INTERNATIONAL STANDARD

**ISO 20346**

First edition
2004-08-01

# Personal protective equipment — Protective footwear

*Équipement de protection individuelle — Chaussures de protection*



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# Foreword

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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 20346 was prepared by the European Committee for Standardization (CEN) 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).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

This first edition of ISO 20346 cancels and replaces ISO 8782-3:1998, which has been technically revised.

For the purposes of this International Standard the CEN annex regarding fulfilment of European Council Directives has been removed.

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# Foreword

This document (EN ISO 20346:2004) has been prepared by Technical Committee CEN/TC 161 “Foot and leg protectors”, the secretariat of which is held by BSI, in collaboration with Technical Committee ISO/TC 94 “Personal safety - Protective clothing and equipment”.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2005, and conflicting national standards shall be withdrawn at the latest by August 2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

In conjunction with EN ISO 20344:2004, this standard supersedes EN 346:1992 and EN 346-2:1996.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

## 1 Scope

This European Standard specifies basic and additional (optional) requirements for protective footwear.

## 2 Normative references

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

EN 12568:1998, *Foot and leg protectors – Requirements and test methods for toecaps and metal penetration resistant inserts*

EN ISO 20344: 2004, *Personal protective equipment - Test methods for footwear (ISO 20344:2004)*

## 3 Terms and definitions

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

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

**3.1**
**protective footwear**
footwear, incorporating protective features to protect the wearer from injuries which could arise through accidents, fitted with toecaps, designed to give protection against impact when tested at an energy level of at least 100 J and against compression when tested at a compression load of at least 10 kN

**3.2**
**leather**

**3.2.1**
**full grain leather**
hide or skin tanned to be imputrescible having conserved the totality of its grain

**3.2.2**
**corrected grain leather**
hide or skin tanned to be imputrescible which has been subjected to mechanical buffing to modify its grain structure

**3.2.3**
**leather split**
flesh or middle part of a hide or skin tanned to be imputrescible obtained by splitting a thick leather

**3.3**
**rubber**
vulcanized elastomers

**3.4**
**polymeric materials**
for example polyurethane or polyvinylchloride

**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 permanent footwear component used to cover part or all of the insole

**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(s)**
protruding part(s) of the outer surface of the sole

**3.9**
**rigid outsole**
sole which, when the complete footwear is tested in accordance with EN ISO 20344: 2004, 8.4.1, cannot be bent through an angle of 45° under a load of 30 N

**3.10**
**cellular outsole**
outsole having a density of 0,9 g/ml or less with a cell structure visible under 10x magnification

**3.11**
**penetration-resistant insert**
footwear component placed in the sole complex in order to provide protection against penetration

**3.12**
**safety toecap**
footwear component built into the footwear designed to protect the toes of the wearer from impacts up to an energy level of at least 100 J and compression at a load of at least 10 kN

**3.13**
**seat region**
back part of the footwear (upper and sole)

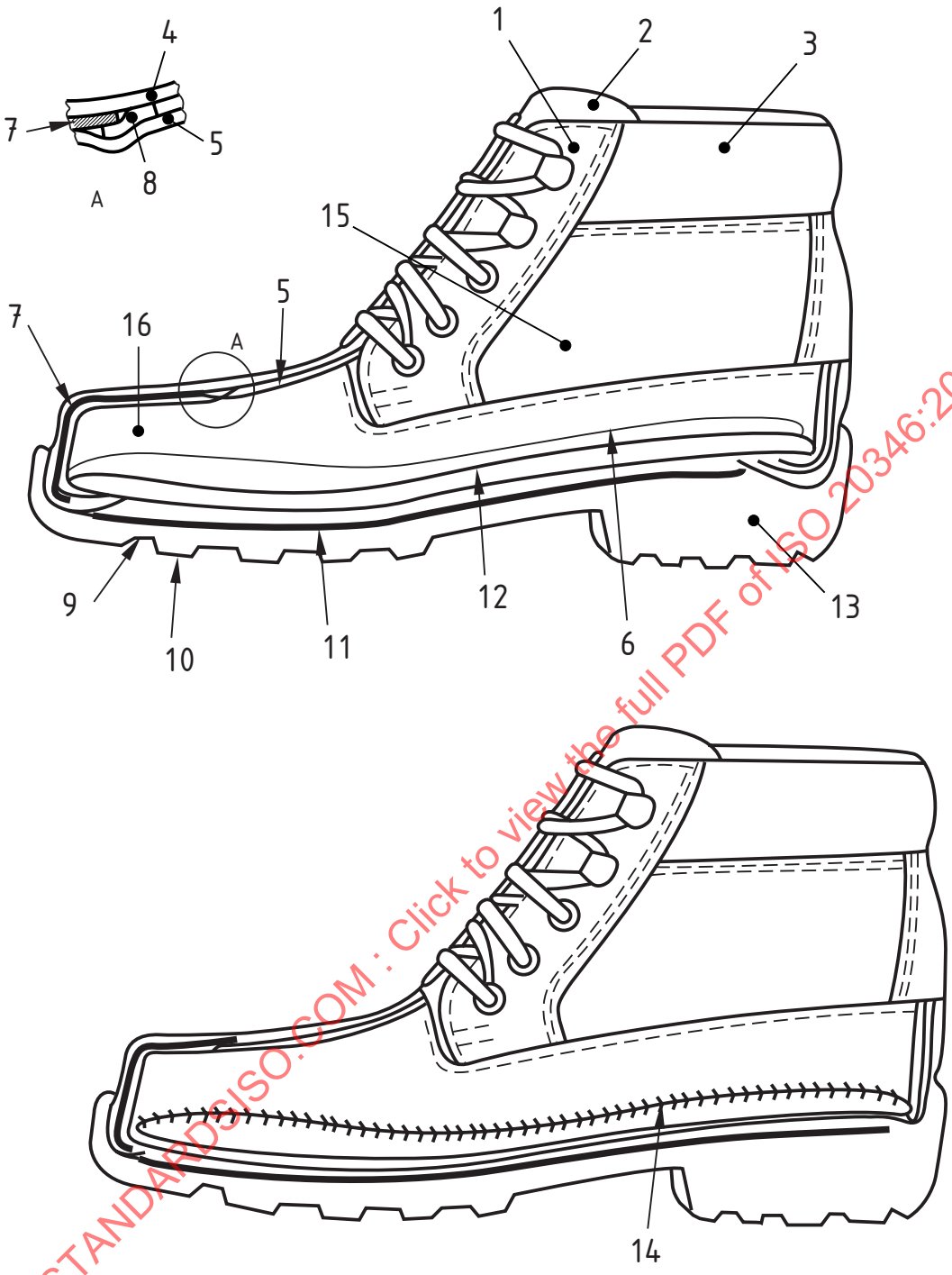
**3.14**
**conductive footwear**
footwear whose resistance, when measured according to EN ISO 20344: 2004, 5.10, lies in the range of 0 to 100 kΩ

