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C 73

National Standard of the People's Republic of China

GB ××××—200×

Personal protective equipment — Safety Footwear

(ISO 20345: 2004, MOD)

(Draft Approval)
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Content

Foreword

Sections 5.3.1.2, 5.3.2, 5.3.3, 5.4.3, 5.4.4, 5.4.5, 5.5.1, 5.5.2, 5.8.1, 5.8.2, 5.8.3, 5.8.4, 5.8.5, 5.8.6, and 5.8.7 of this standard are mandatory. For additional provisions applicable to safety footwear, those stipulated in Chapter 6 are mandatory while the rest are recommendable.

This Standard is modified based on ISO20345: 2004 “Personal Protective Equipment – Safety Footwear” (English edition). This draft of this Standard is based on ISO20345: 2004.

This Standard has the following modifications with comparison to ISO20345: 2004:

— Transformation from international standard formats and statements into formats and statements of the People’s Republic of China; editorial modifications based on Chinese language practices; some terminology and definitions are modified to meet with customary practices of the People’s Republic of China.

— ISO and EN forewords are deleted.

— For scopes, additional regulations, together with applicable and non-applicable ranges, are incorporated.

— All ISO20344: 2004 quotations of the international standard are re-written as “GB/T××××—200×”

— All ISO20345: 2004 footwear numbers are revised into corresponding international footwear numbers and simplified as “Footwear Numbers”.

— In Section 3.14, as regards the definition of conductive footwear, “resistance within 0Ω~100kΩ”is revised to “resistance < 100kΩ”.

— In Section 3.15, as regards the definition of antistatic footwear, “resistance above 100kΩ”, is revised to “resistance ≥ 100kΩ…”.

— Deletion of “3.18, Terminology” of the international standard.

— In 5.3.2.5.2 and 6.2.1.5.2 of EN12568: 1998, content quoted by the international standard is directly incorporated into this Standard, together with the addition of Table 7, Appendices A and B.

— In 5.7.4.1, “abrasive damage shall not be more severe than that described of standard specimens of similar materials” is revised to “shall not have severe abrasive damage”.

— In 6.2.2.1, “resistance shall be no greater than 100kΩ” is revised to “resistance shall be less than 100kΩ”.

— In 6.2.2.2, “resistance shall be greater than 100kΩ” is revised to “resistance ≥ 100kΩ…”.

— In 6.2.3.1, “30min later,” is inserted before “temperature rise on the surface of the inner bottom…”.

— Deletion of 7b of the International Standard.

— Deletion of 8.1b of the International Standard.

— In 8.2.1, “…upper-limit of value of the 100kΩ resistance” is revised to “… resistance is less than 100kΩ”.

— In 8.2.3, “resistance” in c) is revised to “electrical property”; deletion of sub-item 2) of d); cancellation of the serial indicator “1)”, the text of which is used as the direct content of item d).

— Content of references is increased according to the revision of this Standard.

Appendices A and B to this Standard are specification Appendices.

This Standard was proposed by the State Administration of Work Safety.

This Standard is under the jurisdiction of the National Technical Committee of Standardisation for Personal Protective Equipment (CSBTS/TC112).

Drafting units of this Standard: Sinosteel Wuhan Safety & Environmental Protection Research Institute; National Labour Protection Appliances Quality Supervision Inspection Centre (Wuhan); Guangzhou OSH Safety Technology Ltd.; Saina Group Co., LTD., Zhejiang; Jiangsu Jinhu Guoxiang Industry & Grade Col, Ltd.; RongGuang Group Co., Ltd.; and Jon Long Safety Wear Co., Ltd., Dongguan.

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Personal Protective Equipment – Safety Footwear

1 Scope

This Standard sets the terms and definitions, classifications, basic and additional requirements, labelling and available information concerning safety footwear.

This Standard is applicable to safety footwear that protects the wearer's feet and legs from being injured by hazards in the workplace.

This Standard is not applicable to safety footwear without insole and insock, or without insole but with removable insock.

2 Normative references

The provisions of the following documents constitute the provisions of this Standard after being referenced. For dated reference documents, all later amendments (excluding corrigenda) and versions do not apply to this Standard; however, it is encouraged to study with all agreed parties whether the latest versions of these documents are applicable. For non-dated reference documents, the latest versions apply to this Standard.

GB/T××××—200× Test Methods of Personal Protective equipment – Safety Footwear (ISO20344: 2004, MOD)

3 Terms and definitions

The following terms and definitions are applicable to this Standard.

