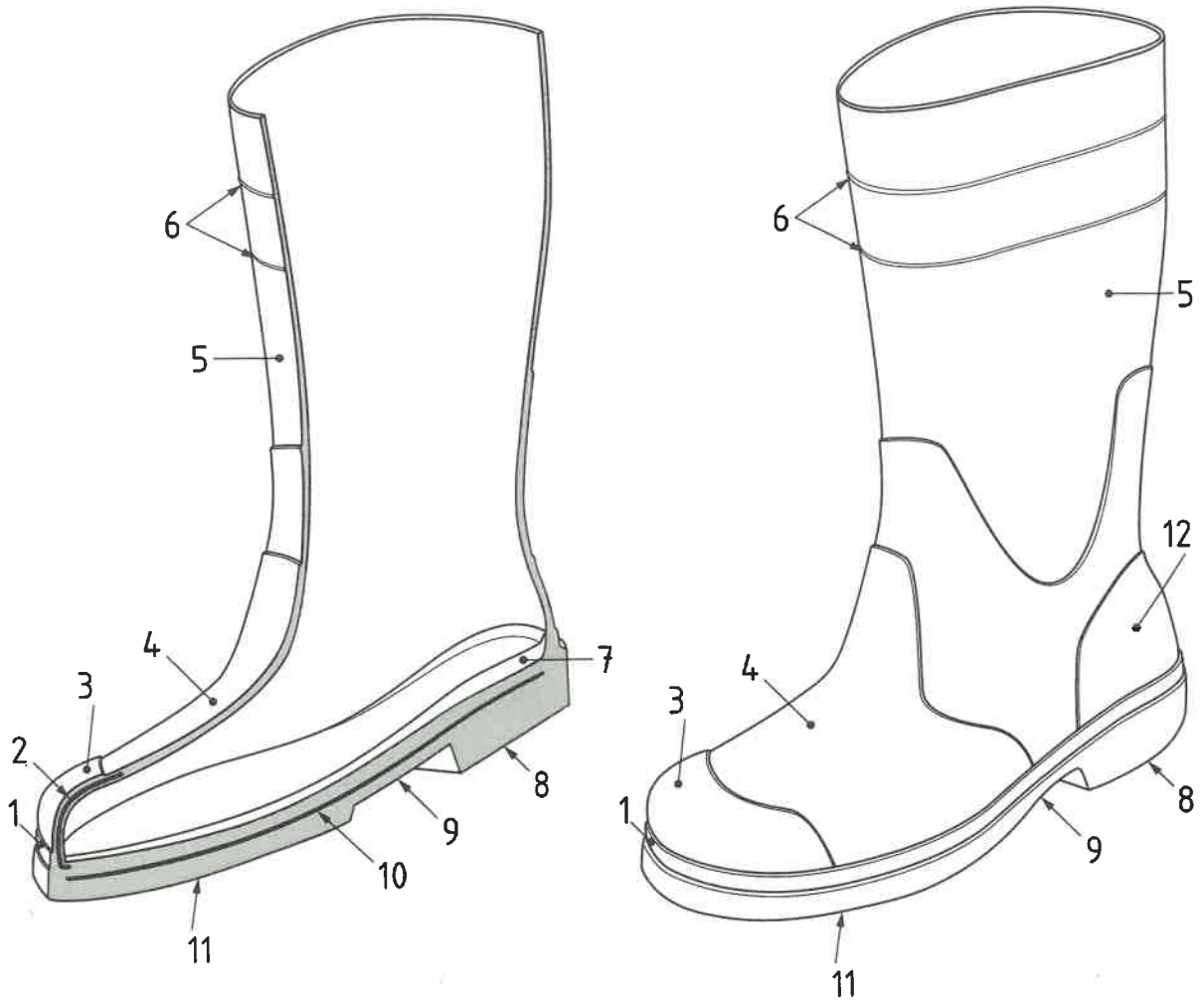

Key

1	foxing strip	7	insock/footbed
2	safety toecap	8	outsole – heel
3	scuff cap	9	outsole – waist
4	upper – vamp	10	perforation resistant insert
5	upper – shaft	11	outsole – forepart
6	trim marks	12	upper – counter

Figure 2 — Example parts of class II safety footwear

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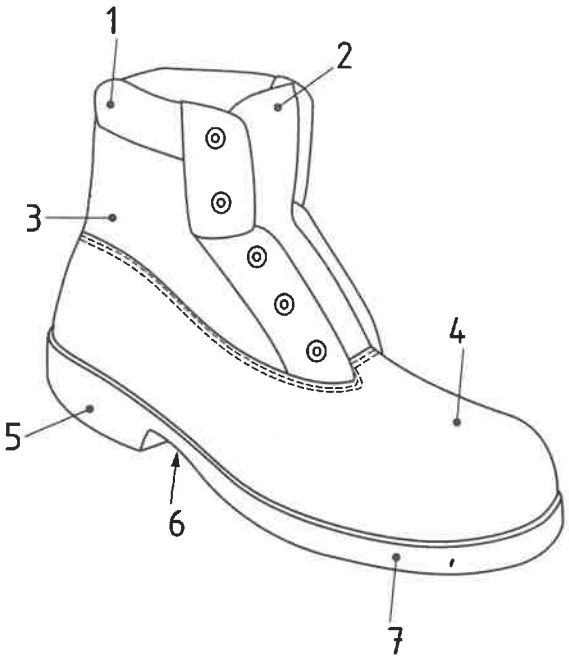

a) Example of hybrid safety footwear in general

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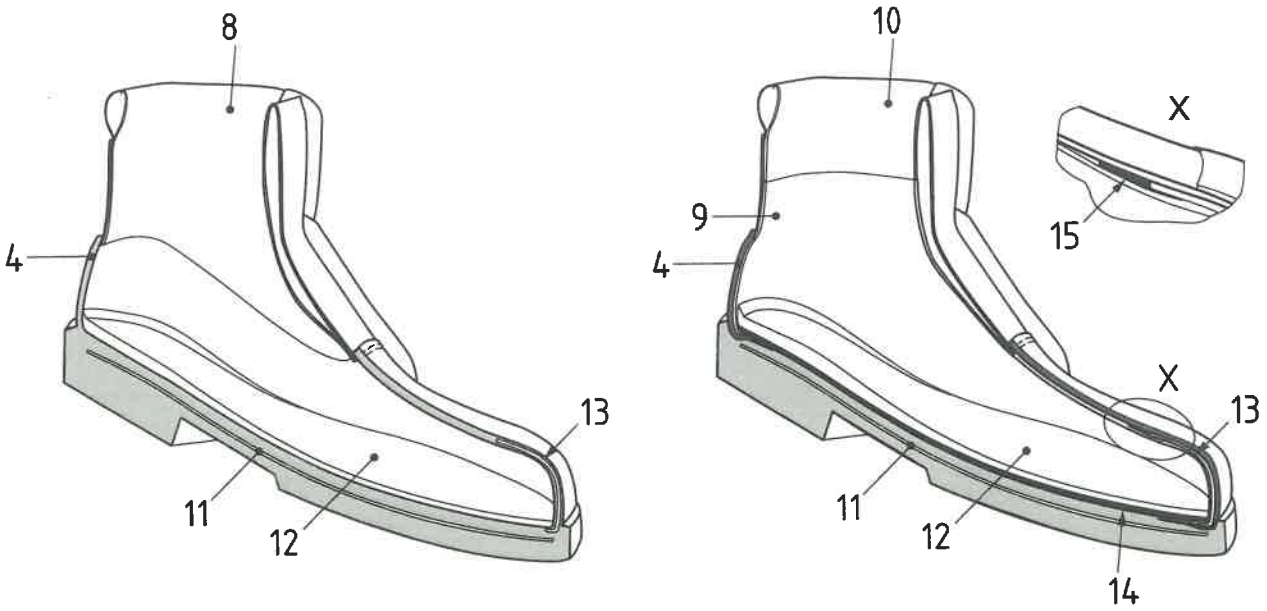

b) Hybrid moulded (entirely moulded lower section) **c) Hybrid mounted (separately attached sole unit)**

Key

1 collar
2 tongue
3 upper leather or fabric section
4 upper moulded rubber or polymeric part
5 outsole – heel
6 outsole – waist
7 outsole – forepart
8 lining
9 foot section lining
10 collar lining
11 perforation resistant insert
12 insock/footbed
13 safety toecap
14 insole
15 toecap back edge covering

Figure 3 — Example parts of hybrid safety footwear

4 Classification and designs

Safety footwear shall be classified in accordance with Table 1. Designs of footwear are illustrated in Figure 4.

Table 1 — Classification of safety footwear

Classification	Description
Class I	Footwear made from leather and other materials, excluding all-rubber or all-polymeric footwear (see Figure 1)
Class II	All-polymeric (i.e. entirely moulded) including all-rubber (i.e. entirely vulcanized) footwear (see Figure 2)
Hybrid footwear	See 3.19 (see Figure 3)

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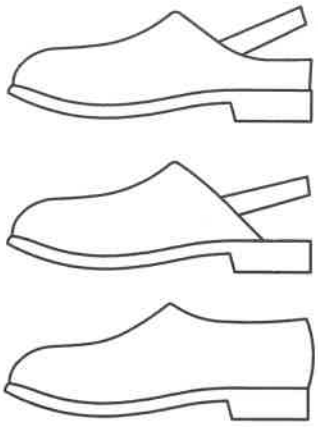
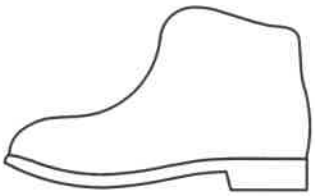


Design A – LOW SHOE



Design B – ANKLE BOOT

Design C – HALF KNEE BOOT

Design D – KNEE BOOT

Design E – THIGH BOOT

Key

× Variable extension, which can be adapted to the wearer.