**3.15**
**antistatic footwear**
footwear whose resistance, when measured according to EN ISO 20344: 2004, 5.10, lies above 100 kΩ and is less than or equal to 1 000 MΩ

**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, protective or occupational footwear relating to a specific profession, e.g. footwear for firefighters, footwear with resistance to chain saw cutting, etc.

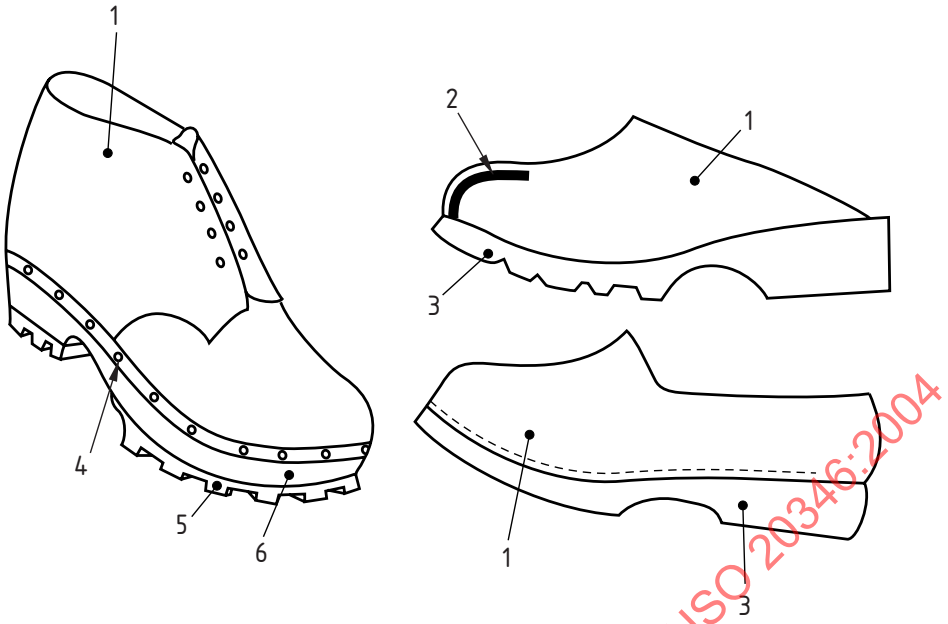





**Key**

| | | | | | |
|---|---|---|---|---|---|
| 1 | Facing | 6 | Insock | 11 | Penetration-resistant insert |
| 2 | Tongue | 7 | Toecap | 12 | Insole |
| 3 | Collar | 8 | Edge covering, e.g. foam strip | 13 | Heel |
| 4 | Upper | 9 | Outsole | 14 | Strobel stitching |
| 5 | Vamp lining | 10 | Cleat | 15 | Quarter |
| | | | | 16 | Vamp |