Note: Fig. 1 and Fig. 2 illustrate parts of footwear.

3.1

Safety footwear

Safety footwear is footwear with protective features used to protect the wearer from accidental injuries, and is equipped with a protective toecap capable of providing protection against 200J of impact in an impact test, and compression protection against at least 15kN pressure in a compression test.

3.2 Leather

3.2.1

Full grain leather

Tanned leather that does not decay and that retains a full surface grain.

3.2.2

Corrected grain leather

Tanned leather that does not decay and whose surface grain structure has been modified by mechanical processing.

3.2.3

Leather split

A layer of tanned, decay-preventive leather, attained by splitting a thick hide; normally an upper-first or intermediate layer.

3.3

Rubber

Rubber refers to vulcanised rubber in this Standard.

3.4

Polymeric materials

Polymeric materials refers to materials such as polyurethane or polyethylene (vinyl chloride).

3.5

Insole

A non-moveable component, usually connected to the vamp in the shoe-making process, used to form the bottom part of the shoe.

3.6

Insock

The moveable or fixed shoe element that covers the insole either partially or entirely.

3.7

Lining

The material covering the inner surface of the upper.

Note 1: The wearer's foot comes into direct contact with the lining.

Note 2: For shoes with a safety toecap, lining is installed where the fore-part of the vamp is cut open for accommodating the safety toecap, or seamed onto the vamp to form a pocket for accommodating the safety toecap, so as to protect the material underneath the safety toecap.

3.7.1

Vamp lining

The material that covers the inner surface of the front part of the upper (the vamp).

3.7.2

Quarter lining

The material that covers the inner surface of the rear part of the upper (the quarter).

3.8

Cleat(s)

The protruding component on the outer surface of the sole.

3.9

Rigid outsole

When the entire shoe is measured in accordance with 8.4.1 of GB/T××××—200×, a rigid outsole shall be bent less than 45° when under a load of 30N.

3.10

Cellular outsole

An outsole structure with a density of 0.9g/cm^3 or less, of which the porous structure is visible under a 10X magnifier.

3.11

Penetration-resistant insert

An element inserted into the sole combination for providing the wearer with protection against penetration.

3.12

Safety toecap

A component installed inside the shoe to protect the wearer's toes from being injured by any impact of over 200J energy and at least 15kN pressure.

3.13

Seat region

The rear part of the shoe (upper and sole).

3.14

Conductive footwear

Footwear with a resistance of less than 100kΩ, measured in accordance with 5.10 of GB/T××××—200×.

3.15

Antistatic footwear

Footwear with a resistance of between 100kΩ - 1000MΩ, measured in accordance with 5.10 of GB/T××××—200×.