NOTE Design E of class I and II safety footwear can be a knee-height boot (design D), equipped with a thin impermeable material which extends the upper which can be cut to adapt the boot height to the wearer. This design does not constitute hybrid footwear.

Figure 4 — Example designs of safety footwear

5 Basic requirements for safety footwear

5.1 General

Safety footwear class I, class II and hybrid footwear (depending on production method) shall conform to the basic requirements given in Table 2. Customized safety footwear (3.18) shall conform the requirements given in Table 2 and Annex A.

NOTE Footwear sizes are given in ISO 20344:2021, Annex B.

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Table 2 — Basic requirements for safety footwear

Requirement		Clause of this standard	Classification			
			Class I	Class II	Hybrid	
					mounted	moulded
Design	Height of upper	5.2.2	X	X	X	X
	Heel area (design A)	5.2.3	o	o	X	X
	Heel area (design B, C, D, E)	5.2.3	X	X	X	X
Whole footwear	Constructional performance:	5.3.1				
	— Construction	5.3.1.1	X		X	
	— Upper/outsole bond strength	5.3.1.2	X		X	
	Toe protection:	5.3.2				
	— General	5.3.2.1	X	X	X	X
	— Internal length	5.3.2.2	X	X	X	X
	— Width of toecap flange	5.3.2.3	X	X	X	X
	— Corrosion resistance	5.3.2.4	X	X	X	X
	— Behaviour of toecaps (thermal and chemical)	5.3.2.5	X	X	X	X
	— Impact resistance	5.3.2.6	X	X	X	X
	— Compression resistance	5.3.2.7	X	X	X	X
	Leak proofness	5.3.3		X		
	Specific ergonomic features	5.3.4	X	X	X	X
	Slip resistance[a] "not tested " (symbol Ø)	5.3.5.1	X	X	X	X
	ceramic tile floor with NaLS (without symbol)	5.3.5.2				
	Innocuousness	5.3.6	X	X	X	X
	Seam Strength	5.3.7			X	X
	Water resistance	6.2.5.			X	X
Upper	**General**	5.4.1	X	X	X	X
	Height of the area where upper requirements apply (class I)	5.4.1.1	X			
	Height of the area where upper requirements apply (hybrid)	5.4.1.2			X	X
	Thickness	5.4.2		X	X	X
	Tear strength	5.4.3	X			
	Tensile properties	5.4.4	X	X	X	X
	Flexing resistance	5.4.5		X	X	X
	Water vapour permeability and coefficient	5.4.6	X			
	Resistance to hydrolysis	5.4.7		X	X	X
Lining (Vamp)	Tear strength	5.5.2	X	o	o	o
	Abrasion resistance	5.5.3	X	o	o	o
	Water vapour permeability and coefficient	5.5.4	X			

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Table 2 *(continued)*

Requirement		Clause of this standard	Classification			
			Class I	Class II	Hybrid	
					mounted	moulded
Lining (Quarter)	Tear strength	5.5.2	o	o	o	o
	Abrasion resistance	5.5.3	o	o	o	o
	Water vapour permeability and coefficient	5.5.4	o			
Insole/ Insock/ Seat sock/ Footbed[b]		See Table 3	X	o	X	o
Tongue	Tear strength	5.6.2	o		o	o
Outsole	Design	5.8.2	X	X	X	X
	Tear strength	5.8.3	X	X	X	X
	Abrasion resistance	5.8.4	X	X	X	X
	Flexing resistance	5.8.5	X	X	X	X
	Resistance to Hydrolysis	5.8.6	X	X	X	X
	Interlayer bond strength	5.8.7	o	o	o	o

NOTE 1 The applicability of a requirement to a particular property is indicated by X or o.

X means the requirement shall be met. In some cases, the requirement relates only to single materials within the classification. This does not mean that other materials are precluded from use.

o means, that if the component part exists, the requirement shall be met.

The absence of X or o indicates that there is no requirement.

NOTE 2 For class II and hybrid moulded footwear usually no insole is present. However, if a removable insock is used, Table 3 is applicable.

NOTE 3 For class II footwear and hybrid moulded footwear stockings, covering the last before the moulding process, are not considered a lining.

[a] One of the two shall be chosen.

[b] Footbeds are treated like insocks.

Table 3 — Basic requirements for insoles and/or insocks/footbeds/seat socks

Options		Component to be assessed	Requirements to fulfil			
			Thickness 5.7.1	Water absorption desorption 5.7.3	Insole abrasion 5.7.4.1	Insock abrasion 5.7.4.2
No insole or if present not fulfilling the requirements	Non-removable insock	Insock	X	X		X

X means that the requirement shall be met.

NOTE 1 For removable insocks see 8.3.

NOTE 2 Footbeds are treated like insocks.

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Table 3 *(continued)*

Options		Component to be assessed	Requirements to fulfil			
			Thickness 5.7.1	Water absorption desorption 5.7.3	Insole abrasion 5.7.4.1	Insock abrasion 5.7.4.2
Insole present	No insock/Seat sock present	Insole	X	X	X	
		Seat sock				X
	Full insock/non-removable	Insock and insole together	X	X		
		Insock				X
	Full insock, removable and water permeable according to 5.7.2	Insole	X	X	X	
		Insock				X
	Full insock, removable, not water permeable	Insole	X	X	X	
		Insock		X		X
X means that the requirement shall be met.						
NOTE 1 For removable insocks see 8.3.						
NOTE 2 Footbeds are treated like insocks.						

5.2 Design

5.2.1 General

Footwear shall conform to one of the designs given in Figure 4.

5.2.2 Height of upper

The height of the upper, measured in accordance with ISO 20344:2021, 6.2, shall be as given in Table 4.

Table 4 — Height of upper

Size of footwear	Height mm			
European	Design A	Design B	Design C	Design D and E
36 and below	<103	≥103	≥162	≥255
37 and 38	<105	≥105	≥165	≥260
39 and 40	<109	≥109	≥172	≥270
41 and 42	<113	≥113	≥178	≥280
43 and 44	<117	≥117	≥185	≥290
45 and above	<121	≥121	≥192	≥300

5.2.3 Heel area

The heel area is defined by the rear (10 ± 2) % of the total length of the footwear (upper and outsole, measured along the test axis according to ISO 20344:2021, Figure 12) and a minimum height given in Table 8, design A.

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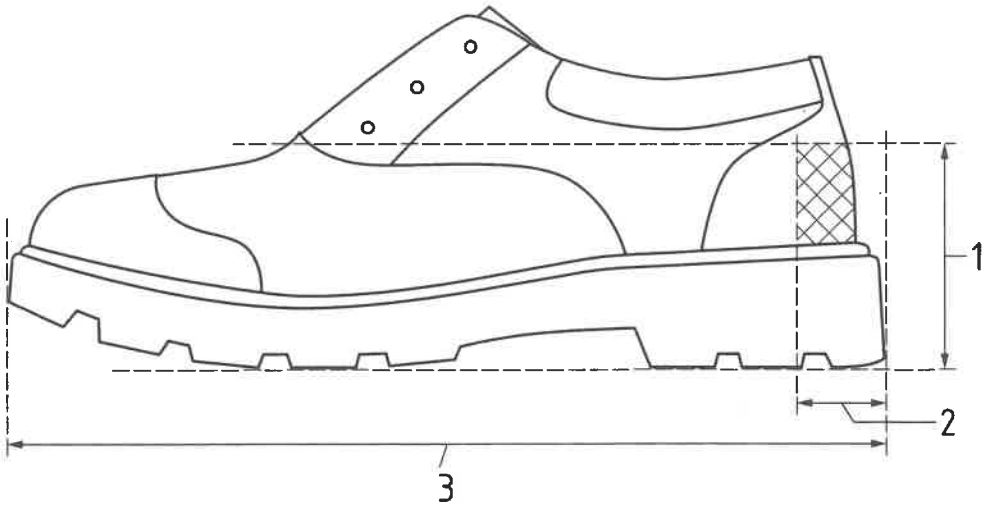

Key

1 height
2 10 % of the length
3 total length of the footwear

Figure 5 — Heel area

For all class I and II footwear other than design A and marked with the category of protection "SB" (see Table 20) the heel area shall be closed. This area of the upper shall not contain any holes other than to form seams.

5.3 Whole footwear

5.3.1 Constructional performance

5.3.1.1 Construction

When an insole is used, it shall not be possible to remove it without damaging the footwear. If there is no insole, a permanently attached insock/footbed shall be present which cannot be removed without damaging the footwear and/or the insock/footbed.

5.3.1.2 Upper/outsole bond strength

Footwear shall be tested in accordance with the method described in ISO 20344:2021, 5.2. The bond strength shall be not less than 4,0 N/mm, unless there is a tearing of the outsole, in which case the bond strength shall be not less than 3,0 N/mm. The test is not applicable when the bond has been made by mechanical attachment, e.g. using nails or screws or stitching.

5.3.2 Toe protection

5.3.2.1 General

Toecaps shall be incorporated into the footwear in such a manner, that it cannot be removed without damaging the footwear.

Class I footwear shall have a vamp lining or an element of the upper that serves as a lining. 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.

Metallic toecaps shall fulfil the requirements given in ISO 22568-1:2019, 4.2.

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Non-metallic toecaps shall fulfil the requirements given in ISO 22568-2:2019, 4.2.

NOTE Several types of toecaps (e.g. metallic, non-metallic, type A and B, etc.) are available for the choice of the footwear manufacturer.