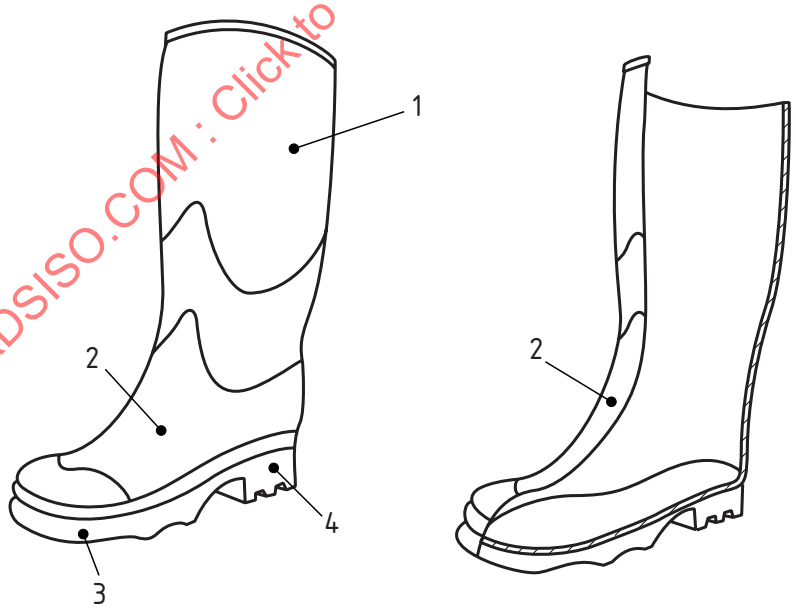
**Figure 1a) Parts of footwear of Strobel construction**




**Key**

| | | | | | |
|---|---|---|---|---|---|
| 1 | Upper | 3 | Rigid sole | 5 | Outsole |
| 2 | Toecap | 4 | Reinforcing welt with nails | 6 | Wooden sole |

**Figure 1b) Parts of footwear of conventional construction**




**Key**

| | | | |
|---|---|---|---|
| 1 | Upper | 3 | Outsole |
| 2 | Vamp | 4 | Heel |

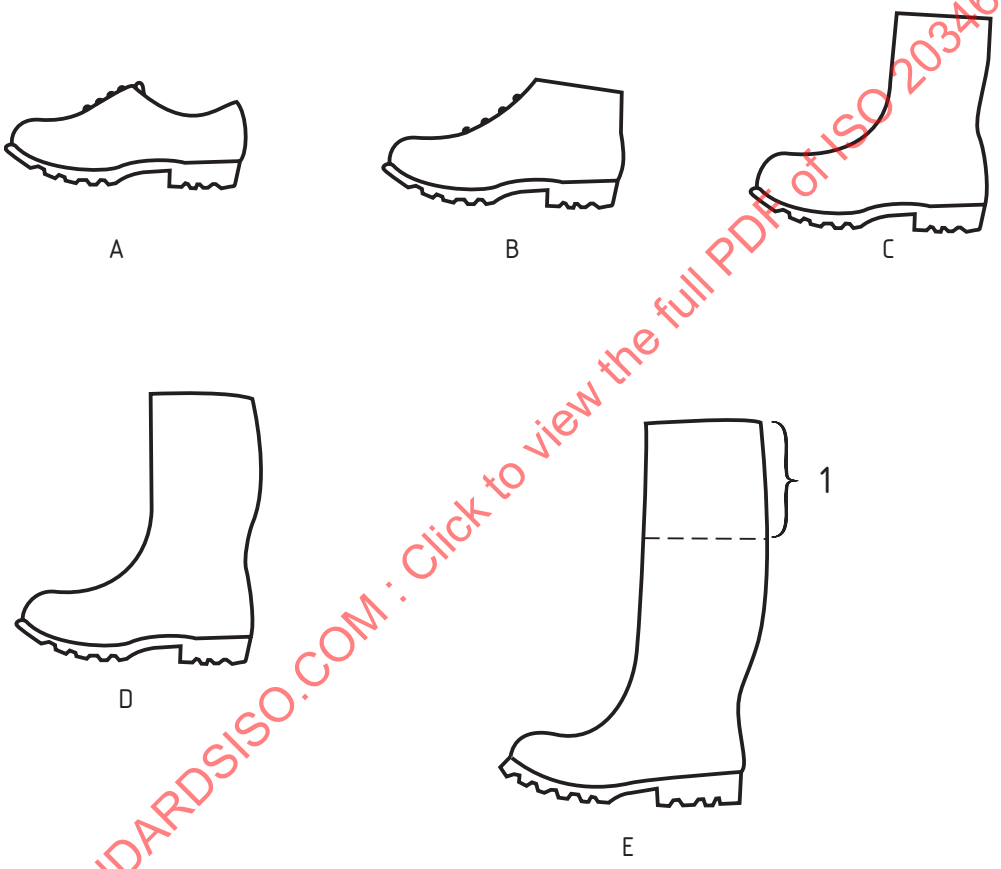
**Figure 2 — Parts of all-rubber (i.e. vulcanized) or all polymeric (i.e. entirely moulded) footwear**

## 4 Classification

Footwear shall be classified in accordance with table 1.