3.16

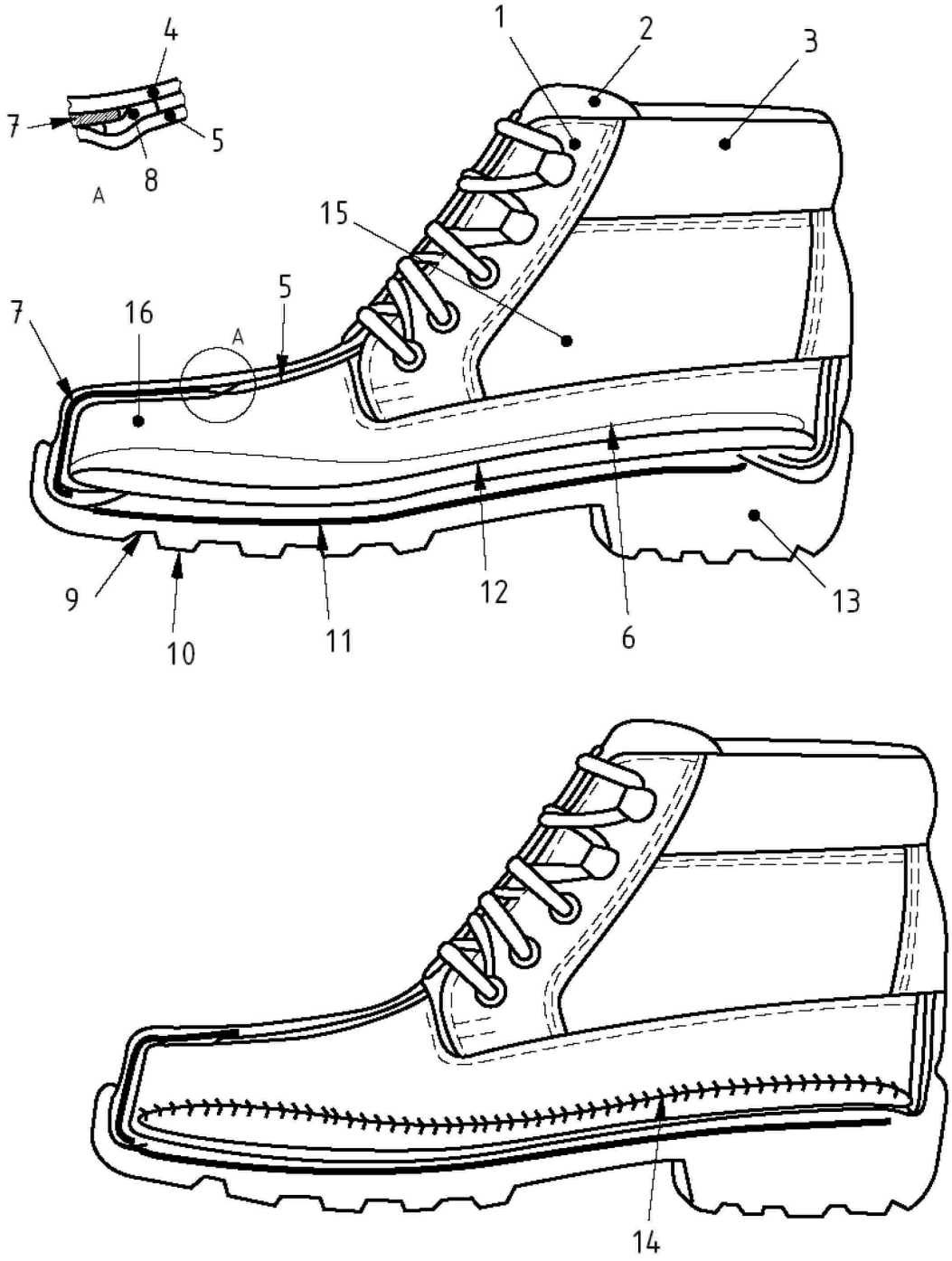
Electrically insulating footwear

Footwear that protects the wearer against electrical shocks, by blocking electric currents from running through the wearer's body.

3.17

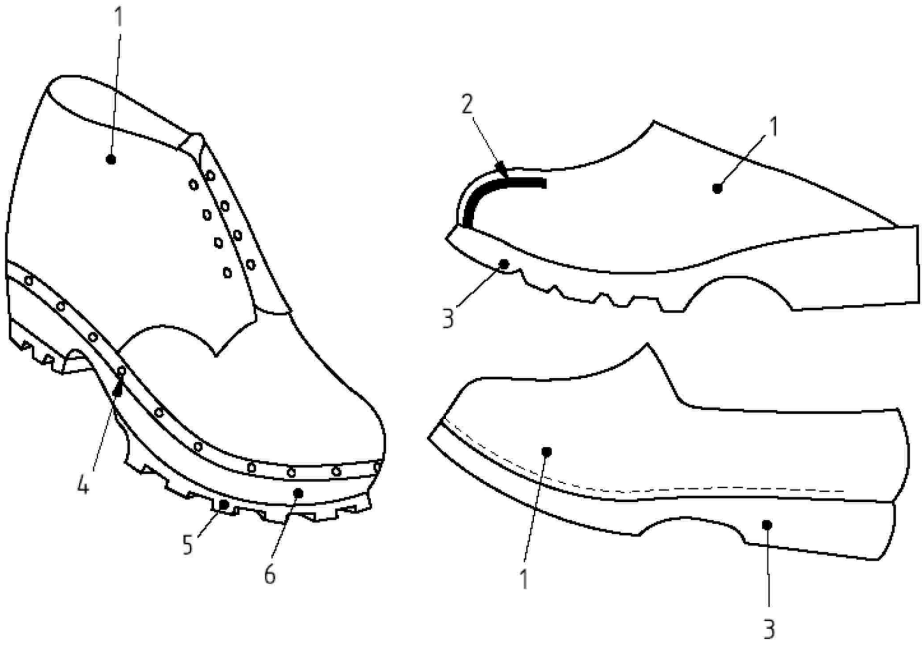
Fuel oil

The aliphatic hydrocarbon content of petroleum.