5.3.2.2 Internal length

Toecaps shall fulfil the requirements given in Table 5, when tested according to ISO 20344:2021, 5.3.2.1.

Table 5 — Minimum internal length of toecaps

Size of footwear European	Minimum internal length mm
36 and below	34
37 and 38	36
39 and 40	38
41 and 42	39
43 and 44	40
45 and above	42

5.3.2.3 Width of toecap flange

The width of the flange of metallic toecaps shall not be greater than 12 mm, when tested according to ISO 20344:2021, 5.3.2.2.

The width of the flange of non-metallic toecaps shall not be greater than 15 mm, when tested according to ISO 20344:2021, 5.3.2.2.

5.3.2.4 Corrosion resistance

5.3.2.4.1 Class I footwear and hybrid mounted footwear

Metallic toecaps shall not exhibit more than three areas of corrosion, none of which shall measure more than 2 mm in any direction when tested in accordance with the method described in ISO 20344:2021, 5.6.2.

5.3.2.4.2 Class II and hybrid moulded footwear

When tested in accordance with ISO 20344:2021, 5.6.2.1. a metallic toecap shall exhibit not more than three areas of corrosion, none of which shall measure more than 2 mm in any direction.

5.3.2.5 Behaviour of toecaps (thermal and chemical)

When non-metallic toecaps are subject to each single one of the treatments according to ISO 20344:2021, 5.6.2, the clearance under the toecap, at the moment of impact, shall not be less than the appropriate value given in Table 6. In addition, the non-metallic toecap shall not develop delamination or sharp edges or any cracks passing through the material (i.e. through which light can be seen). During the assessment of the non-metallic toecap designed with perforations the criteria whether light can be seen shall not be applied to the perforation.

5.3.2.6 Impact resistance

For safety footwear tested in accordance with the method described in ISO 20344:2021, 5.4, at an impact energy of (200 ± 4) J, the clearance under the toecap at the moment of impact shall be in accordance with Table 6. In addition, the toecap shall not develop delamination or any cracks, which go

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through the material, i.e. through which light can be seen. During the assessment of toecaps designed with perforations, the criteria whether light can be seen, shall not be applied to the perforation.

Table 6 — Minimum clearance under toecaps

Size of footwear European	Minimum clearance mm
36 and below	12,5
37 and 38	13,0
39 and 40	13,5
41 and 42	14,0
43 and 44	14,5
45 and above	15,0

5.3.2.7 Compression resistance

For safety footwear tested in accordance with ISO 20344:2021, 5.5, the clearance under the toecap at a compression load of (15 ± 0,1) kN shall be in accordance with Table 6. In addition, the toecap shall not develop delamination or any cracks, which go through the material, i.e. through which light can be seen. During the assessment of toecaps designed with perforations, the criteria whether light can be seen, shall not be applied to the perforation.

5.3.3 Leak proofness

When tested in accordance with ISO 20344:2021, 5.7 there shall be no leakage of air. For design A of class II footwear with open heel area and/or perforations, this requirement is not applicable.

5.3.4 Specific ergonomic features

The footwear shall be considered to satisfy the ergonomic requirements, if the questionnaire given in ISO 20344:2021, 5.1 is completed and all answers are positive.

If the footwear is rigid in accordance with ISO 20344:2021, 8.5, then question 4.3 of ISO 20344:2021, Table 2 is not applicable.

5.3.5 Slip resistance

5.3.5.1 General

This basic requirement is applicable to conventionally soled footwear.

For footwear designed for special purposes containing spikes, metal studs or similar and for use for very special work places (soft ground e.g. sand, sludge, forestry timber, etc.) this test is not applicable. This type of footwear shall be marked with symbol "Ø" (for "not tested") according to this standard.

NOTE Additional useful information about slip resistance is available in Annex C.

5.3.5.2 Slip resistance on ceramic tile floor with sodium lauryl sulphate (NaLS) solution

Footwear resistant to slip on a ceramic tile floor with NaLS shall fulfil the requirements of Table 7 when tested in accordance with ISO 20344:2021, 5.14.

Table 7 — Requirements for footwear resistant to slip on ceramic tile floor with NaLS

Test conditions	Coefficient of friction
Condition A (forward heel slip)	≥0,31

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Table 7 *(continued)*

Test conditions	Coefficient of friction
Condition B (backward forepart slip)	≥0,36

5.3.6 Innocuousness

Safety footwear shall not adversely affect the health or hygiene of the user. Safety footwear shall be made of materials such as textiles, leather, rubbers or plastics that pose no risk to the wearer health and hygiene. The materials shall not, in the foreseeable conditions of normal use, release or degrade to release substances generally known to be toxic, carcinogenic, mutagenic, allergenic, toxic to reproduction or otherwise harmful.

For all leather parts tested in accordance with ISO 20344:2021, 6.9, the pH value shall be not less than 3,2. If the pH value is below 4, the difference Figure shall be less than 0,7.

For all leather parts tested in accordance with ISO 20344:2021, 6.11, the quantity of chromium VI shall not exceed 3,0 mg/kg.

NOTE Information about critical substances in footwear and footwear components are available in ISO/TR 16178[2] and Regulation (EC) No. 1907/2006 (REACH) Annex 17[10].

5.3.7 Seam strength

The materials of area A and B (see Figure 6) may be connected by stitching, welding or other suitable methods. When tested according to ISO 20344:2021, 5.25 the connection shall fulfil a strength of at least 10 N/mm.

5.4 Upper

5.4.1 General

The materials used in the upper of footwear shall be assessed according to their type and the type of footwear.

5.4.1.1 Class I footwear, determination of the area where upper requirements apply

The area where upper requirements apply shall be assessed by measuring from the horizontal surface beneath the outsole (as "*H*" is measured in Figure 6). Any materials in the upper below the height defined in Table 8 shall meet the requirements of the upper (see Table 2).

Table 8 — Height, below which upper requirements apply

Size of footwear European	Minimum height mm			
	Design A	Design B	Design C	Design D and E
36 and below	44	64	113	172
37 and 38	46	66	115	175
39 and 40	48	68	119	182
41 and 42	50	70	123	188
43 and 44	52	72	127	195
45 and above	53	73	131	202

All upper materials shall fulfil the requirements given in 5.4.2 to 5.4.7.

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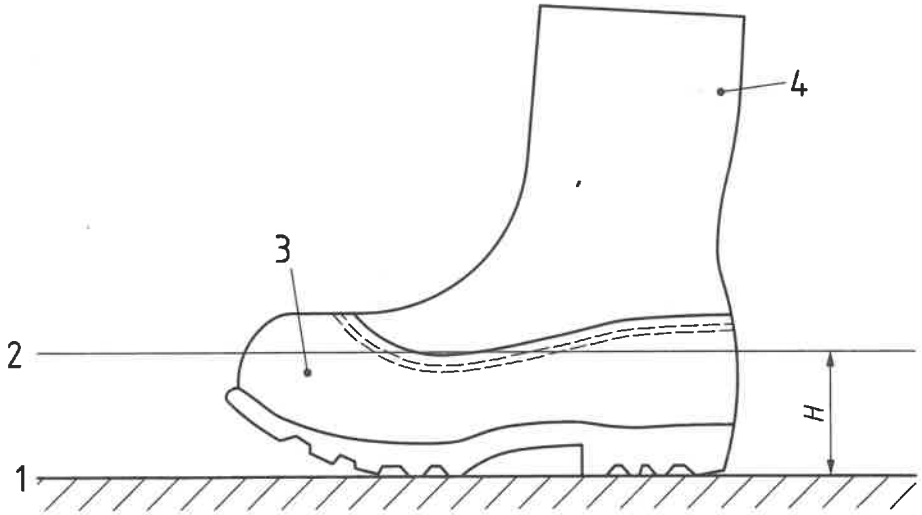
When other than upper materials exist in the footwear above the heights given in Table 8, they shall meet the tear strength (5.5.2) and abrasion resistance (5.5.3) requirements for lining. In the case of leather materials, they shall also meet the requirements for pH value and for chromium VI content (5.3.6).

5.4.1.2 Hybrid footwear, determination of the area where upper requirements apply

The Area A, shall be measured as *H*, between the lowest point of the top of the visible polymer (or rubber) part and the ground (see Figure 6) and shall have a minimum height corresponding to the values given in Table 8 for design B. All materials in this area shall meet the requirements of the upper (see Table 2).



Key

1 ground
2 H, lowest point of the area A and the ground
3 area A
4 area B

Figure 6 — Measurement "*H*"

5.4.2 Thickness

When tested in accordance with ISO 20344:2021, 6.1, the minimum thickness of the upper shall be at least at any point in accordance with Table 9.

Table 9 — Minimum thickness of upper material

Type of material	Minimum thickness mm
Rubber	1,5
Polymeric material	1,0

5.4.3 Tear strength

When tested in accordance with ISO 20344:2021, 6.3, the tear strength shall be in accordance with Table 10.

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Table 10 — Minimum tear strength of upper

Type of material	Minimum force N
Leather	120
Coated fabric and textile	60

5.4.4 Tensile properties

When tested in accordance with ISO 20344:2021, 6.4, the tensile properties shall be in accordance with Table 11.

Table 11 — Tensile properties

Type of material	Tensile strength N/mm²	Breaking force N	Modulus at 100 % elongation N/mm²	Elongation at break %
Leather split	≥15	—	—	—
Rubber	—	≥180	—	—
Polymeric material	—	—	≥1,0	≥250

5.4.5 Flexing resistance

Tested in accordance with ISO 20344:2021, 6.5, the flexing resistance shall be in accordance with Table 12. No damages, like e.g. pinholes and cracks, shall be visible to the unaided eye.