**Table 1 — Classification of footwear**

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






**Key**

1 Variable extension which can be adapted to the wearer

A Low shoe
B Ankle boot
C Half-knee boot
D Knee-height boot
E Thigh boot

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**

# 5 Basic requirements for protective footwear

## 5.1 General

Protective footwear shall comply with the basic requirements given in table 2 and one of the 5 options given in table 3.

Footwear without both an insole and insock or without an insole but with a removable insock is non-compliant with this standard.

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

| Requirement | | Clause | Classification | |
|---|---|---|---|---|
| | | | I | II |
| **Design** | Height of upper | 5.2.1 | X | X |
| | Seat region: | 5.2.2 | | |
| | Design A | | | X |
| | Design B, C, D, E | | X | X |
| **Whole footwear** | 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 |
| **Upper** | General | 5.4.1 | X | 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 | |
| **Vamp lining** | Tear strength | 5.5.1 | X | |
| | Abrasion resistance | 5.5.2 | X | |
| | Water vapour permeability and coefficient | 5.5.3 | X | |
| | pH value | 5.5.4 | X | |
| | Chromium VI content | 5.5.5 | X | |
| **Quarter lining** | Tear strength | 5.5.1 | O | |
| | Abrasion resistance | 5.5.2 | O | |
| | Water vapour permeability and coefficient | 5.5.3 | O | |
| | pH value | 5.5.4 | O | |
| | Chromium VI content | 5.5.5 | O | |
| **Tongue** | Tear strength | 5.6.1 | O | |
| | pH value | 5.6.2 | O | |
| | Chromium VI content | 5.6.3 | O | |
| **Outsole** | Thickness of non-cleated outsoles | 5.8.1 | X | X |
| | Tear strength | 5.8.2 | X | |
| | Abrasion resistance | 5.8.3 | X | X |
| | Flexing resistance | 5.8.4 | X | X |
| | Hydrolysis | 5.8.5 | X | X |

**Table 2 — Basic requirements for protective footwear** *(concluded)*

| Requirement | | Clause | Classification | |
|---|---|---|---|---|
| | | | I | II |
| **Outsole** | Interlayer bond strength | 5.8.6 | O | O |
| | Resistance to fuel oil | 5.8.7 | X | X |

NOTE The applicability of a requirement to a particular classification is indicated in this table by the following:

X 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 if the component part exists, the requirement shall be met.

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

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

| Options | | | Component to be assessed | Requirements to fulfil | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Thick-ness 5.7.1 | pH [a] 5.7.2 | Water absorp-tion desorp-tion 5.7.3 | Abrasion 5.7.4.1 | Chrom-ium VI [a] 5.7.5 | Abras-ion 5.7.4.2 |
| 1 | No insole or if present not fulfilling the requirements | Non-removable insock | Insock | X | X | X | | X | X |
| 2 | Insole present | No insock | Insole | X | X | X | X | X | |
| | | Seat sock present | | | | | | | |
| 3 | | Full insock, non-removable | Insock and insole together | X | | X | | | |
| | | | Insock | | X | | | X | X |
| 4 | | Full insock, removable and water permeable [b] | Insole | X | X | X | X | X | |
| | | | Insock | | X | | | X | X |
| 5 | | Full insock, removable, not water permeable [b] | Insole | X | X | X | X | X | |
| | | | Insock | | X | X | | X | X |

Note 1: X means that the requirement shall be met.

Note 2: For removable insocks see clause 8.3.

[a]) those requirements are only for leather

[b]) a water permeable insock is one that, when tested in accordance with EN ISO 20344: 2004, 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 measured in accordance with EN ISO 20344: 2004, 6.2, shall be as given in table 4.

**Table 4 — Height of upper**

| Footwear size | | Height | | | |
|---|---|---|---|---|---|
| French | English | Design A mm | Design B mm min. | Design C mm min. | Design D mm min. |
| 36 and below | up to 3 ½ | < 103 | 103 | 162 | 255 |
| 37 and 38 | 4 to 5 | < 105 | 105 | 165 | 260 |
| 39 and 40 | 5 ½ to 6 ½ | < 109 | 109 | 172 | 270 |
| 41 and 42 | 7 to 8 | < 113 | 113 | 178 | 280 |
| 43 and 44 | 8 ½ to 10 | < 117 | 117 | 185 | 290 |
| 45 and above | 10 ½ and above | < 121 | 121 | 192 | 300 |

### 5.2.3 Seat region

The seat region shall be closed.

## 5.3 Whole footwear

### 5.3.1 Sole performance

#### 5.3.1.1 Construction

When used an insole shall be present in such a way that it cannot be removed without damaging the footwear.

#### 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 EN ISO 20344: 2004, 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, and 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.