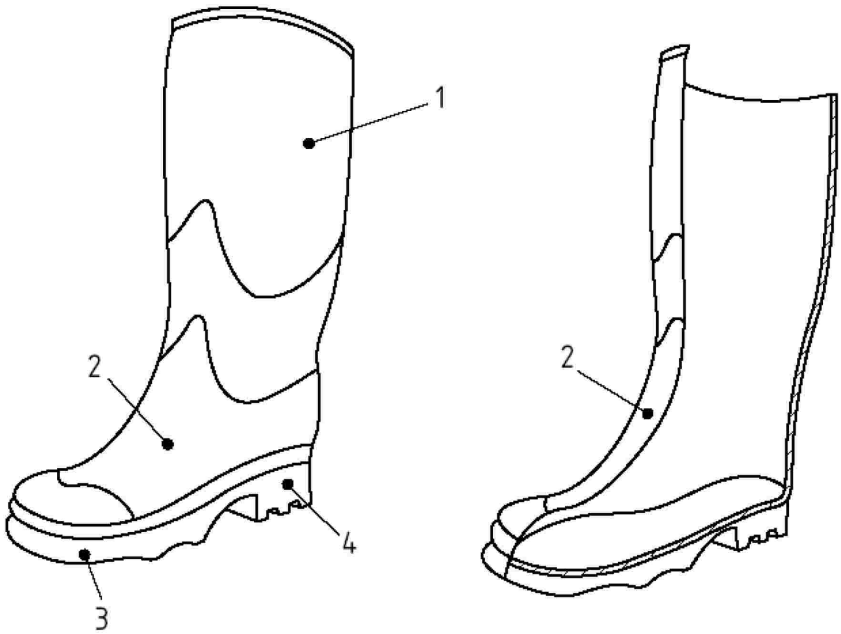
1 - side sticker;	5 - vamp lining;	9 - outsole;	13 - heel;
2 - tongue;	6 - pad;	10 - cleats;	14 - stitch-line between insole and upper;
3 - collar;	7 - safety toecap;	11 - penetration-resistant insert;	15 - quarter;
4 - upper;	8 - side cover layer, such as foam;	12 - insole;	16 - vamp.

Fig. 1a) Insole and Upper are parts of a seamed shoe structure



1 - upper; 3 - rigid sole; 5 - outsole;
2 - safety toecap; 4 - tacked side reinforcement band; 6 - wooden sole.

Fig. 1b) Parts of the traditional shoe structure



1 - Upper; 2 - Vamp; 3 - Outsole; 4 - Heel.

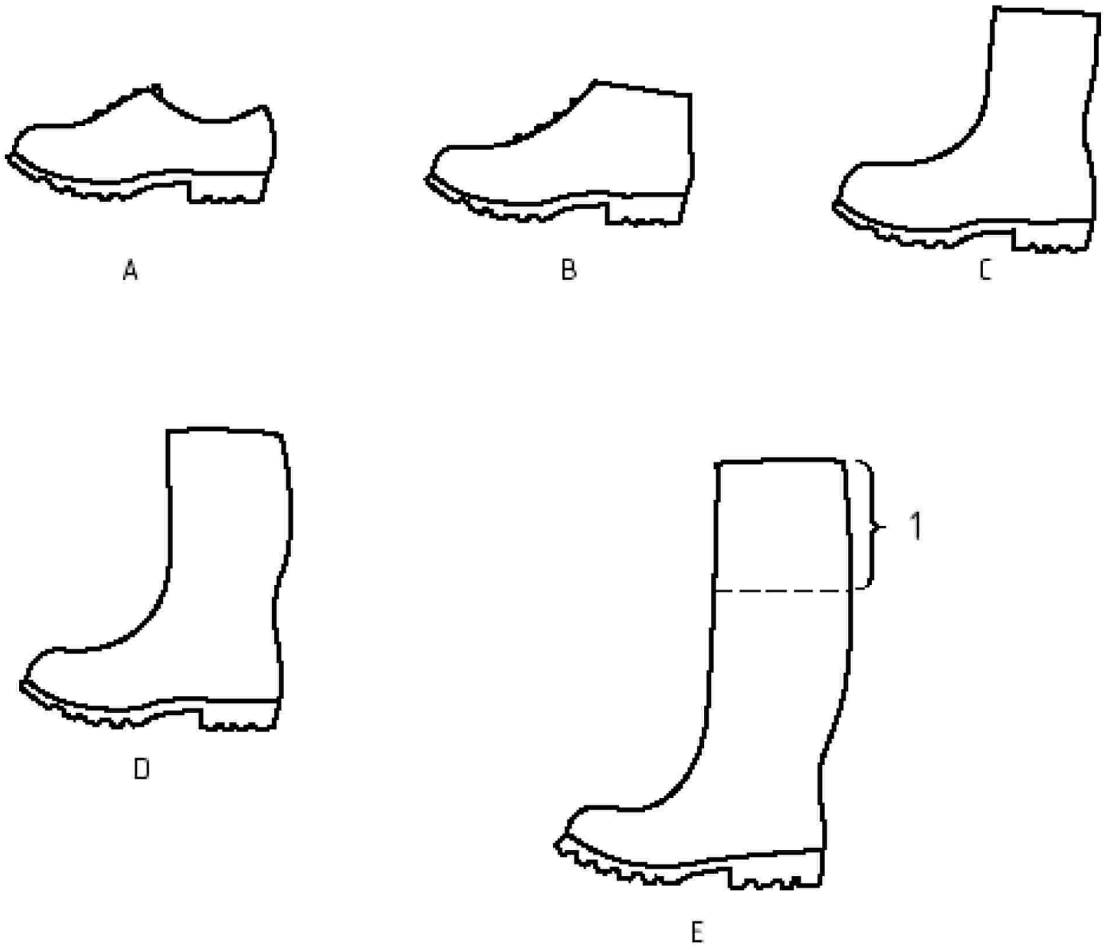
Fig. 2 All-rubber (i.e. vulcanised) or all polymer (i.e. fully moulded) shoes