Table 12 — Flexing resistance

Type of material	Flexing resistance
Rubber	no cracking before 125 000 flex cycles
Polymeric material	no cracking before 150 000 flex cycles

5.4.6 Water vapour permeability and coefficient

Footwear shall comply with one of the following criteria's:

— The water vapour permeability of upper materials shall be at least 0,8 mg/(cm²·h) and the water vapour coefficient shall be at least 15 mg/cm² when tested in accordance with ISO 20344:2021, 6.6, 6.7 and 6.8. A maximum area of 10 % of non-water vapour permeable materials is acceptable when measured according to ISO 20344:2021, 6.2.3.

— If the upper contains an area of maximum 25 % of non-water vapour permeable material, measured according to ISO 20344:2021, 6.2.3, all remaining materials shall fulfil a water vapour permeability of at least 2,0 mg/(cm²·h).

5.4.7 Resistance to hydrolysis

For polyurethane uppers tested in accordance with ISO 20344:2021, 6.10, no cracking shall occur before 150 000 flex cycles.

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5.5 Lining

5.5.1 General

The requirements apply for all class I footwear. The requirements for class II and hybrid footwear (3.19) apply depending on their type (see Table 2).

5.5.2 Tear strength

Determined in accordance with ISO 20344:2021, 6.3, the tear strength of the lining shall be in accordance with Table 13.

Table 13 — Minimum tear strength of lining

Type of material	Minimum force N
Leather	30
Coated fabric and textiles	15

5.5.3 Abrasion resistance

Tested in accordance with ISO 20344:2021, 6.12, the lining shall not develop any holes before the following number of cycles have been performed.

For vamp and quarter lining:

— 25 600 cycles at dry condition;

— 12 800 cycles at wet condition.

For lining used at heel area (5.2.3):

— 51 200 cycles at dry condition;

— 25 600 cycles at wet condition.

When quarter lining and lining at heel area is of the same material, the requirements of lining at heel area apply.

5.5.4 Water vapour permeability and coefficient

Tested in accordance with ISO 20344:2021, 6.6, 6.7 and 6.8, the water vapour permeability shall be not less than 2,0 mg/(cm^2·h) and the water vapour coefficient shall be not less than 20 mg/cm^2.

No test is required, when lining material is present only in the heel area (5.2.3). When there is no stiffener or the stiffener is perforated, the material shall comply also WVP.

There is no requirement to test unlined stiffeners.

5.6 Tongue

5.6.1 General

The tongue need to be tested only, when the material, from which it is made or its thickness, or both, differs from that of the upper material.

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5.6.2 Tear strength

When tested in accordance with ISO 20344:2021, 6.3, the tear strength of the tongue shall be in accordance with Table 14.

Table 14 — Minimum tear strength of tongue

Type of material	Minimum force N
Leather	36
Coated fabric and textiles	18

5.7 Insole, insock and footbed

5.7.1 Thickness

When tested in accordance with ISO 20344:2021, 7.1, the thickness of the insole or insock or insole/insock combination (see Table 3) shall be not less than 2,0 mm.

5.7.2 Water permeability

An insock is water-permeable when it lets water through in 60 s or less, when tested in accordance with ISO 20344:2021, 7.2.

5.7.3 Water absorption and desorption

Tested in accordance with ISO 20344:2021, 7.2, the water absorption of the insole or insock shall be not less than 70 mg/cm^2 and the water desorption shall be not less than 80 % of the water absorbed.

When the insole is covered by a membrane lining, the test piece shall be taken from both, the membrane lining and insole in combination.

5.7.4 Abrasion resistance

5.7.4.1 Insoles

When non-leather insoles are tested in accordance with ISO 20344:2021, 7.3, the minimum final thickness in the tested area after 400 cycles shall not be less than 66 % of the original thickness (5.7.1).

5.7.4.2 Insocks

For insocks tested in accordance with ISO 20344:2021, 6.12, the wearing surface shall not develop any holes before the following number of cycles have been performed:

— 25 600 cycles at dry condition;

— 12 800 cycles at wet condition.

5.8 Outsole

5.8.1 General

All basic outsole requirements (see 5.8.2 to 5.8.7) shall be tested on materials in contact with the floor during footwear use. Testing materials of the outsole, not in contact with the floor, is not compulsory.

Depending on the type of hybrid footwear (3.19), the requirements of class I or class II footwear outsoles apply.

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5.8.2 Design

5.8.2.1 Thickness

When measured in accordance with ISO 20344:2021, 8.2.3, the outsole thickness, d_1 and d_3, (see ISO 20344:2021, Figure 37, 38 and 39) shall fulfil the requirements in Table 15.

The thickness of the full outsole material d_4 of a mounted (cemented) outsole with cavities shall not be less than 2,0 mm (see ISO 20344:2021, Figure 40).

Table 15 — Requirements for outsole thickness and cleat height

Type of outsole	Class I	Class II
Non-cleated outsole	$d_1 \geq 6$ mm	$d_1 \geq 6$ mm
Cleated outsole	$d_1 \geq 4$ mm $d_2 \geq 2{,}5$ mm	$d_1 \geq 3$ mm $d_2 \geq 4$ mm $d_3 \geq 6$ mm

5.8.2.2 Cleated area

With exception of the region under the flange of the toecap, at least the shaded area as shown in Figure 36 of ISO 20344:2021, 8.2.2 shall have cleats, which are open to the sides.

5.8.2.3 Cleat height

The outsole may be either cleated or non-cleated.

Class I and hybrid mounted footwear: outsoles with a cleat height of less than 2,5 mm are regarded as non-cleated.

Class II footwear and hybrid moulded footwear: outsoles with a cleat height of less than 4,0 mm are regarded as non-cleated.

When tested in accordance with ISO 20344:2021, 8.2.3, the cleat height, d_2 (see ISO 20344:2021, Figure 37, 38 and 39), shall fulfil the requirements in Table 15.

5.8.3 Tear strength

When tested in accordance with ISO 20344:2021, 8.3, the tear strength shall be not less than:

— 8 kN/m for a material with a density higher than 0,9 g/cm^3;

— 5 kN/m for a material with a density lower or equal to 0,9 g/cm^3.

5.8.4 Abrasion resistance

For outsoles of class I and hybrid mounted footwear tested in accordance with ISO 20344:2021, 8.4, the relative volume loss shall be not greater than:

— 250 mm^3 for materials with a density of 0,9 g/cm^3 or less;

— 150 mm^3 for materials with a density greater than 0,9 g/cm^3.

For outsoles of class II and hybrid moulded footwear tested as described in ISO 20344:2021, 8.4, the relative volume loss shall be not greater than 250 mm^3.

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5.8.5 Flexing resistance

For outsoles tested in accordance with ISO 20344:2021, 8.6, the cut growth shall be not greater than 4 mm after 30 000 flex cycles. This requirement is not applicable for rigid outsoles (see ISO 20344:2021, 8.5).

Spontaneous cracks are acceptable, unless one of the following conditions occurs:

— deeper than 1,5 mm;

— longer than 4 mm;

— more than five in number;

— any damage of the metallic insert, if present.

5.8.6 Resistance to hydrolysis

For polyurethane outsoles or outsoles with an outer layer composed of polyurethane tested in accordance with ISO 20344:2021, 8.7, the cut growth shall be not more than 6 mm until 150 000 flex cycles.

5.8.7 Interlayer bond strength

Tested in accordance with ISO 20344:2021, 5.2, the bond strength between the outer or cleated layer and the adjacent layer of multi-layer outsoles shall be not less than 4,0 N/mm. If there is tearing of the material, the bond strength shall not be less than 3,0 N/mm.

6 Additional requirements for safety footwear

6.1 General

Additional requirements can be necessary for safety footwear depending upon risks to be encountered at the workplace. In such cases, safety footwear shall conform to the appropriate additional requirements and corresponding marking given in Table 16.

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Table 16 — Additional requirements for special applications with appropriate symbols for marking

Requirement		Clause of this standard	Classification				Symbol
			Class I	Class II	hybrid		
					mounted	moulded	
Whole footwear	Perforation resistance (metal insert type P)[a]	6.2.1	X	X	X	X	P
	Perforation resistance (non-metal insert)						
	Type PL [a]		X	X	X	X	PL
	Type PS [a]		X	X	X	X	PS
	Electrical properties[b]:	6.2.2					
	— partially conductive footwear	6.2.2.1	X	X	X	X	C
	— antistatic footwear	6.2.2.2	X	X	X	X	A
	Resistance to inimical environments:	6.2.3					
	— heat insulation of outsole complex	6.2.3.1	X	X	X	X	HI
	— cold insulation of outsole complex	6.2.3.2	X	X	X	X	CI
	Energy absorption of seat region	6.2.4	X	X	X	X	E
	Water resistance	6.2.5	X				WR
	Metatarsal protection	6.2.6	X	X	X	X	M
	Ankle protection	6.2.7	X	X	X	X	AN
	Cut resistance	6.2.8	X	X	X	X	CR
	Scuff cap abrasion	6.2.9	X				SC
	Slip resistance	6.2.10					
	— on ceramic tile floor with glycerine		X	X	X	X	SR
Upper	Water penetration and absorption	6.3	X				WPA
Outsole	Resistance to hot contact	6.4.1	X	X	X	X	HRO
	Resistance to fuel oil	6.4.2	X	X	X	X	FO
	Ladder Grip	6.4.3	X	X	X	X	LG

[a] One of the three shall be chosen.

[b] One of the two shall be chosen.