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 EN ISO 20344: 2004, 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 |
|---|---|---|
| French | English | mm |
| 36 and below | up to 3 ½ | 34 |
| 37 and 38 | 4 to 5 | 36 |
| 39 and 40 | 5 ½ to 6 ½ | 38 |
| 41 and 42 | 7 to 8 | 39 |
| 43 and 44 | 8 ½ to 10 | 40 |
| 45 and above | 10 ½ and above | 42 |

#### 5.3.2.3 Impact resistance of protective footwear

When protective footwear is tested in accordance with the method described in EN ISO 20344: 2004, 5.4, at an impact energy of at least 100 J ± 2 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 on the test axis 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 |
|---|---|---|
| French | English | mm |
| 36 and below | up to 3 ½ | 12,5 |
| 37 and 38 | 4 to 5 | 13,0 |
| 39 and 40 | 5 ½ to 6 ½ | 13,5 |
| 41 and 42 | 7 to 8 | 14,0 |
| 43 and 44 | 8 ½ to 10 | 14,5 |
| 45 and above | 10 ½ and above | 15,0 |

#### 5.3.2.4 Compression resistance of protective footwear

When protective footwear is tested in accordance with EN ISO 20344: 2004, 5.5, the clearance under the toecap at a compression load of 10 kN ± 0,1 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 classification II footwear is tested and assessed in accordance with EN ISO 20344: 2004, 5.6.1, the metallic toecap shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 $mm^2$ in area.

When metallic toecaps to be used in classification I footwear are tested and assessed in accordance with EN ISO 20344: 2004, 5.6.2, they shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 $mm^2$ in area.

#### 5.3.2.5.2 Non-metallic toecaps

Non-metallic toecaps used in safety footwear shall comply with the requirements of EN 12568:1998, 4.3.

### 5.3.3 Leakproofness

When tested in accordance with EN ISO 20344: 2004, 5.7, there shall be no leakage of air.

### 5.3.4 Specific ergonomic features

The footwear shall be considered to satisfy the ergonomic requirements if all the answers are positive in the questionnaire given in EN ISO 20344: 2004, 5.1.

## 5.4 Upper

### 5.4.1 General

For designs B, C, D and E the area which shall fulfil the upper requirements shall have a minimum height measured from the horizontal surface beneath the sole in accordance with table 7.

**Table 7 — Minimum height below which the upper requirements shall be completely fulfilled**

| Size of footwear | | Design<br>Minimum height<br>mm | | | |
|---|---|---|---|---|---|
| French | English | B | C | D | E |
| 36 and below | up to 3 ½ | 64 | 113 | 172 | 265 |
| 37 and 38 | 4 to 5 | 66 | 115 | 175 | 270 |
| 39 and 40 | 5 ½ to 6 ½ | 68 | 119 | 182 | 280 |
| 41 and 42 | 7 to 8 | 70 | 123 | 188 | 290 |
| 43 and 44 | 8 ½ to 10 | 72 | 127 | 195 | 300 |
| 45 and above | 10 ½ and above | 73 | 131 | 202 | 310 |

When collar and insert materials are present above the heights given in table 7, such materials shall meet the tear strength, 5.5.1, and abrasion resistance, 5.5.2, requirements for lining. In the case of leather materials they shall meet in addition the requirements for the pH value, 5.4.7, and for the chromium VI content, 5.4.9.

### 5.4.2 Thickness

When determined in accordance with EN ISO 20344: 2004, 6.1, the thickness of the upper of classification II footwear at any point shall be in accordance with table 8.

**Table 8 — Minimum thickness of upper**

| Type of material | Minimum thickness<br>mm |
|---|---|
| Rubber | 1,50 |
| Polymeric | 1,00 |

### 5.4.3 Tear strength

When determined in accordance with EN ISO 20344: 2004, 6.3, the tear strength of the upper of classification I footwear shall be in accordance with table 9.

**Table 9 — Minimum tear strength of upper**

| Type of material | Minimum force<br>N |
|---|---|
| Leather | 120 |
| Coated fabric and textile | 60 |

### 5.4.4 Tensile properties

When determined in accordance with EN ISO 20344: 2004, 6.4, table 7, the tensile properties shall be in accordance with table 10.

**Table 10 — Tensile properties**

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

### 5.4.5 Flexing resistance

When tested in accordance with EN ISO 20344: 2004, 6.5, the flexing resistance shall be in accordance with table 11.

**Table 11 — Flexing resistance**

| Type of material | Flexing resistance |
|---|---|
| Rubber | No cracking before 125 000 flexes |
| Polymeric | No cracking before 150 000 flexes |

### 5.4.6 Water vapour permeability and coefficient

When tested in accordance with EN ISO 20344: 2004, 6.6, and EN ISO 20344: 2004, 6.8, the water vapour permeability shall be not less than 0,8 $mg/(cm^2 \cdot h)$ and the water vapour coefficient shall be not less than 15 $mg/cm^2$.

### 5.4.7 pH value

When leather uppers are tested in accordance with EN ISO 20344: 2004, 6.9, the pH value shall be not less than 3,2 and, 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 EN ISO 20344: 2004, 6.10, no cracking shall occur before 150 000 flex cycles.

#### 5.4.9 Chromium VI content

When leather uppers are tested in accordance with EN ISO 20344: 2004, 6.11, chromium VI shall not be detectable.

