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**Personal protective equipment — Safety  
footwear**

*Équipement de protection individuelle — Chaussures de sécurité*

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ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

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 second edition cancels and replaces the first edition (ISO 20345:2004), which has been technically revised. It also incorporates the Amendment ISO 20345:2004/Amd. 1:2007 and the Technical Corrigenda ISO 20345:2004/Cor.1:2005 and ISO 20345:2004/Cor.2:2006.

# Personal protective equipment — Safety footwear

## 1 Scope

This International Standard 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.

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 motor cycle riders).

## 2 Normative references

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

ISO 17075, *Leather — Chemical tests — Determination of chromium(VI) content*

ISO 20344:2011, *Personal protective equipment — Test methods for footwear*

EN 12568:2010, *Foot and leg protectors — Requirements and test methods for toecaps and penetration resistant inserts*

EN 50321, *Electrically insulating footwear for working on low voltage installations*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

### 3.1 safety footwear

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

NOTE Items of safety footwear are fitted with toecaps designed to give protection against impact when tested at an energy level of at least 200 J and against compression when tested at a compression load of at least 15 kN.

**3.2**

**leather**

hide or skin tanned to be imputrescible

**3.2.1**

**leather split**

flesh or middle part of a hide or skin, obtained by splitting a thick leather, which is tanned to be imputrescible

**3.3**

**rubber**

vulcanized elastomers

**3.4**

**polymeric materials**

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

EXAMPLE Polyurethane (PU) or polyvinylchloride (PVC).

**3.5**

**insole**

non-removable component used to form the base of the shoe to which the upper is usually attached during lasting

**3.6**

**insock**

removable or non-removable footwear component used to cover part or all of the insole

NOTE "Non-removable" means that the insock cannot be removed without being damaged.

**3.7**

**lining**

material covering the inner surface of the upper

NOTE 1 The wearer's foot is in direct contact with the lining.

NOTE 2 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.

**3.7.1**

**vamp lining**

material covering the inner surface of the forepart of the upper

**3.7.2**

**quarter lining**

material covering the inner surface of the quarters of the upper

**3.8**

**cleat**

protruding part of the outer surface of the sole

**3.9**

**rigid outsole**

sole which cannot be bent through an angle of 45° under a load of 30 N

NOTE Testing is performed in accordance with ISO 20344:2011, 8.4.1.

**3.10**

**cellular outsole**

outsole which has a density of 0,9 g/ml or less with a cell structure that is visible under 10× magnification

**3.11****penetration-resistant insert**

footwear component placed in the sole complex in order to provide protection against penetration

**3.12****safety toecap**

built-in footwear component designed to protect the toes of the wearer from impacts of an energy level of at least 200 J and compression at a load of at least 15 kN

**3.13****seat region****counter area**

rear 10 % of the total length of the footwear (upper and sole)

**3.14****conductive footwear**

footwear, the resistance of which is in the range of 0 k $\Omega$  to 100 k $\Omega$

NOTE Resistance is measured in accordance with ISO 20344:2011, 5.10.

**3.15****antistatic footwear**

footwear, the resistance of which is above 100 k $\Omega$  and less than or equal to 1 000 M $\Omega$

NOTE Resistance is measured in accordance with ISO 20344:2011, 5.10.

**3.16****electrically insulating footwear**

footwear which protects the wearer against electrical shocks by preventing the passage of dangerous current through the body via the feet

**3.17****fuel oil**

aliphatic hydrocarbon constituent of petroleum

**3.18****specific job-related footwear**

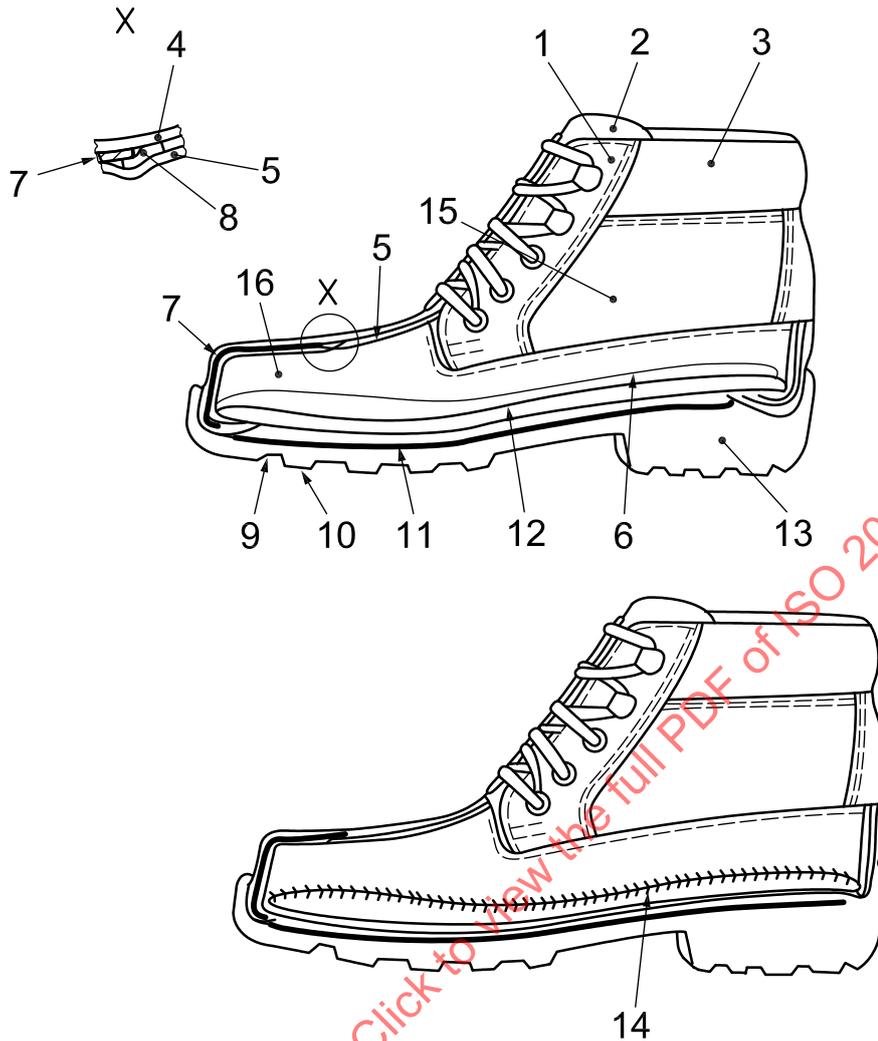
safety or occupational footwear relating to a specific profession

EXAMPLE Footwear for firefighters; footwear with resistance to chain saw cutting.