NOTE The applicability of a requirement to a particular property is indicated in this table by an X.

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6.2 Whole footwear

6.2.1 Perforation resistance

6.2.1.1 Determination of perforation force

6.2.1.1.1 General

Footwear offering perforation resistance shall meet one of the following requirements.

NOTE Several types of perforation resistant inserts (e.g. metallic, non-metallic) are available for the choice of the footwear manufacturer.

6.2.1.1.2 Metallic perforation-resistant inserts (Type P)

For footwear tested in accordance with ISO 20344:2021, 5.9, the lowest value required to perforate the outsole unit shall be not less than 1 100 N.

6.2.1.1.3 Non-metallic perforation-resistant inserts and insoles (Type PL)

For footwear with non-metallic inserts (type PL) tested in accordance with ISO 20344:2021, 5.10.4.2.2. no perforation shall occur at any of the four measurements. In addition, no separation of the layers shall occur during all tests, e.g. tent effect.

6.2.1.1.4 Non-metallic perforation-resistant inserts and insoles (Type PS)

For footwear with non-metallic inserts (type PS) tested in accordance with ISO 20344:2021, 5.10.4.2.1 the average value of the force required to perforate the outsole unit shall be not less than 1 100 N. No single value shall be lower than 950 N.

6.2.1.2 Construction

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

Metallic perforation resistant inserts shall lie beneath the flange of the safety toecaps and shall not be attached to them.

Non-metallic inserts incorporated as a layer into the outsole shall not be skived at all.

Non-metallic inserts that also function as an insole:

— may lie above the flange of the safety toecap;

— shall not be skived apart from the following exception:

  they may be skived where they are covering the toecap flange (Figure 7a), maintaining a minimum thickness of 2 mm in the skived area (Figure 7b).

NOTE Roughing is not considered skiving.

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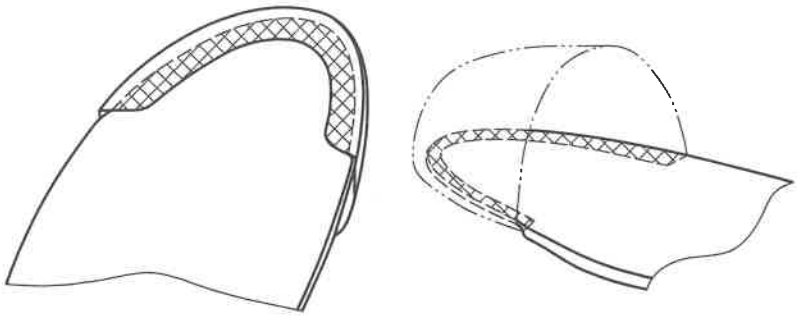
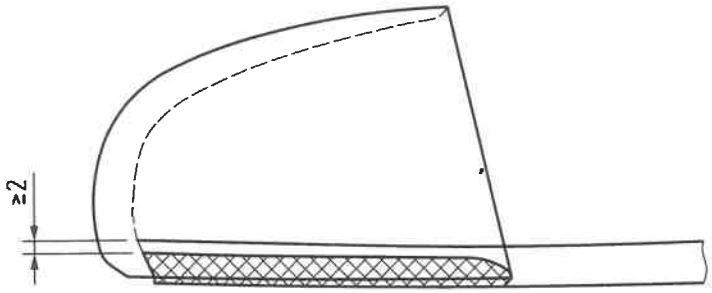


a) Area of toecap flange



b) Visualization of the remaining thickness

Key

permitted area of thickness reduction

Figure 7 — Skiving area at toecap flange region

6.2.1.3 Dimensions

The perforation-resistant insert dimensions shall be measured according ISO 20344:2021, 5.8.

The perforation-resistant inserts shall be of such a size, that, with exception of the heel area, the maximum distance between the line represented by the feather edge of the last and the edge of the insert (X) is 6,5 mm. In the heel area, the maximum distance between the line represented by the feather edge of the last and the insert (Y) shall be 17 mm (see ISO 20344:2021, Figure 15).

Metallic perforation-resistant inserts shall have not more than three holes with a maximum diameter of 3,0 mm to attach it to the bottom of the footwear. The holes shall not lie in the shaded area 1 (see ISO 20344:2021, Figure 15). Holes in the shaded area 2 shall be disregarded (see ISO 20344:2021, Figure 15).

6.2.1.4 Behaviour of perforation-resistant inserts

6.2.1.4.1 Flex resistance of perforation-resistant inserts

When tested in accordance with the method described in ISO 20344:2021, 5.12, the perforation resistant inserts shall exhibit no visible signs of cracking, disintegration or delamination after having been subjected to at least 1×10^6 (one million) flexion cycles.

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6.2.1.4.2 Corrosion resistance of perforation-resistant metallic inserts

6.2.1.4.2.1 Class I footwear and hybrid mounted footwear

When tested in accordance with the method described in ISO 20344:2021, 5.11.2 metallic inserts shall not exhibit more than three areas of corrosion, none of which shall measure more than 2 mm in any direction.

6.2.1.4.2.2 Class II footwear and hybrid moulded footwear

When tested in accordance with ISO 20344:2021, 5.6.2.1 the metallic insert shall exhibit not more than three areas of corrosion, none of which shall measure more than 2 mm in any direction.

6.2.1.4.3 Stability against ageing and environmental influence of non-metallic perforation-resistant inserts

When non-metallic inserts are subject to each single one of the treatments according to ISO 20344:2021, 5.11.2 they shall conform to the requirements of either 6.2.1.1.3 or 6.2.1.1.4.

6.2.2 Electrical properties

6.2.2.1 Partially conductive footwear

When measured in accordance with ISO 20344:2021, 5.13, after conditioning in a dry atmosphere (see ISO 20344:2021, 5.13.3.2 a), the electrical resistance shall be not greater than 100 kΩ.

6.2.2.2 Antistatic footwear

When measured in accordance with ISO 20344:2021, 5.13, after conditioning in a dry and wet atmosphere (see ISO 20344:2021, 5.13.3.2 a) and b)), the electrical resistance shall be for both conditions above 100 kΩ and less than or equal to 1 000 MΩ.

6.2.3 Resistance to inimical environments

6.2.3.1 Heat insulation of outsole complex

For footwear tested in accordance with ISO 20344:2021, 5.15, with the temperature of the hotplate, T_{hp}, at (150 ± 5) °C, the temperature rise (final temperature, T_f, minus initial temperature, T_i) on the upper surface of the insole or insock, if present, after (30 ± 1) min shall be not higher than 22 °C.

After (30 ± 1) min the footwear shall not show any sign of degradation as described in ISO 20344:2021, A.2.

Except for the insock, the insulation shall be incorporated in the footwear in such a manner, that it cannot be removed without damaging the footwear.

6.2.3.2 Cold insulation of outsole complex

For footwear tested in accordance with ISO 20344:2021, 5.16, the temperature decrease on the upper surface of the insole or insock, if present, shall be not more than 10 °C.

Except for the insock, the insulation shall be incorporated in the footwear in such a manner that it cannot be removed without damaging the footwear.

6.2.4 Energy absorption of seat region

For footwear tested in accordance with ISO 20344:2021, 5.17, the energy absorption of the seat region shall be not less than 20 J.

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6.2.5 Water resistance

To determine water resistance of safety footwear two alternative test methods are available.

No water penetration inside the footwear shall be detected when tested according to one of the following test methods:

— ISO 20344:2021, 5.18.

— ISO 20344:2021, 5.19. Rigid footwear with a flexing angle lower than 22° shall be tested in accordance with ISO 20344:2021, 5.18.

6.2.6 Metatarsal protection

6.2.6.1 Construction

The metatarsal protective device shall be such that, under impact, the resulting forces are distributed over the outsole, the toecap and as large a surface of the foot as possible.

The metatarsal protective device shall be attached to the footwear in such a manner, that it cannot be removed without damaging the footwear.

The metatarsal protective device shall fit the shape of the footwear at the inner and outer side of the foot and the device shall overlap the toecap by a minimum of 5 mm and lean on it.

6.2.6.2 Impact resistance of metatarsal protective device

Tested in accordance with ISO 20344:2021, 5.20, the minimum clearance at the moment of impact, shall be in accordance with Table 17.

Table 17 — Minimum clearance at impact

Size of footwear European	Minimum clearance after impact mm
36 and below	37,0
37 and 38	38,0
39 and 40	39,0
41 and 42	40,0
43 and 44	40,5
45 and above	41,0

The device shall be supported by the toecap during the metatarsal impact test and shall remain in place above the toecap after testing.

6.2.7 Ankle protection

The ankle areas shall be protected at least on the outer side of the footwear. Additional protection on the inner side is optional. Ankle protectors, placed in the footwear, do not necessarily need to be of a unified shape, but they shall match, when tested according to ISO 20344:2021, 5.21, at least the circular sizes given in Table 18.

Table 18 — Dimensions for ankle impact zones

Size of footwear European	Minimum diameter in mm
40 and below	55

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Table 18 *(continued)*

Size of footwear European	Minimum diameter in mm
41 to 43	60
44 and above	65

Tested in accordance with ISO 20344:2021, 5.22, the mean value of the test results shall not exceed 10 kN and no single value shall exceed 15 kN.

6.2.8 Cut resistance

6.2.8.1 Design

Cut resistant footwear shall have a minimum upper height as design B (see Clause 4 and 5.2.2). Cut-resistant footwear shall also comply with the requirements of 6.2.1.

6.2.8.2 Dimensions and construction of protective area

When determined according to ISO 20344:2021, 5.23.2 cut resistance footwear shall have a protective area extending from the feather edge to at least 30 mm above it and from the toecap to the heel end of the footwear. It shall extend beyond the rear end of the toecap by at least 10 mm.