4 Categories

Shoes are categorised in Table 1

Table 1 Shoe categories

Specification Number	Category
I	Shoes made of leather or other materials, with the exception of all-rubber or all-polymer.
II	All-rubber (i.e. fully vulcanised) or all polymer (i.e. fully moulded) shoes



1 - Any extension that fits the wearer;

A - Low cut shoe;

B - Ankle boot;

C - Half-calf boot;

D - Calf boot;

E - Knee boot.

Note: Style E is a calf boot (style D) with an added, extended upper made of non-permeable material, with a cutout that fits to the wearer's leg.

Fig. 3 Footwear Styles

5 Basic requirements for safety footwear

5.1 General requirements

Safety footwear shall comply with the basic requirements given in Table 2 and any of the five options given in Table 3.

Table 2 Safety Footwear - basic requirements

Requirements		Provision	Category	
			I	II
Style	Height of upper	5.2.1	×	×
	Seat region:	5.2.2		
	Style A			×
	Styles B, C, D, E		×	×
Finished footwear	Sock properties:	5.3.1		
	Structure	5.3.1.1	×	
	Upper/outsole binding strength	5.3.1.2	×	
	Toe protection:	5.3.2		
	General requirements	5.3.2.1	×	×
	Length of safety toecap	5.3.2.2	×	×
	Impact resistance	5.3.2.3	×	×
	Pressure resistance	5.3.2.4	×	×
	Safety toecap properties	5.3.2.5	×	×
	Leak resistance	5.3.3		×
	Specific ergonomic features	5.3.4	×	×
Upper	General requirements	5.4.1	×	×
	Thickness	5.4.2		×
	Tear strength	5.4.3	×	
	Tensile properties	5.4.4	×	×
	Flex resistance	5.4.5		×
	Steam permeability and steam coefficient	5.4.6	×	
	pH value	5.4.7	×	
	Hydrolysis	5.4.8		×
	Hexavalent chromium content	5.4.9	×	
Vamp Lining	Tear strength	5.5.1	×	
	Wear resistance	5.5.2	×	
	Steam permeability and steam coefficient	5.5.3	×	
	pH value	5.5.4	×	
	Hexavalent chromium content	5.5.5	×	
Quarter Lining	Tear strength	5.5.1	○	
	Wear resistance	5.5.2	○	
	Steam permeability and steam coefficient	5.5.3	○	
	pH value	5.5.4	○	
	Hexavalent chromium content	5.5.5	○	
Tongue	Tear strength	5.6.1	○	
	pH value	5.6.2	○	
	Hexavalent chromium content	5.6.3	○	
Outsole	Thickness of non-slip outsole	5.8.1	×	×
	Tear strength	5.8.2	×	
	Wear resistance	5.8.3	×	×
	Flex resistance	5.8.4	×	×
	Hydrolysis	5.8.5	×	×
	Binding strength of intermediate layers	5.8.6	○	○
	Oil resistance	5.8.7	×	×

Note: the requirements listed in this table are applicable to a specific category as follows:

× The requirements shall be complied with. In certain cases, requirements only pertain to materials in a specific range – such as the pH value of leather parts. This does not mean that other materials are not applicable.