### 5.5 Lining

NOTE The following requirements are applicable to vamp lining and quarter lining.

#### 5.5.1 Tear strength

When determined in accordance with EN ISO 20344: 2004, 6.3, the tear strength of the lining shall be in accordance with table 12.

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

| Type of material | Minimum force in N |
|---|---|
| Leather | 30 |
| Coated fabric and textile | 15 |

#### 5.5.2 Abrasion resistance

When tested in accordance with EN ISO 20344: 2004, 6.12, the lining shall not develop any holes before the following number of cycles has been performed:

— dry: 25 600 cycles;

— wet: 12 800 cycles.

#### 5.5.3 Water vapour permeability and coefficient

When tested in accordance with EN ISO 20344: 2004, 6.6, and EN ISO 20344: 2004, 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$^2$.

NOTE There is no requirement to test unlined stiffeners.

#### 5.5.4 pH value

When leather linings are tested in accordance with EN ISO 20344: 2004, 6.9, the pH value shall be not less than 3,2 and, if the pH value is below 4, the difference figure shall be less than 0,7.

#### 5.5.5 Chromium VI content

When leather linings are tested in accordance with EN ISO 20344: 2004, 6.11, chromium VI shall not be detectable.

## 5.6 Tongue

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

### 5.6.1 Tear strength

When determined in accordance with EN ISO 20344: 2004, 6.3, the tear strength of the tongue shall be in accordance with table 13.

**Table 13 — Minimum tear strength of tongue**

| Type of material | Minimum force in N |
|---|---|
| Leather | 36 |
| Coated fabric and textile | 18 |

### 5.6.2 pH value

When leather tongues are tested in accordance with EN ISO 20344: 2004, 6.9, the pH value shall be not less than 3,2 and, if the pH value is below 4, the difference figure shall be less than 0,7.

### 5.6.3 Chromium VI content

When leather tongues are tested in accordance with EN ISO 20344: 2004, 6.11, chromium VI shall not be detectable.

## 5.7 Insole and insock

### 5.7.1 Thickness

When determined in accordance with EN ISO 20344: 2004, 7.1, the thickness of the insole shall be not less than 2,0 mm.

### 5.7.2 pH value

When leather insoles or leather insocks are tested in accordance with EN ISO 20344: 2004, 6.9, the pH value shall be not less than 3,2 and, 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 EN ISO 20344: 2004, 7.2, the water absorption shall be not less than 70 mg/cm² 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 EN ISO 20344: 2004, 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 EN ISO 20344: 2004, 7.3.6 ).

#### 5.7.4.2 Insocks

When non-leather insocks are tested in accordance with EN ISO 20344: 2004, 6.12, the wearing surface shall not develop any holes before the following number of cycles has been performed

— dry: 25 600 cycles;

— wet: 12 800 cycles.

### 5.7.5 Chromium VI content

When leather insoles are tested in accordance with EN ISO 20344: 2004, 6.11, chromium VI shall not be detectable.

## 5.8 Outsole

### 5.8.1 Thickness of non-cleated outsoles

When tested in accordance with EN ISO 20344: 2004, 8.1, the total thickness of a non-cleated outsole, at any point, shall be not less than 6 mm.

### 5.8.2 Tear strength

When non-leather outsoles are tested in accordance with EN ISO 20344: 2004, 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$^3$;

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

### 5.8.3 Abrasion resistance

When non-leather outsoles other than those from all-rubber or all-polymeric footwear are tested in accordance with prEN ISO 20344: 2000, 8.3, 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 and not greater than 150 mm$^3$ for materials with a density greater than 0,9 g/cm$^3$.

When outsoles from all-rubber or all-polymeric footwear are tested as described in EN ISO 20344: 2004, 8.3, the relative volume loss shall be not greater than 250 mm$^3$.

### 5.8.4 Flexing resistance

When non-leather outsoles are tested in accordance with EN ISO 20344: 2004, 8.4, the cut growth shall be not greater than 4 mm before 30 000 flex cycles.

### 5.8.5 Hydrolysis

When polyurethane outsoles and soles with an outer layer composed of polyurethane are tested in accordance with EN ISO 20344: 2004, 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 EN ISO 20344: 2004, 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.

### 5.8.7 Resistance to fuel oil

When tested in accordance with EN ISO 20344: 2004, 8.6.1, the increase in volume shall be not greater than 12%.

If after testing in accordance with EN ISO 20344: 2004, 8.6.1, the test piece shrinks by more than 0,5 % 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 EN ISO 20344: 2004, 8.6.2, and the cut growth shall be not greater than 6 mm before 150 000 flex cycles.

## 6 Additional requirements for protective footwear

### 6.1 General

Additional requirements can be necessary for protective footwear, depending upon risks to be encountered at the work place. In such cases, protective footwear shall conform to the appropriate additional requirements and corresponding marking, given in table 14.