The protective material shall be permanently attached to the footwear. When different materials are used for protection against cutting, they shall either be attached to each other or overlap.

6.2.8.3 Resistance to cutting

Tested according to ISO 20344:2021, 5.23.3 the footwear complies, if the cut-resistant index is not less than 2,5 or blade dulling is reported.

6.2.9 Scuff cap abrasion

When tested in accordance with reference to ISO 20344:2021, 5.24.2, the scuff cap shall not develop any hole through the full thickness before 8 000 cycles have been performed.

6.2.10 Slip resistance

In addition to the basic slip resistance requirements (5.3.5.2), the following additional floor conditions can be tested.

Slip resistance on ceramic tile floor with glycerine. When tested in accordance with ISO 20344:2021, 5.14, safety footwear resistant to slip on a ceramic tile floor with glycerine shall fulfil the requirements of Table 19.

Table 19 — Requirements for footwear resistant to slip on ceramic tile floor with glycerine

Test conditions	Coefficient of friction
Condition C (forward heel slip)	≥0,19
Condition D (backward forepart slip)	≥0,22

NOTE Additional useful information about slip resistance is available in Annex C.

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6.3 Upper — Water penetration and absorption

When tested in accordance with ISO 20344:2021, 6.13, the water penetration, expressed as the mass increase of the absorbent cloth after (60 ± 1) min, shall not be higher than 0,2 g and the water absorption shall not be more than 30 %.

Within the area as specified in 5.4.1.1 non-functional and decorative stitching and perforations shall not be present on footwear, unless they fulfil the requirements of 6.2.5.

6.4 Outsole

6.4.1 Resistance to hot contact

When tested in accordance with ISO 20344:2021, 8.9, outsoles shall not melt and shall not develop any cracks when bent around the mandrel.

6.4.2 Resistance to fuel oil

When tested in accordance with ISO 20344:2021, 8.8.2.1, the increase in volume of all visible outsole materials shall be not greater than 12 %.

If, after testing the test piece shrinks by more than 1 % in volume or increases in hardness by more than 10 Shore A hardness units, a further test piece shall be taken and tested in accordance with the method described in ISO 20344:2021, 8.8.2.2. The cut growth shall be not greater than 6 mm before 150 000 flex cycles.

6.4.3 Ladder grip

6.4.3.1 Mechanical properties

All materials in contact with a ladder rung shall fulfil the requirements given in 5.8.4.

6.4.3.2 Design

The outsole shall conform the requirements of 5.8.2.1, 5.8.2.2 and 5.8.2.3 for cleated outsoles.

6.4.3.3 Cleat height in the waist area

When measured according to ISO 20344:2021, 8.2.4 and Figure 41 the outsole shall have transverse cleats 'd' with a height of at least 1,5 mm in the waist area.

6.4.3.4 Heel breast

When measured according to ISO 20344:2021, 8.2.4 and Figure 41 the outsole shall have an inclined-breast heel. Distance 'a' (the waist area) shall be at least 35 mm, angle α shall be between 90° and 120° and dimension 'b' shall be at least 10 mm.

7 Marking

Each item of safety footwear shall be clearly and permanently marked, e.g. by embossing or branding, with the following:

a) size;

b) manufacturer's name and postal address;

c) manufacturer's type designation;

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d) at least year and month of footwear manufacture;

e) reference to this document, i.e. ISO 20345:2021;

f) the appropriate category, as described in Table 20 and/or, where applicable the symbol(s) from Table 16 appropriate to the protection provided.

The markings for e) and f) should be adjacent to one another or lie below or above each other.

Table 20 — Marking categories of safety footwear

Category	Basic requirements (Table 2 and Table 3)	Additional requirements
SB	Class I or II	
S1	Class I	as SB, plus Closed heel area Energy absorption of seat region Antistatic
S2	Class I	as S1, plus: Water penetration and absorption
S3 (metal insert type P) or S3L (non-metal insert type PL) or S3S (non-metal insert type PS)	Class I	as S2, plus: Perforation resistance according to the type Cleated outsole
S4	Class II	as SB, plus Closed heel area Energy absorption of seat region Antistatic
S5 (metal insert type P) or S5L (non-metal insert type PL) or S5S (non-metal insert type PS)	Class II	as S4, plus: Perforation resistance according to type Cleated outsole
S 6	Class I	as S2, plus Water resistance of the whole footwear
S 7 (metal insert type P) or S7L (non-metal insert type PL) or S7S (non-metal insert type PS)	Class I	as S3, plus Water resistance of the whole footwear
NOTE 1 For ease of marking, this table categorizes safety footwear with the most widely used combinations of basic and additional requirements. NOTE 2 If the footwear is not tested against slip resistance requirement, it is marked with symbol "Ø".		

Hybrid footwear shall be marked "SBH". For any additional marking, see Table 16.

For any additional marking on the footwear related to safety, the manufacturer shall provide evidence to support the claim and an explanation in the user notice. For example, if the manufacturer claims "acid resistant", the footwear shall be tested in accordance with EN 13832-3:2018 [8].

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8 Manufacturer's instructions and information

8.1 General

Safety footwear shall be supplied to the end user with at least the following information given in 8.1 to 8.5.

All information shall be unambiguous and shall include the following.

a) Name and full address of the manufacturer;

b) Reference to this document, i.e. ISO 20345:2021;

c) Explanation of any graphical symbols, markings or levels of performance, if applicable;

d) Basic explanation of the tests that have been applied to the footwear, if applicable;

e) Instructions for use:

1) tests to be carried out by the wearer before use, if required;

2) fitting and how to put on and take off the footwear, if relevant (e.g. use of heel strap or mechanical closing systems);

3) application (basic information on possible uses and, where detailed information is given, the source);

4) limitations of use (e.g. temperature range);

5) instructions for storage and maintenance, with maximum periods between maintenance checks (if important, drying procedures to be defined);

6) instructions for cleaning and/or decontamination;

7) obsolescence deadline or period of obsolescence;

8) if appropriate, warnings against problems likely to be encountered during use

9) a warning, that the footwear shall not be modified, exept for orthopeadic adaptions according to Annex A;

10) if helpful, additional illustrations, part numbers, etc.

f) Reference to accessories and spare parts, if relevant (e.g. recommended socks);

g) Type of packaging suitable for transport, if relevant.

NOTE Useful information for the user are explained in Annex B and C.

8.2 Electrical properties

8.2.1 Partially conductive footwear

Additional information shall be given regarding partially conductive properties:

"Electrically partially conductive footwear should be used if it is necessary to minimize electrostatic charges in the shortest possible time, e.g. when handling explosives. Electrically partially conductive footwear should not be used, if the risk of shock from any electrical apparatus or live parts with AC or DC voltages has not been completely eliminated. In order to ensure that this footwear is partially conductive, it has been specified to have an upper limit of resistance of 100 kΩ in its new state.

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During service, the electrical resistance of footwear made from conducting material can change significantly due to flexing and contamination, and it is necessary to ensure, that the product is capable of fulfilling its designed function of dissipating electrostatic charges during its entire life. Where necessary, it is therefore recommended, that the user establish an in-house test for electrical resistance and use it at regular intervals. This test and those mentioned below should be a routine part of the accident prevention program at the workplace.

If the footwear is worn in conditions where the soling material becomes contaminated with substances that can increase the electrical resistance of the footwear, wearers should always check the electrical properties of their footwear before entering a hazard area.

It is recommended to use an electrical dissipative socks.

Where partially conductive footwear is in use, the resistance of the flooring should be such that it does not invalidate the protection provided by the footwear. In use, no insulating elements should be introduced between the inner sole of the footwear and the foot of the wearer. If an insert (i.e. insocks, socks) is put between the inner sole and the foot the combination footwear/insert should be checked for its electrical properties."

8.2.2 Antistatic footwear

Additional information shall be given regarding antistatic properties:

"Antistatic footwear should be used if it is necessary to minimize electrostatic build-up by dissipating electrostatic charges, thus avoiding the risk of spark ignition of, for example, flammable substances and vapours, and if the risk of electric shock from mains voltage equipment cannot be completely eliminated from the workplace. Antistatic footwear introduces a resistance between the foot and ground but may not offer complete protection. Antistatic footwear is not suitable for work on live electrical installations.. It should be noted, however, that antistatic footwear cannot guarantee adequate protection against electric shock from a static discharge as it only introduces a resistance between foot and floor. If the risk of static discharge electric shock, has not been completely eliminated, additional measures to avoid this risk are essential. Such measures, as well as the additional tests mentioned below, should be a routine part of the accident prevention programme at the workplace.

Antistatic footwear will not provide protection against electric shock from AC or DC voltages. If the risk of being exposed to any AC or DC voltage exists, then electrical insulating footwear shall be used to protect from against serious injury.

The electrical resistance of antistatic footwear can be changed significantly by flexing, contamination or moisture. This footwear might not perform its intended function if worn in wet conditions.

Class I footwear can absorb moisture and can become conductive if worn for prolonged periods in moist and wet conditions. Class II footwear is resistant to moist and wet conditions and should be used is if the risk of exposure exists.

If the footwear is worn in conditions where the soling material becomes contaminated, wearers should always check the antistatic properties of the footwear before entering a hazard area.

Where antistatic footwear is in use, the resistance of the flooring should be such that it does not invalidate the protection provided by the footwear."

It is recommended to use an antistatic socks.

"It is, therefore, necessary to ensure, that the combination of the footwear its wearers and their environment is capable, to fulfil the designed function of dissipating electrostatic charges, and of giving some protection during its entire life. Thus, it is recommended, that the user establish an in-house test for electrical resistance, which is carried out at regular and frequent intervals."