**3.19****hybrid footwear**

class II footwear incorporating another material which extends the upper

NOTE See Figure A.1.

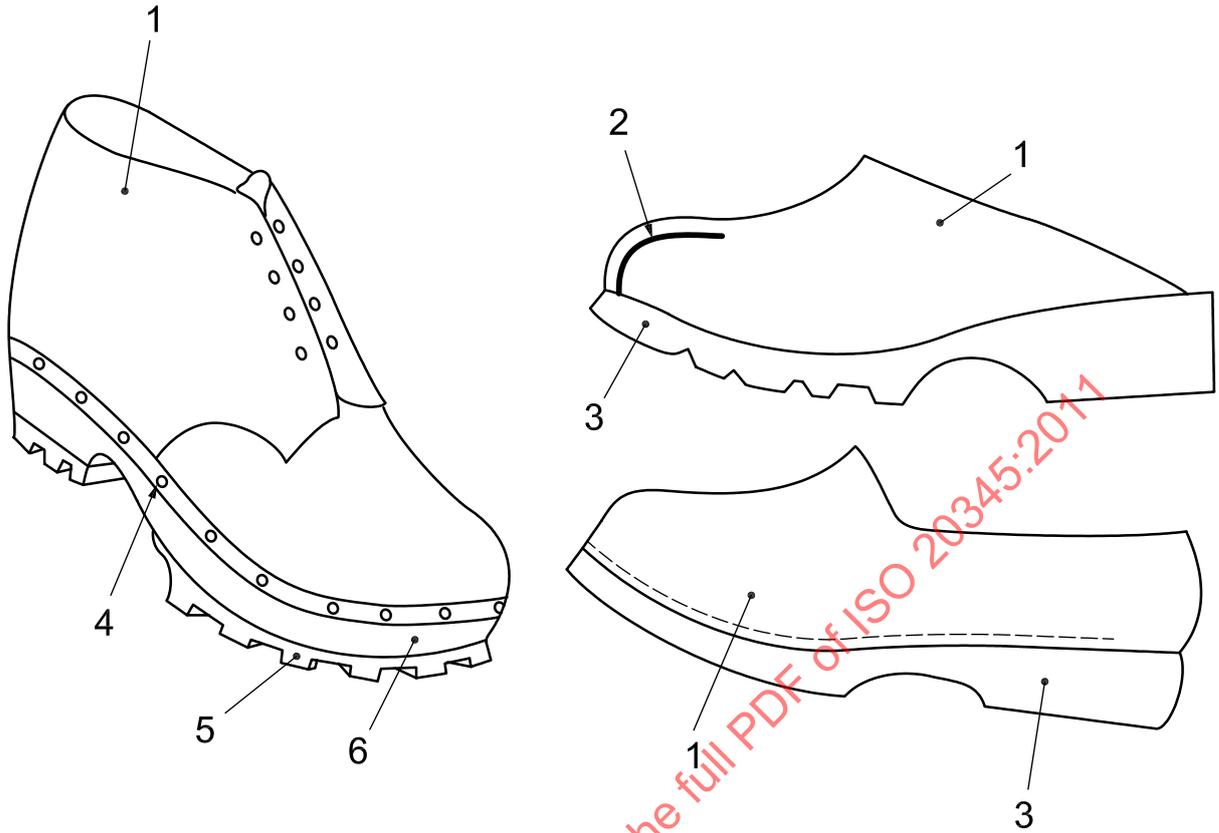


**Key**

- 1 facing
- 2 tongue
- 3 collar
- 4 upper
- 5 vamp lining
- 6 insock
- 7 toecap
- 8 edge covering, e.g. foam strip
- 9 outsole
- 10 cleat
- 11 penetration-resistant insert
- 12 insole
- 13 heel
- 14 Strobel stitching
- 15 quarter
- 16 vamp