**Table 14 — Additional requirements for special applications with appropriate symbols for marking**

| Requirement | | Clause | Classification | | 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 | I |
| | 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 |
| **Upper** | Water penetration and water absorption | 6.3.1 | X | | WRU |
| | Construction | 6.3.2 | X | | |
| | Cut resistance | 6.3.3 | X | X | CR |
| **Outsole** | Cleated area | 6.4.1 | X | X | |
| | Thickness of cleated outsoles | 6.4.2 | X | X | |
| | Cleat height | 6.4.3 | X | X | |
| | Resistance to hot contact | 6.4.4 | X | X | HRO |

NOTE The applicability of a requirement to a particular classification is indicated in this table by the following:
X If the property is claimed the requirement shall be met.

## 6.2 Whole footwear

### 6.2.1 Penetration resistance

#### 6.2.1.1 Determination of penetration force

When footwear is tested in accordance with EN ISO 20344: 2004, 5.8.2, the force required to penetrate the sole unit shall be not less than 1 100 N.

#### 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. The insert shall not lie above the flange of the safety or protective toecap and shall not be attached to it.

#### 6.2.1.3 Dimensions

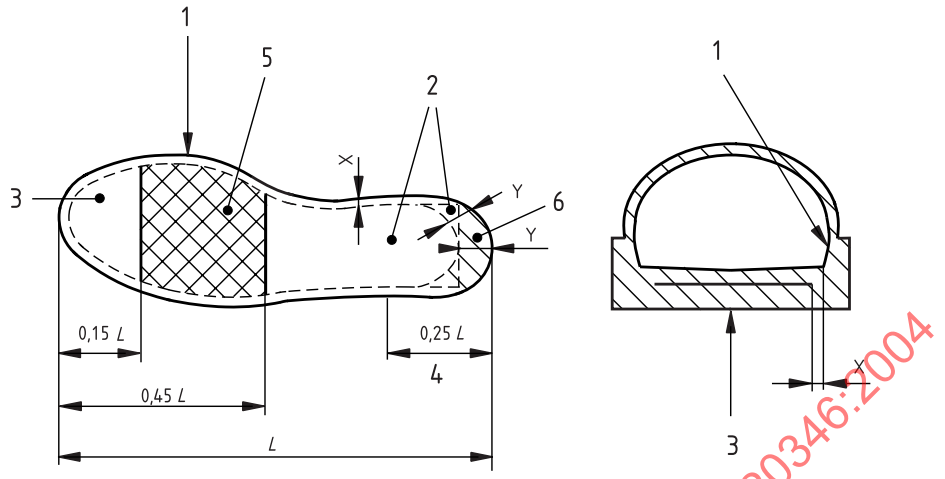
The penetration-resistant insert dimensions shall be measured according to prEN 20344:2000, 5.8.1.

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 4).

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

The holes shall not lie in the shaded area 1 (see figure 4).

Holes in the shaded area 2 shall be disregarded (see figure 4).




**Key**

1 Line left by feather edge of the last

2 Alternative shapes of insert

3 Insert

4 Heel region

5 Shaded area 1

6 Shaded area 2

*L* Length of the inside of the bottom of the footwear

**Figure 4 — Position of penetration-resistant insert**



#### 6.2.1.4 Flex resistance of penetration-resistant inserts

When penetration-resistant inserts in all types of footwear are tested in accordance with EN ISO 20344: 2004, 5.9, they shall show no visible signs of cracking after being subjected to $1x10^6$ flexes.

#### 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 EN ISO 20344: 2004, 5.6.1, the penetration-resistant metallic insert shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 $mm^2$ in area. When penetration-resistant metallic inserts to be used in all other types of footwear are tested in accordance with the method described in EN ISO 20344: 2004, 5.6.3, they shall exhibit no more than five areas of corrosion, none of which shall exceed 2,5 $mm^2$ in area.

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

Penetration-resistant non-metallic inserts shall comply with the requirements of EN 12568:1998, 5.2, measuring the maximum force after being subjected to the treatments described in EN 12598: 1998, 7.1.5..

### 6.2.2 Electrical properties

#### 6.2.2.1 Conductive footwear

When measured in accordance with EN ISO 20344: 2004, 5.10, after conditioning in a dry atmosphere (EN ISO 20344: 2004, 5.10.3.3 a), the electrical resistance shall be not greater than 100 kΩ.

#### 6.2.2.2 Antistatic footwear

When measured in accordance with EN ISO 20344: 2004, 5.10, after conditioning in a dry and wet atmosphere (EN ISO 20344: 2004, 5.10.3.3 a and b), the electrical resistance shall be above 100 kΩ and less than or equal to 1 000 MΩ.

#### 6.2.2.3 Electrically insulating footwear

When measured in accordance with EN ISO 20344: 2004, 5.11, footwear shall comply with electrical class O or electrical class OO.

### 6.2.3 Resistance to inimical environments

#### 6.2.3.1 Heat insulation of sole complex

When footwear is tested in accordance with EN ISO 20344: 2004, 5.12, the temperature increase on the upper surface of the insole shall be not greater than 22 °C.

There shall be no distortion or embrittlement of the sole that reduces its functionality.