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8.3 Insocks

If the footwear is supplied with a removable insock, it should be made clear in the leaflet that testing was carried out with the insock in place. A warning shall be given that the footwear shall only be used with the insock in place and that the insock shall only be replaced by a comparable insock supplied by the original footwear manufacturer or supplied by an insocks manufacturer which will supply insocks that fulfil the properties of this standard in combination with the foreseen safety footwear.

If the footwear is supplied without an insock, it should be made clear in the leaflet that testing was carried out with no insock present. A warning shall be given that only insocks that fulfil the properties of this standard in combination with the identified safety footwear can be fitted.

8.4 Perforation resistance

Additional information shall be given regarding perforation resistance:

"The perforation resistance of this footwear has been measured in the laboratory using standardized nails and forces. Nails of smaller diameter and higher static or dynamic loads will increase the risk of perforation occurring. In such circumstances, additional preventative measures should be considered. Three generic types of perforation resistant inserts are currently available in PPE footwear. These are metal types and those from non-metal materials, which shall be chosen on basis of a job-related risk assessment. All types give protection against perforation risks, but each has different additional advantages or disadvantages including the following:

Metal (e.g. S1PS, S3): Is less affected by the shape of the sharp object/hazard (i.e. diameter, geometry, sharpness) but due to shoemaking techniques may not cover the entire lower area of the foot.

Non-metal (PS or PL or category e.g. S1PS, S3L): May be lighter, more flexible and provide greater coverage area, but the perforation resistance may vary more depending on the shape of the sharp object/hazard (i.e. diameter, geometry, sharpness). Two types in terms of the protection afforded are available. Type PS may offer more appropriate protection from smaller diameter objects than type PL.

8.5 Date of obsolescence

The obsolescence date of footwear during storage before use depends on the effects of time, environment and has to be stated by the manufacturer.

It is the responsibility of the manufacturer to determine all factors, which can influence the time of use and/or foreseen protection (e.g. UV radiation, heat, cold, water, salt, temporal factors of material properties ...)

The obsolescence dates should be proven by supporting evidence (tests, experience). The manufacturer cannot predict the obsolescence date during use.

NOTE Further information is available in ISO/TR 18690[3].

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Annex A
(normative)

Customized safety footwear (safety footwear adapted to fit an individual user or a single unit to fit an individual user)

A.1 General

This annex covers three types of customized safety footwear.

A.2 Basic requirements

A.2.1 Type 1 – equipped with customized insocks

A.2.1.1 General

Customized insocks adapted to fit an individual user are used in conjunction with safety footwear according to this document. Only full insocks from the heel to the toe may be used. Outside the area under the toecap, openings of up to 6,0 cm^2 are permitted (e.g. heel spur supply).

NOTE Type 1 and type 2 footwear can be combined.

A.2.1.2 Property to be tested for Type 1

Each different type of customized insocks shall be tested together with the foreseen safety footwear as specified in table A.1. The sampling shall be done according to ISO 20344:2021, Table 1. Where only one size of customized insock for an individual person is available, only this size shall be tested.

The ergonomic assessment for customized insocks is based on the approval of the wearer in conjunction with the customized shoemaker.

Table A.1 — Required tests for type 1

	B , A	Clause of this standard	Condition requiring testing
Whole footwear			
Toe protection	B	5.3.2	worst case situation, e.g. in case of higher thickness than the original insock in the area of the toecap and in combination with the foreseen safety footwear
Insock			
pH value	B	5.3.6	only valid for leather
Water permeability	B	5.7.2	change of material
Water absorption/desorption	B	5.7.3	only valid for non-permeable insocks
Abrasion resistance	B	5.7.4.2	change of top material
Chromium VI	B	5.3.6	only valid for leather
A means where the additional requirement is claimed and marked on the footwear B means basic requirement (mandatory)			

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Table A.1 *(continued)*

	B A	Clause of this standard	Condition requiring testing
Additional requirements - Whole footwear			
Electrical properties	A	6.2.2	in combination with the foreseen safety footwear
Energy absorption at seat region	A	6.2.4	in case of lower thickness than the original insock in the area of the heel and in combination with the foreseen safety footwear
Heat insulation	A	6.2.3.1	in combination with the foreseen safety footwear
Cold insulation	A	6.2.3.2	in combination with the foreseen safety footwear
Metatarsal protection	A	6.2.6	in combination with the foreseen safety footwear
A means where the additional requirement is claimed and marked on the footwear B means basic requirement (mandatory)			

A.2.2 Type 2 – Modified safety footwear

A.2.2.1 General

Modified (adapted) safety footwear are to correct misalignments of the foot (examples see 3.19). For modification safety footwear according to this document is used.

The examination samples of the modified footwear shall reflect the worst-case situation (e.g. minimum and maximum outsole thickness).

NOTE Type 1 and type 2 footwear can be combined.

A.2.2.2 Property to be tested for Type 2

Each type of adaption shall be tested according to Table A.2. The sampling shall be done according to ISO 20344:2021, Table 1. Where only one size of customized safety footwear for an individual person is available, only this size shall be tested.

The ergonomic assessment for customized modification is based on the approval of the wearer in conjunction with the customized shoemaker.

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Table A.2 — Required tests for type 2

	Clause of this standard	Raises (heel or heel and sole)[b] Addition of heel wedges[b] Addition of sole wedges[b]	Medial/ lateral heel or sole flares[c]	Cushion heels[c]	Different rockers[b]	Stiffened soles[b]
Whole footwear						
Upper/outsole bond strength	5.3.1.2	B	B			
Toe protection[a]	5.3.2	B	B		B	B
Slip resistance	5.3.5.2.		B	B		
Outsole						
Tear strength	5.8.3		B			
Abrasion resistance	5.8.4		B			
Flexing resistance	5.8.5		B			
Resistance to Hydrolysis	5.8.6		B			
Interlayer bond strength	5.8.7	B	B	B	B	B
Additional requirements						
Whole footwear						
Slip resistance "SR"	6.2.10		A	A		
Electrical properties	6.2.2	A	A	A		A
Energy absorption at seat region	6.2.4	A	A	A		A
Heat insulation	6.2.3.1	A	A	A		A
Cold insulation	6.2.3.2		A			
Metatarsal protection	6.2.6	A	A			A
Outsole						
Resistance to hot contact	6.4.1		A			
resistance to fuel oil	6.4.2		A			

NOTE The applicability of a requirement to a particular property is indicated by B or A.

B means basic requirement – mandatory.

A means where the additional requirement is claimed and marked on the footwear (optional).

The absence of B or A indicates that there is no requirement.

[a] Only when the construction under the area of the toecap has changed.

[b] When original outsole is used.

[c] Not possible with original outsole (material and/or cleat design is changed).

If the original outsole is not re-applied to the footwear, the whole outsole, whole footwear and additional properties, if claimed, shall be re-tested.

A.2.3 Type 3 - Bespoke safety footwear

A.2.3.1 General

Bespoke (made to measure) safety footwear are constructed and manufactured as a single unit to meet the specific needs of an individual user based on information such as moulds, lasts and measurements.

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The examination samples of the bespoke footwear shall reflect the worst-case situation (e.g. minimum insock and outsole thickness and maximum insock and outsole thickness, low and high material hardness).

From the specified materials as well as different constructions, which cover the requirements of the users, examination samples are manufactured.

All materials and the bespoke safety footwear itself shall fulfil the requirements of this document.

A.2.3.2 Properties to be tested for Type 3

The requirements of Table A.2 apply. The sampling shall be done according to ISO 20344:2021, Table 1. Only the size of bespoke safety footwear for the individual person is tested.

The ergonomic assessment for bespoke footwear is based on the approval of the wearer in conjunction with the customized shoemaker.

A.3 Marking

Customized safety footwear shall be marked according to Clause 7.

A.4 Manufacturer's instructions and information

In addition to the information according to Clause 8, all information related to the customized modification shall be given, e.g. identification of the customized insocks suitable with to be used this safety footwear, identification of the customized adaptions for this safety footwear, e.g.

— The manufacturer of the safety footwear and/or manufacturer of the customized insocks shall identify the customized insocks suitable to be used with this safety footwear (type 1).

— The manufacturer of the customized safety footwear shall identify the modifications for this safety footwear (type 2).

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Annex B
(informative)

Assessment of the footwear by the wearer

B.1 General

At regular intervals safety footwear should be assessed by inspection before each wearing. The obsolescence date should not be exceeded, if applicable.

The footwear durability depends on the duration and intensity of use, storage, cleaning and maintenance. The following list and drawings can be provided to assist the wearer in assessing the performance of safety footwear.

B.2 Criteria for the assessment of the state of footwear

Safety footwear should be replaced when any of the signs of wear identified below are found. Some of these criteria's can vary according to the type of footwear and materials used:

— Beginning of pronounced and deep cracking affecting half of the upper material thickness (Figure B.1 a);

— Strong abrasion of the upper material, especially if the toe puff or the toecap is revealed (Figure B.1 b);

— The upper shows areas with deformations or split seams in the leg (Figure B.1 c);

— The outsole shows cracks higher than 10 mm long and 3 mm deep (Figure B.1 d);

— Upper/outsole separation of more than 15 mm long and 5 mm deep (Figure B.1 g);

— Cleat height for cleated outsoles at any point lower than 1,5 mm (Figure B.1 e);

— Original insock/s (if any) showing pronounced deformation and crushing;

— Destruction of the lining or sharp borders of the toe protection which could cause wounds (Figure B.1 f);

— Delamination of the soling materials (Figure B.1 h);

— Pronounced deformation of the outsole due to heat exposure any of the following causes (Figure B.1 i);

  — joining of 2 or more cleats due to the material melting;

  — decrease of the height of any cleat to less than 1,5 mm;

  — melting of the outside of the cleat and the midsole becomes visible;

— The closing mechanism is not in working order (zip, laces, eyelets, touch and close system).