**a) Example of parts of footwear of Strobel construction**

**Figure 1 (continued)**



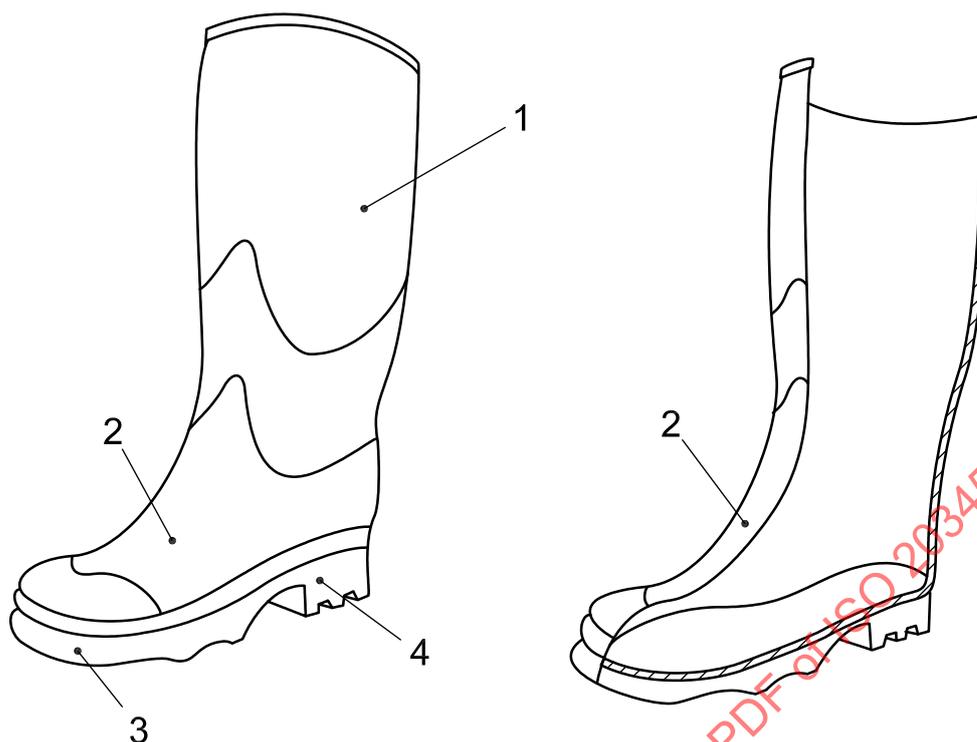
**Key**

- 1 upper
- 2 toecap
- 3 rigid sole
- 4 reinforcing welt with nails
- 5 outsole
- 6 wooden sole

b) Example of other footwear

Figure 1 — Types of footwear

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**Key**

- 1 upper
- 2 vamp
- 3 outsole
- 4 heel

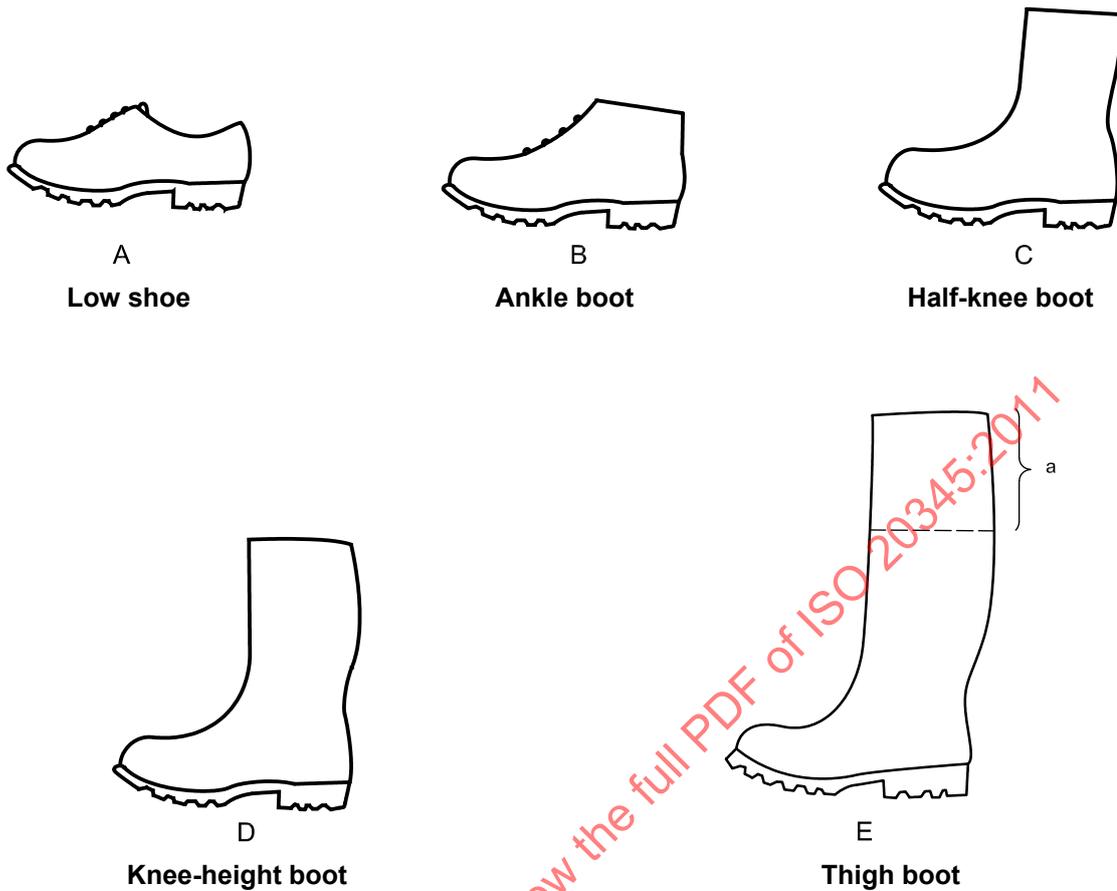
**Figure 2 — Example of all-rubber (i.e. vulcanized) or all-polymeric (i.e. entirely moulded) footwear**

#### 4 Classification and designs

Footwear shall be classified in accordance with Table 1.

**Table 1 — Classification of footwear**

Classification	Description
Class I	Footwear made from leather and other materials, excluding all-rubber or all-polymeric footwear
Class II	All-rubber (i.e. entirely vulcanized) or all-polymeric (i.e. entirely moulded) footwear



<sup>a</sup> Variable extension which can be adapted to the wearer.

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

**Figure 3 — Designs of footwear**

Class II footwear can be equipped with another material which extends the upper. The requirements for this footwear are given in Annex A.

## 5 Basic requirements for safety footwear

### 5.1 General

Safety footwear shall conform to the basic requirements given in Table 2.