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 EN ISO 20344: 2004, 5.13, the temperature decrease on the upper surface of the insole shall be not more than 10 °C.

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 EN ISO 20344: 2004, 5.14, the energy absorption of the seat region shall be not less than 20 J.

### 6.2.5 Water resistance

When tested in accordance with EN ISO 20344: 2004, 5.15.1, the total area of water penetration after 100 trough lengths shall be not greater than 3 $cm^2$ or when tested in accordance with EN ISO 20344: 2004, 5.15.2, no water penetration shall occur before 15 min.

### 6.2.6 Metatarsal protection

#### 6.2.6.1 Construction

The metatarsal protective device shall be made from suitable materials and be of a suitable shape, 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 and shall be designed so as not to impair normal foot movement.

#### 6.2.6.2 Impact resistance of metatarsal protective device

When tested in accordance with EN ISO 20344: 2004, 5.16, the minimum clearance at the moment of impact shall be in accordance with table 15.

**Table 15 — Minimum clearance at impact**

| Size of footwear | | Minimum clearance after impact |
|---|---|---|
| French | English | mm |
| 36 and below | Up to 3 ½ | 37,0 |
| 37 and 38 | 4 to 5 | 38,0 |
| 39 and 40 | 5 ½ to 6 ½ | 39,0 |
| 41 and 42 | 7 to 8 | 40,0 |
| 43 and 44 | 8 ½ to 10 | 40,5 |
| 45 and over | 10 ½ and above | 41,0 |

#### 6.2.7 Ankle protection

When tested in accordance with EN ISO 20344: 2004, 5.17, the mean value of the test results shall not exceed 20 kN and no single value shall exceed 30 kN.

### 6.3 Upper

#### 6.3.1 Water penetration and water absorption

When tested in accordance with EN ISO 20344: 2004, 6.13, the water penetration (expressed as 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 %.

#### 6.3.2 Construction

Non-functional and decorative stitching and perforations shall not be used on footwear for which water resistance of the upper is claimed.

#### 6.3.3 Cut resistance

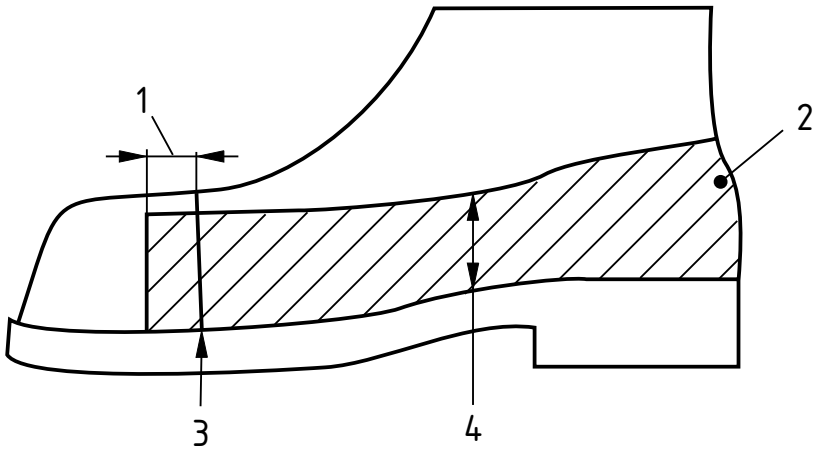
##### 6.3.3.1 Design

Footwear shall not be of design A as described in clause 4.

##### 6.3.3.2 Construction

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 5).




**Key**

1 10 mm overlap over toecap
2 Protective area
3 Rear edge of toecap
4 30 mm minimum height above the feather line

**Figure 5 — Coverage of protective area**

#### 6.3.3.3 Resistance to cutting

When tested in accordance with the method described in EN ISO 20344: 2004, 6.14, the factor *I* shall be not less than 2,5.

#### 6.3.3.4 Penetration resistance

Footwear shall also comply with the requirements of 6.2.1.

### 6.4 Outsole

#### 6.4.1 Cleated area

With the exception of the region under the flange of the toecap, at least the shaded area as shown in figure 6 shall have cleats which are open to the side.

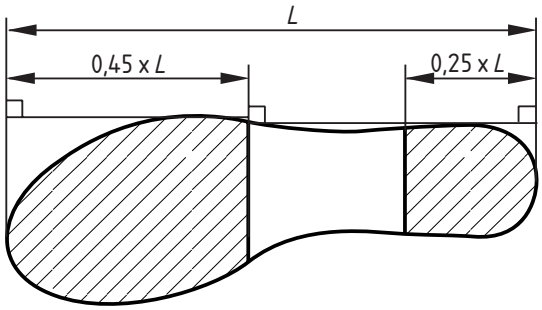



**Figure 6 — Cleated area**

#### 6.4.2 Thickness of cleated outsoles

When tested in accordance with EN ISO 20344: 2004, 8.1, for direct-injected, vulcanized or cemented outsoles the thickness $d_1$, shall be not less than 4 mm, for multilayered outsoles, the thickness $d_1$ shall be not