NOTE Replacement of safety footwear in this context means also replacement of damaged parts, which are attached to the footwear, e.g. insocks, zippers, tongues, laces ...

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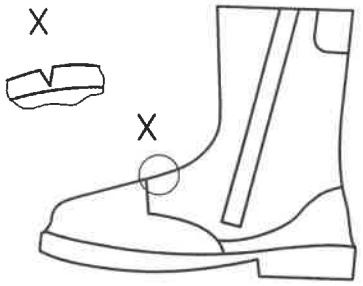
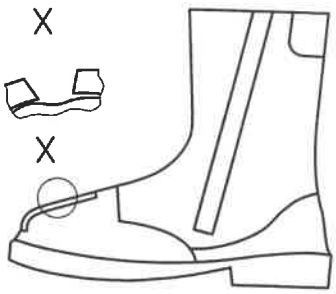
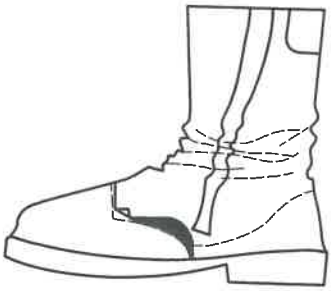
Dimensions in millimetres



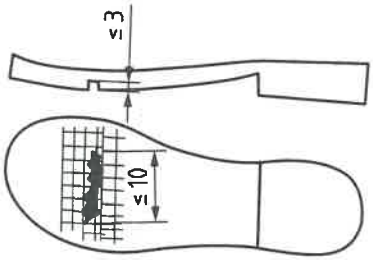
a) Deep cracks in the upper



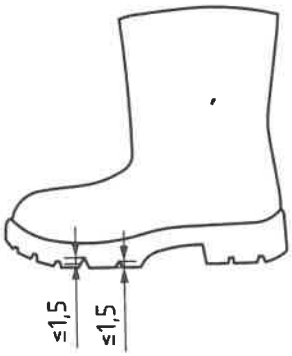
b) Strong abrasion of the upper



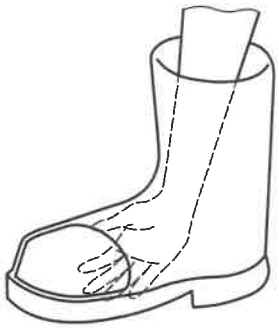
c) Separation of upper material



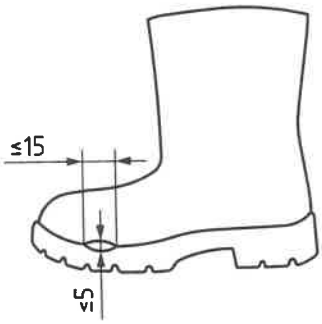
d) Cracks in the outsole



e) Decreased cleat height



f) Destruction of lining; sharp edges



g) Upper/outsole separation

h) Delamination of the sole

i) Pronounced deformation

Figure B.1 — Examples for criteria for the assessment of the state of safety footwear

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Annex C
(informative)

Slip resistance

C.1 Introduction

This annex provides the reader with information on slip resistance in relation to footwear. When specifying and selecting footwear, slip resistance should be given a high priority.

In this context 'slip resistance' is a specific term referring to the coefficient of friction (CoF) between the footwear and the floor.

Slips, trips and falls are the biggest cause of accidents in the workplace across Europe. Many other types of accident such as a fall from height are often initiated by a slip. In addition to the personal costs of these accidents, the resultant injuries can bring about great financial costs.

The slip resistance test, specified in ISO 13287[1], provides a benchmark to give end users a better idea of which products will work well in service. The information given here is intended to interpret and to complement the test data generated by ISO 13287, and to ultimately reduce the number of accidents and associated costs.

The slip resistance of footwear has been tested in laboratory conditions. Additional testing by the user at working place conditions may provide additional information. Footwear field trials are recommended to assess suitability in the workplace.

Terms such as "anti-slip", "non-slip", "slip proof" are misleading and should not be used.

It is important, that slip resistant footwear is used at all times, when there is a potential risk of slip; comfortable footwear will encourage this.

C.2 Explanation of ISO 13287 and marking codes SR and Ø

According to research[11] if the coefficient of friction value is below 0,24 then it is highly likely that a slip will occur during normal walking. A higher figure will reduce the likelihood of slipping accidents. It is generally accepted that at a value of 0,36 the pedestrian has a low risk of slip.

ISO 13287 identifies a range of test floors, lubricants and test modes applicable to conventionally soled footwear.

This document calls up as the mandatory test conditions for product testing, the heel and forepart test modes using floor tile 'E2' with lubricant 'SLS', and performance requirements are specified. For this test no special marking is applied. 'E2/SLS' is a ceramic tile wetted with dilute soap solution. This represents a generic test for assessing performance on water-based contaminants. If the intended conditions of use only involve wet paved surfaces, for example, this can be adequate.

To supplement this, there is an option to additionally test in the heel and forepart test mode using a 'floor tile 'E2' with lubricant 'Glycerine' and performance requirements are specified. If this test is performed and the product meet the performance requirements, then the label 'SR' may be added to the marking of the footwear.

The test 'SR' is intended as a generic test for assessing performance on more viscous contaminants such as oil. It should be noted that this test condition is particularly demanding and results in this test tend to be inherently low. It is always better to use protective equipment that has been shown to perform well under test conditions that are as similar as possible to the conditions of use.

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It should also be noted that neither the mandatory nor the 'SR' test conditions mimic outdoor environments when walking on heavy or lose ground. Under these condition small cleats or narrow footwear tread patterns can become clogged with contamination such as mud or gravel thus leading to a significant reduction in slip resistance. Once again, additional testing and trials can be more informative than the standard slip resistance test results.

Special-purpose footwear containing spikes, metal studs or similar, designed to enhance performance on soft ground (sand, sludge, forestry timber, etc.) should be marked with "Ø". The symbol "Ø" indicates that the footwear has not been tested for slip resistance.

No footwear can ever provide complete safety under particularly demanding conditions such as spillages of cooking or mineral oil. Under such conditions, slip-resistance footwear can only reduce the risk. Often the only solution in such circumstances is to either prevent contamination in the first place or promptly clean-up the spill.

C.3 Further complementary testing

C.3.1 General

The standard details specific combinations of floor surface and liquid contaminant (lubricant) to be used for testing. However, it is clearly impossible for any limited set of test conditions to successfully model the wide range of walking surfaces encountered in real-life. In the majority of cases, it would be useful to know the performance of footwear when tested against other surfaces and contaminants.

C.3.2 Additional surfaces

Slip resistance is highly dependent on the test conditions, and the particular combination of surface and contaminant. It would therefore be prudent to test footwear, as far as is practicable, against real-life surfaces and other challenges.

Caution should be applied when testing or using footwear on profiled floors. Such combinations may give the impression of providing slip resistance through friction; in many cases this impression could be misleading. Specific tread patterns may interlock with profiled floors. This interaction can change quickly with even a small amount of wear.

C.4 Factors influencing footwear performance

C.4.1 General

The heel and forepart cleat (tread) patterns and the material from which they are made are both important for slip resistance. A softer material and close-packed cleat pattern generally work well with fluid contaminants. A more open pattern usually works better with solid loose contaminants. Ideally all footwear should be trialled in the end-use environment.

Ideally the whole area of the bottom of the footwear should carry a tread pattern. The minimum area of coverage is specified in ISO 20344:2021, 8.2.2 (see Figure C.1).

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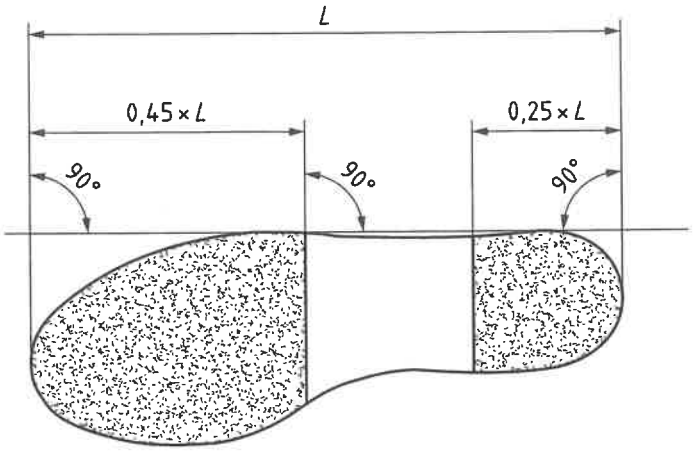

Figure C.1 — Cleated area

C.4.2 Durability of slip resistance

Slip resistance properties are generally only measured on new footwear. Slip-resistance is likely to change with wear. For example, if the cleated sole-pattern has fine detail, this can quickly be worn away with use. It can therefore be desirable to monitor the performance of footwear throughout its service-life. Monitoring can include periodic inspection of footwear, field-trials involving used footwear, and recording of slip-related incidents.

C.4.3 Other factors

Footwear performance can be impaired by the following factors:

— clogging of cleats;

— soiling;

— degradation due to exposure to certain environmental contaminants;

— wear;

— damage;

— exceeding the obsolescence date.

It is recommended that footwear is cleaned, maintained, inspected and replaced as necessary to ensure optimum performance.

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