**Table 2 — Basic requirements for safety footwear**

Requirement		Subclause	Classification	
			I	II
<b>Design</b>	Height of upper	5.2.2	X	X
	Seat region (design B, C, D, E)	5.2.3	X	X
<b>Whole footwear</b>	Sole performance:	5.3.1		
	— Construction	5.3.1.1	X	
	— Upper/outsole bond strength	5.3.1.2	X	
	Toe protection:	5.3.2		
	— General	5.3.2.1	X	X
	— Internal length of toecaps	5.3.2.2	X	X
	— Impact resistance	5.3.2.3	X	X
	— Compression resistance	5.3.2.4	X	X
	— Behaviour of toecaps	5.3.2.5	X	X
	Leakproofness	5.3.3		X
	Specific ergonomic features	5.3.4	X	X
	Slip resistance:	5.3.5	X	X
	— Slip resistance on ceramic tile floor with NaLS <sup>a</sup>	5.3.5.2		
	— Slip resistance on steel floor with glycerine <sup>b</sup>	5.3.5.3		
— Slip resistance on ceramic tile floor with NaLS and on steel floor with glycerine <sup>c</sup>	5.3.5.4			
<b>Upper</b>	General	5.4.1	X	
	Thickness	5.4.2		X
	Tear strength	5.4.3	X	
	Tensile properties	5.4.4	X	X
	Flexing resistance	5.4.5		X
	Water vapour permeability and coefficient	5.4.6	X	
	pH value	5.4.7	X	
	Hydrolysis	5.4.8		X
	Chromium VI content	5.4.9	X	
<b>Vamp lining</b>	Tear strength	5.5.1	X	O
	Abrasion resistance	5.5.2	X	O
	Water vapour permeability and coefficient	5.5.3	X	
	pH value	5.5.4	X	O
	Chromium VI content	5.5.5	X	O

Table 2 (continued)

Requirement		Subclause	Classification	
			I	II
<b>Quarter lining</b>	Tear strength	5.5.1	O	O
	Abrasion resistance	5.5.2	O	O
	Water vapour permeability and coefficient	5.5.3	O	
	pH value	5.5.4	O	O
	Chromium VI content	5.5.5	O	O
<b>Insole/insock</b>		See Table 3	X	O
<b>Tongue</b>	Tear strength	5.6.1	O	
	pH value	5.6.2	O	
	Chromium VI content	5.6.3	O	
<b>Outsole</b>	Design	5.8.1	X	X
	Tear strength	5.8.2	X	X
	Abrasion resistance	5.8.3	X	X
	Flexing resistance	5.8.4	X	X
	Hydrolysis	5.8.5	X	X
	Interlayer bond strength	5.8.6	O	O
<p>NOTE 1 The applicability of a requirement to a particular classification is indicated by X or O. X means the requirement shall be met. In some cases the requirement relates only to particular materials within the classification, e.g. pH value of leather components. 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.</p> <p>NOTE 2 For class II footwear, it is usual to have no insole present. However, if a removable insock is used, Table 3 is not applicable; only chromium VI and pH requirements are fulfilled for leather material.</p> <p>NOTE 3 Stockings covering the last before the moulding process are not considered a lining.</p>				
<p><sup>a</sup> One of the three slip resistance requirements shall be met.</p> <p><sup>a</sup> Marking symbol "SRA".</p> <p><sup>b</sup> Marking symbol "SRB".</p> <p><sup>c</sup> Marking symbol "SRC".</p>				

**Table 3 — Basic requirements for insoles and/or insocks**

Options		Component to be assessed	Requirements to fulfil					
			Thickness	pH <sup>a</sup>	Water absorption/desorption	Insole abrasion	Chromium VI <sup>a</sup>	Insock abrasion
			5.7.1	5.7.2	5.7.3	5.7.4.1	5.7.5	5.7.4.2
No insole or, if present, not fulfilling the requirements	Non-removable insock	Insock	X	X	X		X	X
Insole present	No insock	Insole	X	X	X	X	X	
	Seat sock present							
	Full insock, non-removable	Insock and insole together	X		X			
		Insock		X			X	X
	Full insock, removable and water permeable <sup>b</sup>	Insole	X	X	X	X	X	
		Insock		X			X	X
Full insock, removable, not water permeable <sup>b</sup>	Insole	X	X	X	X	X		
	Insock		X	X		X	X	
NOTE 1 X denotes that the requirement shall be met.								
NOTE 2 For removable insocks, see 8.3.								
<sup>a</sup> Applies only to leather.								
<sup>b</sup> A water-permeable insock is one that, when tested in accordance with ISO 20344:2011, 7.2, lets water through in 60 s or less.								

**5.2 Design**

**5.2.1 General**

Footwear shall conform to one of the designs given in Figure 3.

**5.2.2 Height of upper**

The height of the upper, when measured in accordance with ISO 20344:2011, 6.2, shall be as given in Table 4.

**Table 4 — Height of upper**

Size of footwear		Height			
France	UK	Design A mm	Design B min. mm	Design C min. mm	Design D and E min. mm
36 and below	up to 31/2	<103	103	162	255
37 and 38	4 to 5	<105	105	165	260
39 and 40	5 1/2 to 6 1/2	<109	109	172	270
41 and 42	7 to 8	<113	113	178	280
43 and 44	8 1/2 to 10	<117	117	185	290
45 and above	10 1/2 and above	<121	121	192	300

### 5.2.3 Seat region

The seat region shall be closed. In this area of the upper, below the minimum height given for design A in Table 10, there shall be no holes other than to form seams.

## 5.3 Whole footwear

### 5.3.1 Sole 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 shall be present.

#### 5.3.1.2 Upper/outsole bond strength

When footwear other than with a stitched sole is tested in accordance with the method described in ISO 20344:2011, 5.2, the bond strength shall be not less than 4,0 N/mm, unless there is tearing of the sole, in which case the bond strength shall be not less than 3,0 N/mm.

### 5.3.2 Toe protection

#### 5.3.2.1 General

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

With the exception of all-rubber and all-polymeric footwear, footwear fitted with internal toecaps shall have a vamp lining or an element of the upper that serves as a lining. 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.