○ Total compliance if the part exists.

No × or ○ indication means no such requirement.

Table 3 Optional Basic Requirements in the Insole and/or Insock

Option			Evaluated Parts	Conformity Requirements					
				Thickness 5.7.1	PH Value[a] 5.7.2	Water absorbance and hydrolysis tendency 5.7.3	Wear 5.7.4.1	Hexavalent chromium content[a] 5.7.5	Wear 5.7.4.2
1	No insole or insole does not comply	Non-movable insock	Insock	×	×	×		×	×
2	With Insole	No insock	Insole	×	×	×	×	×	
3		With insock seat							
4		Non-movable full insock	Insock with Insole	×		×			
5			Insock		×			×	×
		Movable and permeable[b] full insock	Insole	×	×	×	×	×	
			Insock		×			×	×
		Movable and non-permeable[b] full insock	Insole	×	×	×	×	×	
			Insock		×	×		×	×

× Indicates that the requirement must be complied with.
Note: See 8.3 for movable insole.
[a] Applicable to leather parts only
[b] Permeable insock subject to water permeation within 60 seconds or under in accordance with 7.2 of GB/T××××—200×.

5.2 Style

The footwear shall comply with any of the styles given in Fig. 3.

5.2.1 Height of the upper

The height of the footwear upper shall comply with requirements listed in Table 4 in accordance with the methods specified in 6.2 of GB/T××××—200×.

Table 4 Footwear Upper Height

Footwear Number	Height (mm)			
	Style A	Style B	Style C	Style D
≤ 225	□ 103	≥ 103	≥ 162	≥ 255
230~240	□ 105	≥ 105	≥ 165	≥ 260
245~250	□ 109	≥ 109	≥ 172	≥ 270
255~265	□ 113	≥ 113	≥ 178	≥ 280
270~280	□ 117	≥ 117	≥ 185	≥ 290
≥ 285	□ 121	≥ 121	≥ 192	≥ 300

5.2.2 Seat Region

The seat region shall be closed.

5.3 Finished footwear

5.3.1 Properties of soles

5.3.1.1 Structure

If present, the insole shall be immovable unless the footwear is damaged.

5.3.1.2 Binding strength between upper and outsole.

With the exception of seamed soles, the binding strength shall be ≥ 4.0N/mm, when tested, in accordance with the method stipulated in 5.2 of GB/T××××—200×; in the case of a tear in the sole, the binding strength shall be ≥ 3.0N/mm.

5.3.2 Toe protection

5.3.2.1 General requirements

The safety toecap insert shall not be moved unless the footwear is damaged.

With the exception of full rubber and full polymer, footwear with an internal safety toecap has a vamp lining (or part of the upper acts as this lining). Additionally, a safety toecap shall consist of a rim cover layer that extends at least 5mm under the safety toecap, starting from the rear of the safety toecap, and extending by at least 10mm in the opposite direction.

The wear-resistant cover layer at the toe position shall have a thickness of at least 1mm.

5.3.2.2 Internal length of the safety toecap

The internal length of the safety toecap shall comply with the requirements set out in Table 5 when measured with the methods specified in 5.3 of GB/T××××—200×.

Table 5 Minimum Internal Length of the Safety Toecap

Footwear Number	Minimum internal length mm
≤ 225	≥34
230~240	≥36
245~250	≥38
255~265	≥39
270~280	≥40
≥285	≥42

5.3.2.3 Impact resistance of Safety Footwear

When measured in accordance with the methods specified in 5.4 of GB/T××××—200×, Safety Footwear shall maintain a minimum clearance in the safety toecap conforming to the requirements stipulated in Table 6, after enduring an impact of no less than 200±4 J. Additionally, no penetration (i.e. light penetration) shall occur in the testing axis of the safety toecap.