Toecaps shall fulfil the requirements given in EN 12568:2010, 4.2.2.2.

Scuff-resistant coverings for the toe region shall be not less than 1 mm in thickness.

#### 5.3.2.2 Internal length of toecaps

When measured in accordance with the method described in ISO 20344:2011, 5.3, the internal toecap length shall be in accordance with Table 5.

**Table 5 — Minimum internal length of toecaps**

Size of footwear		Minimum internal length mm
France	UK	
36 and below	Up to 31/2	34
37 and 38	4 to 5	36
39 and 40	51/2 to 61/2	38
41 and 42	7 to 8	39
43 and 44	81/2 to 10	40
45 and above	101/2 and above	42

### 5.3.2.3 Impact resistance of safety footwear

When safety footwear is tested in accordance with the method described in ISO 20344:2011, 5.4, at an impact energy of  $(200 \pm 4)$  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 any cracks which go through the material, i.e. through which light can be seen.

**Table 6 — Minimum clearance under toecaps at impact**

Size of footwear		Minimum clearance mm
France	UK	
36 and below	Up to 31/2	12,5
37 and 38	4 to 5	13,0
39 and 40	5 1/2 to 6 1/2	13,5
41 and 42	7 to 8	14,0
43 and 44	8 1/2 to 10	14,5
45 and above	10 1/2 and above	15,0

### 5.3.2.4 Compression resistance of safety footwear

When safety footwear is tested in accordance with ISO 20344:2011, 5.5, the clearance under the toecap at a compression load of  $15 \text{ kN} \pm 0,1 \text{ kN}$  shall be in accordance with Table 6.

### 5.3.2.5 Behaviour of toecaps

#### 5.3.2.5.1 Corrosion resistance of metallic toecaps

When class II footwear is tested and assessed in accordance with ISO 20344:2011, 5.6.2, the metallic toecap shall exhibit no more than three areas of corrosion, none of which shall measure more than 2 mm in any direction.

When metallic toecaps are used in class I footwear, they shall be tested and assessed in accordance with ISO 20344:2011, 5.6.2, and they shall exhibit not more than three areas of corrosion, none of which shall measure more than 2 mm in any direction.

#### 5.3.2.5.2 Non-metallic toecaps

Non-metallic toecaps used in safety footwear shall conform to the requirements of EN 12568.

### 5.3.3 Leakproofness

When tested in accordance with ISO 20344:2011, 5.7, there shall be no leakage of air.

For class II footwear without a closed seat region, the 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 20344:2011, 5.1 is completed and all answers are positive.

If the footwear is rigid in accordance with ISO 20344:2011, 8.4.1, then question 4.3 of Table 2 in ISO 20344:2011 is not applicable.

### 5.3.5 Slip resistance requirement

#### 5.3.5.1 General

When tested in accordance with ISO 20344:2011, 5.11, safety footwear shall conform to 5.3.5.2, 5.3.5.3 or 5.3.5.4.

The requirements are applicable to conventionally soled footwear. They are not applicable to special- purpose footwear containing spikes, metal studs or similar, nor to special-purpose safety footwear to be used on soft ground (sand, sludge, etc.).

#### 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.

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

Test conditions of ISO 20344:2011, 5.11.1	Coefficient of friction
Condition A (forward heel slip)	$\geq 0,28$
Condition B (forward flat slip)	$\geq 0,32$

#### 5.3.5.3 Slip resistance on steel floor with glycerine

Footwear resistant to slip on a steel floor with glycerine shall fulfil the requirements of Table 8.

**Table 8 — Requirements for footwear resistant to slip on steel floor with glycerine**

Test conditions of ISO 20344:2011, 5.11.1	Coefficient of friction
Condition C (forward heel slip)	$\geq 0,13$
Condition D (forward flat slip)	$\geq 0,18$

#### 5.3.5.4 Slip resistance on ceramic tile floor with NaLS and on steel floor with glycerine

Footwear resistant to slip on a ceramic tile floor with NaLS and on a steel floor with glycerine shall fulfil the requirements of Table 9.

**Table 9 — Requirements for footwear resistant to slip on ceramic tile floor with NaLS and on steel floor with glycerine**

Test conditions of ISO 20344:2011, 5.11.1	Coefficient of friction
Condition A (forward heel slip)	$\geq 0,28$
Condition B (forward flat slip)	$\geq 0,32$
Condition C (forward heel slip)	$\geq 0,13$
Condition D (forward flat slip)	$\geq 0,18$

**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 have been shown to be chemically suitable. 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. Information claiming that the product is innocuous shall be checked.

NOTE Information about critical substances in footwear and footwear components can be found in 2.6.1 and Table 1 of ISO/TR 16178:2010.

**5.4 Upper**

**5.4.1 General**

The area which shall fulfil the requirements given in this subclause shall have a minimum height in accordance with Table 10, when measured from the horizontal surface beneath the sole.

**Table 10 — Minimum heights, below which the requirements for the upper shall be fulfilled**

Size of footwear		Design minimum heights mm			
France	UK	A	B	C	D and E
36 and below	Up to 31/2	44	64	113	172
37 and 38	4 to 5	46	66	115	175
39 and 40	5 1/2 to 6 1/2	48	68	119	182
41 and 42	7 to 8	50	70	123	188
43 and 44	8 1/2 to 10	52	72	127	195
45 and above	10 1/2 and above	53	73	131	202

When collar and insert materials are present above the heights given in Table 10, such materials shall meet the tear strength (see 5.5.1) and abrasion resistance (see 5.5.2) requirements for lining. In the case of leather materials, they shall also meet the requirements for pH value (see 5.4.7) and for chromium VI content (see 5.4.9). Materials above the heights given in Table 10 that are not collar and insert shall fulfil the requirements for the upper.

**5.4.2 Thickness**

When determined in accordance with ISO 20344:2011, 6.1, the thickness of the upper of class II footwear at any point shall be in accordance with Table 11.

**Table 11 — Minimum thickness of upper**

Type of material	Minimum thickness mm
Rubber	1,50
Polymeric	1,00

### 5.4.3 Tear strength

When determined in accordance with ISO 20344:2011, 6.3, the tear strength of the upper of class I footwear shall be in accordance with Table 12.

**Table 12 — Minimum tear strength of upper**

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

### 5.4.4 Tensile properties

When determined in accordance with ISO 20344:2011, 6.4.1, the tensile properties shall be in accordance with Table 13.

**Table 13 — Tensile properties**

Type of material	Tensile strength N/mm	Breaking force N	Modulus at 100 % elongation N/mm <sup>2</sup>	Elongation at break %
Leather split	≥15	—	—	—
Rubber	—	>180	—	—
Polymeric	—	—	1,3 to 4,6	≥250

### 5.4.5 Flexing resistance

When tested in accordance with ISO 20344:2011, 6.5, the flexing resistance shall be in accordance with Table 14.

**Table 14 — Flexing resistance**

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

### 5.4.6 Water vapour permeability and coefficient

When tested in accordance with 6.6 and 6.8 of ISO 20344:2011, the water vapour permeability shall be not less than 0,8 mg/(cm<sup>2</sup>·h) and the water vapour coefficient shall be not less than 15 mg/cm<sup>2</sup>.

### 5.4.7 pH value

When leather uppers are tested in accordance with ISO 20344:2011, 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.

#### 5.4.8 Hydrolysis

When polyurethane uppers are tested in accordance with ISO 20344:2011, 6.10, no cracking shall occur before 150 000 flex cycles.

#### 5.4.9 Chromium VI content

When determined in accordance with the test method described in ISO 17075, the quantity of chromium VI in footwear containing leather shall not exceed 3,0 mg/kg.

### 5.5 Vamp and quarter lining

#### 5.5.1 Tear strength

When determined in accordance with ISO 20344:2011, 6.3, the tear strength of the lining shall be in accordance with Table 15.

**Table 15 — Minimum tear strength of lining**

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

#### 5.5.2 Abrasion resistance

When tested in accordance with ISO 20344:2011, 6.12, the lining shall not develop any holes before the following number of cycles has been performed.

— For vamp and quarter lining:

- 25 600 cycles when dry;
- 12 800 cycles when wet.

— For seat region lining:

- 51 200 cycles when dry;
- 25 600 cycles when wet.

#### 5.5.3 Water vapour permeability and coefficient

When tested in accordance with 6.6 and 6.8 of ISO 20344:2011, the water vapour permeability shall be not less than 2,0 mg/(cm<sup>2</sup>·h) and the water vapour coefficient shall be not less than 20 mg/cm<sup>2</sup>.

NOTE There is no requirement to test unlined stiffeners.

#### 5.5.4 pH value

When leather linings are tested in accordance with ISO 20344:2011, 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.

### 5.5.5 Chromium VI content

When determined in accordance with the test method described in ISO 17075, the quantity of chromium VI in footwear containing leather shall not exceed 3,0 mg/kg.

## 5.6 Tongue

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

### 5.6.1 Tear strength

When determined in accordance with ISO 20344:2011, 6.3, the tear strength of the tongue shall be in accordance with Table 16.

**Table 16 — Minimum tear strength of tongue**

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

### 5.6.2 pH value

When leather tongues are tested in accordance with ISO 20344:2011, 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.

### 5.6.3 Chromium VI content

When determined in accordance with the test method described in ISO 17075, the quantity of chromium VI in footwear containing leather shall not exceed 3,0 mg/kg.

## 5.7 Insole and insock

### 5.7.1 Thickness

When determined in accordance with ISO 20344:2011, 7.1, the thickness of the insole and/or insock (see Table 3) shall be not less than 2,0 mm.

### 5.7.2 pH value

When leather insoles or leather insocks are tested in accordance with ISO 20344:2011, 6.9, the pH value shall be not less than 3,2. If the pH is below 4, the difference figure shall be less than 0,7.

### 5.7.3 Water absorption and desorption

When tested in accordance with ISO 20344:2011, 7.2, the water absorption shall be not less than 70 mg/cm<sup>2</sup> and the water desorption shall be not less than 80 % of the water absorbed.

**5.7.4 Abrasion resistance**

**5.7.4.1 Insoles**

When non-leather insoles are tested in accordance with ISO 20344:2011, 7.3, the abrasion damage shall not be more severe than that illustrated by the reference test pieces for the same family of materials before 400 cycles (see ISO 20344:2011, 7.3.6.).

**5.7.4.2 Insocks**

When insocks are tested in accordance with ISO 20344:2011, 6.12, the wearing surface shall not develop any holes before the following number of cycles has been performed:

- 25 600 cycles when dry;
- 12 800 cycles when wet.

**5.7.5 Chromium VI content**

When determined in accordance with the test method described in ISO 17075, the quantity of chromium VI in footwear containing leather shall not exceed 3,0 mg/kg.

**5.8 Outsole**

**5.8.1 Design**

The outsole may be either cleated or non-cleated.

Outsoles with a cleat height of less than 2,5 mm are regarded as uncleated.

**5.8.1.1 Thickness**

The outsole can be composed of several layers. When measured in accordance with ISO 20344:2011, 8.1.2, the sole thickness,  $d_1$  and  $d_3$ , shall fulfil the requirements in Table 17.

**Table 17 — Requirements for outsole thickness and cleat height**

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

**5.8.1.2 Cleated area**

With the exception of the region under the flange of the toecap, at least the shaded area as shown in Figure 38 of ISO 20344:2011 shall have cleats which are open to the side.

**5.8.1.3 Cleat height**

When tested in accordance with ISO 20344:2011, 8.1, the cleat height,  $d_2$ , is given in Table 17.