Table 6 Minimum clearance within the safety toecap after the impact test

Footwear Number	Minimum clearance mm
≤225	≥12.5
230~240	≥13.0
245~250	≥13.5
255~265	≥14.0
270~280	≥14.5
≥285	≥15.0

5.3.2.4 Pressure resistance of Safety Footwear

When measured in accordance with the methods specified in 5.5 of GB/T××××—200×, the minimum clearance within the safety toecap of the Safety Footwear shall remain in accordance with the requirements stipulated in Table 6 under a pressure of (15±0.1) kN.

5.3.2.5 Properties of the safety toecap

5.3.2.5.1 Corrosion resistance of metal safety toecaps

When measured in accordance with the methods specified in 5.6.1 of GB/T××××—200×, the number of corrosion areas in the metal safety toecap of Category II footwear shall not exceed 5, of which each corrosion region shall have an area not exceeding 2.5mm^2.

When measured in accordance with the methods specified in 5.6.2 of GB/T××××—200×, the number of corrosion areas in the metal safety toecap of Category I footwear shall not exceed 5, of which each corrosion region shall have an area not exceeding 2.5mm^2.

5.3.2.5.2 Non metal safety toecap

Table 7 Minimum clearance within the non-metal safety toecap after the impact test

Number of toecap	Minimum clearance mm
≤5	≥19.5
6	≥20.0
7	≥20.5
8	≥21.0
9	≥21.5
≥10	≥22.0

Test results of a non-metal safety toecap of the safety footwear, after treatment with temperature curing as specified in A.1 of Appendix A and followed by the test specified in A.2 of Appendix A, the minimum clearance within the tested safety toecap shall conform to the requirements stipulated in Table

7.

5.3.3 Leak Resistance

When measured in accordance with the methods specified in 5.7 of GB/T××××—200×, no air leakage shall occur.

5.3.4 Specific ergonomic features

If all of the questions in 5.1 of GB/T××××—200× are answered with YES, the footwear shall be deemed as conforming to the ergonomic requirements.

5.4 Footwear upper

5.4.1 General requirements

For styles B, C, D and E, the minimum height measured from the elevation of the sole in the area that meets with requirements for the upper shall meet the requirements set out in Table 8.

Table 8 The minimum height of upper that complies fully with upper requirements

Footwear Number	Minimum Height mm			
	Style B	Style C	Style D	Style E
≤225	≥64	≥113	≥172	≥265
230~240	≥66	≥115	≥175	≥270
245~250	≥68	≥119	≥182	≥280
255~265	≥70	≥123	≥188	≥290
270~280	≥72	≥127	≥195	≥300
≥285	≥73	≥131	≥202	≥310

In the case of the collar and lining being located at a height that exceeds those listed in Table 8, these materials shall conform to tear strength (5.5.1) and wear resistance (5.5.2) of the lining material; for leather materials, additional requirements shall comply with the pH value (5.4.7) and hexavalent chromium content (5.4.9).

5.4.2 Thickness

When measured in accordance with the methods specified in 6.1 of GB/T××××—200×, the thickness of Category II footwear upper at any position shall comply with the requirements set out in Table 9.

Table 9 Minimum Thickness of Upper

Type of Material	Thickness mm
Rubber	≥1.50
Polymer	≥1.00

5.4.3 Tear strength

When measured in accordance with the methods specified in 6.3 of GB/T××××—200×, the tear strength of Category I footwear upper shall comply with the requirements set out in Table 10.

Table 10 Tear Strength of Upper

Type of Material	Minimum Force N
Leather	≥120
Coated fabric or textile	≥60

5.4.4 Tensile properties

When measured in accordance with the methods specified in 6.4 of GB/T××××—200×, tensile properties shall comply with the requirements set out in Table 11.

Table 11 Tensile Properties

Type of material	Tensile strength N/mm^2	Tear Strength N	100□ Fixed Elongation stress N/mm^2	Elongation at break %
Split Leather	≥15	——	——	——
Rubber	——	≥180	——	——
Polymer	——	——	1.3~4.6	≥250

5.4.5 Flex resistance

When measured in accordance with the methods specified in 6.5 of GB/T××××—200×, flex

resistance shall comply with the requirements set out in Table 12.

Table 12 Flex Resistance

Type of material	Flex Resistance
Rubber	No crack shall occur after 125,000 successive bendings.
Polymer	No crack shall occur after 150,000 successive bendings.

5.4.6 Steam permeability and coefficient

When measured in accordance with the methods specified in 6.6 and 6.8 of GB/T××××—200×, steam permeability shall be no less than 0.8mg/ (cm^2·h); steam coefficient shall be no less than 15mg/cm^2.