### 5.8.2 Tear strength

When non-leather outsoles are tested in accordance with ISO 20344:2011, 8.2, the tear strength shall be not less than:

- 8 kN/m for a material with a density higher than 0,9 g/cm<sup>3</sup>;
- 5 kN/m for a material with a density lower or equal to 0,9 g/cm<sup>3</sup>.

### 5.8.3 Abrasion resistance

When outsoles other than those from all-rubber or all-polymeric footwear are tested in accordance with ISO 20344:2011, 8.3, the relative volume loss shall be not greater than 250 mm<sup>3</sup> for materials with a density of 0,9 g/cm<sup>3</sup> or less, and not greater than 150 mm<sup>3</sup> for materials with a density greater than 0,9 g/cm<sup>3</sup>.

When outsoles from all-rubber or all-polymeric footwear are tested as described in ISO 20344:2011, 8.3, the relative volume loss shall be not greater than 250 mm<sup>3</sup>.

### 5.8.4 Flexing resistance

When outsoles are tested in accordance with ISO 20344:2011, 8.4, the cut growth shall be not greater than 4 mm before 30 000 flex cycles.

Spontaneous cracks are acceptable in the following circumstances.

- a) Only the centre of the tread area shall be assessed for cracking, i.e. cracks under the toecap zone shall be ignored.
- b) Superficial cracks up to 0,5 mm deep shall be ignored.
- c) Soles shall be deemed to be satisfactory if cracks are no deeper than 1,5 mm, no longer than 4 mm and no more than five in number.

### 5.8.5 Hydrolysis

When polyurethane outsoles and soles with an outer layer composed of polyurethane are tested in accordance with ISO 20344:2011, 8.5, the cut growth shall be not greater than 6 mm before 150 000 flex cycles.

### 5.8.6 Interlayer bond strength

When tested in accordance with ISO 20344:2011, 5.2, the bond strength between the outer or cleated layer and the adjacent layer shall be not less than 4,0 N/mm unless there is tearing of any part of the sole, in which case the bond strength shall be not 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 18.

**Table 18 — Additional requirements for special applications  
with appropriate symbols for marking**

Requirement		Clause	Class		Symbol
			I	II	
Whole footwear	Penetration resistance	6.2.1	X	X	P
	Electrical properties:	6.2.2			
	— conductive footwear	6.2.2.1	X	X	C
	— antistatic footwear	6.2.2.2	X	X	A
	— electrically insulating footwear	6.2.2.3		X	See EN 50321
	Resistance to inimical environments:	6.2.3			
	— heat insulation of sole complex	6.2.3.1	X	X	HI
	— cold insulation of sole complex	6.2.3.2	X	X	CI
	Energy absorption of seat region	6.2.4	X	X	E
	Water resistance	6.2.5	X		WR
	Metatarsal protection	6.2.6	X	X	M
	Ankle protection	6.2.7	X	X	AN
	Cut resistance	6.2.8	X	X	CR
<b>Upper</b>	Water penetration and absorption	6.3	X		WRU
<b>Outsole</b>	Resistance to hot contact	6.4.1	X	X	HRO
	Resistance to fuel oil	6.4.2	X	X	FO

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

## 6.2 Whole footwear

### 6.2.1 Penetration resistance

#### 6.2.1.1 Determination of penetration force

##### 6.2.1.1.1 Metallic anti-penetration insert

When footwear is tested in accordance with ISO 20344:2011, 5.8.2, the force required to penetrate the sole unit shall be not less than 1 100 N.

##### 6.2.1.1.2 Non-metallic anti-penetration insert

When footwear is tested in accordance with ISO 20344:2011, 5.8.3, using a force of at least 1 100 N, the tip of the test nail shall not penetrate through the test piece. In order to achieve a “pass” result, the tip of the test nail shall not protrude from the test piece. This is to be checked by visual, cinematographic or electrical detection.

##### 6.2.1.2 Construction

The penetration-resistant insert shall be built into the bottom of the shoe in such a manner that it cannot be removed without damaging the footwear. Except for non-metallic inserts that also function as an insole, the insert shall not lie above the flange of the safety toecap and shall not be attached to it.

### 6.2.1.3 Dimensions

The penetration-resistant insert dimensions shall be measured according to ISO 20344:2011, 5.8.1.

The penetration-resistant insert shall be of such a size that, with the exception of the heel region, 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 region, the maximum distance between the line represented by the feather edge of the last and the insert (Y) shall be 17 mm (see Figure 14 of ISO 20344:2011).

The penetration-resistant insert shall have no more than three holes with a maximum diameter of 3 mm to attach it to the bottom of the footwear.

The holes shall not lie in the shaded area 1 (see Figure 14 of ISO 20344:2011).

Holes in the shaded area 2 shall be disregarded (see Figure 14 of ISO 20344:2011).

### 6.2.1.4 Flex resistance of penetration-resistant inserts

When penetration-resistant inserts in all types of footwear are tested in accordance with ISO 20344:2011, 5.9, they shall show no visible signs of cracking or delamination after being subjected to  $1 \times 10^6$  flex cycles.

### 6.2.1.5 Behaviour of penetration-resistant inserts

#### 6.2.1.5.1 Corrosion resistance of penetration-resistant metallic inserts

When all-rubber footwear is tested in accordance with ISO 20344:2011, 5.6.3, the penetration-resistant metallic insert shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 mm<sup>2</sup>. When penetration-resistant metallic inserts to be used in all other types of footwear are tested in accordance with the method described in ISO 20344:2011, 5.6.1, they shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 mm<sup>2</sup>.

#### 6.2.1.5.2 Penetration-resistant non-metallic inserts

Penetration-resistant non-metallic inserts shall comply with the requirements of EN 12568:2010, 6.4, when placed under maximum force after being subjected to the treatments described in EN 12568:2010, 7.4.

## 6.2.2 Electrical properties

### 6.2.2.1 Conductive footwear

When measured in accordance with ISO 20344:2011, 5.10, after conditioning in a dry atmosphere (see ISO 20344:2011, 5.10.3.3), the electrical resistance shall be not greater than 100 k $\Omega$ .

### 6.2.2.2 Antistatic footwear

When measured in accordance with ISO 20344:2011, 5.10, after conditioning:

- in a dry atmosphere, the electrical resistance shall be above 100 k $\Omega$  and less than or equal to 1 000 M $\Omega$ ;
- in a wet atmosphere, the electrical resistance shall be above 100 k $\Omega$  and less than or equal to 1 000 M $\Omega$ .

NOTE See ISO 20344:2011, 5.10.3.3 for determination of dry and wet atmospheres.

### 6.2.2.3 Electrically insulating footwear

Electrically insulating footwear shall fulfil the requirements given in EN 50321.

### 6.2.3 Resistance to inimical environments

#### 6.2.3.1 Heat insulation of sole complex

When footwear is tested in accordance with ISO 20344:2011, 5.12, with the temperature of the hotplate,  $T_{hp}$ , at 150 °C, the temperature increases (final temperature,  $T_f$ , minus initial temperature,  $T_i$ ) on the upper surface of the insole after 30 min shall be not greater than 22 °C.

After testing, the footwear shall conform to the requirements given in ISO 20344:2011, Annex B.

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 sole complex

When footwear is tested in accordance with ISO 20344:2011, 5.13, the temperature decrease on the upper surface of the insole 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

When footwear is tested in accordance with ISO 20344:2011, 5.14, the energy absorption of the seat region shall be not less than 20 J.

### 6.2.5 Water resistance

The total wetted area inside the footwear shall be not greater than 3 cm<sup>2</sup> when tested in accordance with either:

- ISO 20344:2011, 5.15.1, after 100 trough lengths, or
- ISO 20344:2011, 5.15.2, after 80 min

### 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 sole, 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.

#### 6.2.6.2 Impact resistance of metatarsal protective device

When tested in accordance with ISO 20344:2011, 5.16, the minimum clearance at the moment of impact shall be in accordance with Table 19.

Table 19 — Minimum clearance at impact

Size of footwear		Minimum clearance after impact mm
France	UK	
36 and below	Up to 31/2	37,0
37 and 38	4 to 5	38,0
39 and 40	5 1/2 to 6 1/2	39,0
41 and 42	7 to 8	40,0
43 and 44	8 1/2 to 10	40,5
45 and over	10 1/2 and above	41,0

### 6.2.7 Ankle protection

When tested in accordance with ISO 20344:2011, 5.17, 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 footwear

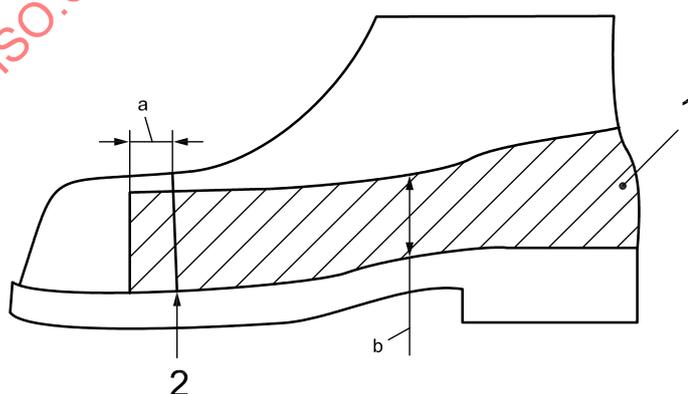
#### 6.2.8.1 Design

Cut resistance footwear shall not be of design A (see Clause 4 and 5.2.1).

#### 6.2.8.2 Construction

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 extends beyond the rear end of the toecap by at least 10 mm.

There shall be no gap between the toecap and the protective material. The protective material shall be permanently attached to the footwear. If different materials are used for protection against cutting, they shall either be attached to each other or overlap (see Figure 4).



#### Key

- 1 protective area
- 2 rear edge of toecap
- a Overlap of 10 mm over toecap.
- b Minimum height of 30 mm above the feather line.

Figure 4 — Coverage of protective area

### 6.2.8.3 Resistance to cutting

When tested in accordance with the method described in ISO 20344:2011, 6.14, the cut-resistant index (see EN 388) shall be not less than 2,5.

### 6.2.8.4 Penetration resistance

Cut-resistant footwear shall also comply with the requirements of 6.2.1.

## 6.3 Upper — Water penetration and absorption

When tested in accordance with ISO 20344:2011, 6.13, the water penetration (expressed as the mass increase of the absorbent cloth after 60 min) shall not be higher than 0,2 g and the water absorption shall not be higher than 30 %.

Non-functional and decorative stitching and perforations shall not be used on footwear on which water resistance of the upper is claimed, unless they fulfil the above requirements.

When the requirement given in 6.2.5 has been met, non-functional and decorative stitching and perforations are acceptable.

## 6.4 Outsole

### 6.4.1 Resistance to hot contact

When tested in accordance with ISO 20344:2011, 8.7, rubber and polymeric 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 20344:2011, 8.6.1, the increase in volume shall be not greater than 12 %.

If, after testing in accordance with ISO 20344:2011, 8.6.1, 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 20344:2011, 8.6.2. The cut growth shall be not greater than 6 mm before 150 000 flex cycles.

## 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 identification mark;
- c) manufacturer's type designation;
- d) year and at least quarter of manufacture;
- e) reference to this International Standard, i.e. ISO 20345:2011;
- f) symbol(s) from Table 2 and Table 18 appropriate to the protection provided and/or, where applicable, the appropriate category (SB, S1 to S5), as described in Tables 20 and 21.

NOTE The markings for e) and f) should be adjacent to one another.