5.4.7 pH Value

When measured in accordance with the methods specified in 6.9 of GB/T××××—200×, the pH value of the leather upper shall be no less than 3.2. If the pH value is less than 4, the dilution difference shall be less than 0.7.

5.4.8 Hydrolysis

When tested in accordance with the methods specified in 6.10 of GB/T××××—200×, cracks shall not occur after 150,000 successive bendings of the polyurethane upper.

5.4.9 Hexavalent Chromium content

When measured in accordance with the methods specified in 6.11 of GB/T××××—200×, no hexavalent chromium shall be found in the leather upper.

5.5 Lining

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

5.5.1 Tear strength

When measured in accordance with the methods specified in 6.3 of GB/T××××—200×, the tear strength of the lining shall comply with the requirements set out in Table 13.

Table 13 Lining tear strength

Type of Material	Minimum Force N
Leather	≥30
Coated fabric / textile	≥15

5.5.2 Wear resistance

When measured in accordance with the methods specified in 6.12 of GB/T××××—200×, no rupture shall occur in the lining on completion of the following number of revolutions:

- dry test: 25,600 turns;
- wet test: 12,800 turns.

5.5.3 Steam permeability and coefficient

When measured in accordance with the methods specified in 6.6 and 6.8 of GB/T××××—200×, steam permeability shall be no less than 2.0mg/ (cm^2·h); steam coefficient shall be no less than 20mg/cm^2.

Note: Not applicable to non-textured hard lining .

5.5.4 pH Value

When measured in accordance with the methods specified in 6.9 of GB/T××××—200×, the pH value of the leather lining shall be no less than 3.2. If the pH value is less than 4, the dilution difference shall be less than 0.7.

5.5.5 Hexavalent Chromium content

When measured in accordance with the methods specified in 6.11 of GB/T××××—200×, no hexavalent chromium shall be found in the leather lining.

5.6 Tongue

Tests shall be performed only if the material or thickness of the tongue is different to that of Upper.

5.6.1 Tear strength

When measured in accordance with the methods specified in 6.3 of GB/T××××—200×, the tear strength of the tongue shall comply with the requirements set out in Table 14.

Table 14 Tear Strength of Tongue

Type of material	Minimum force N
Leather	≥36
Coated fabric / textile	≥18

5.6.2 pH Value

When measured in accordance with the methods specified in 6.9 of GB/T××××—200×, the pH value of the leather tongue shall be no less than 3.2. If the pH value is less than 4, the dilution difference shall be less than 0.7.

5.6.3 Hexavalent Chromium content

When measured in accordance with the methods specified in 6.11 of GB/T××××—200×, no hexavalent chromium shall be found in the leather tongue.

5.7 Insole and insock

5.7.1 Thickness

When measured in accordance with the methods specified in 7.1 of GB/T××××—200×, the thickness of the insole shall be no less than 2.0mm.

5.7.2 pH Value

When measured in accordance with the methods specified in 6.9 of GB/T××××—200×, the pH value of the leather insole or insock shall be no less than 3.2. If the pH value is less than 4, the dilution difference shall be less than 0.7.

5.7.3 Water absorbance and hydrolysis tendency

When measured in accordance with the methods specified in 7.2 of GB/T××××—200×, water absorbance shall be no less than 70mg/cm^2 and hydrolysis tendency shall be no less than 80% of the absorbed water.

5.7.4 Wear resistance

5.7.4.1 Insole

When tested in accordance with the methods specified in 7.3 of GB/T××××—200×, no severe wear shall occur on completion of 400 cycles.

5.7.4.2 Insock

When tested in accordance with the methods specified in 6.12 of GB/T××××—200×, no rupture shall occur on any abrasive surface on completion of the following number of cycles.

- dry test: 25,600 cycles;
- wet test: 12,800 cycles.

5.7.5 Hexavalent Chromium content

When measured in accordance with the methods specified in 6.11 of GB/T××××—200×, no hexavalent chromium shall be found in the leather insole.

5.8 Outsole

5.8.1 Non-slip outsole

When measured in accordance with the methods specified in 8.1 of GB/T××××—200×, the thickness of the non-slip outsole shall be no less than 6mm at any location.

5.8.2 Tear strength

When measured in accordance with the methods specified in 8.2 of GB/T××××—200×, tear strength shall be no less than:

- 8kN/m, applicable to materials having a density >0.9g/cm^3.
- 5kN/m, applicable to materials having a density ≤0.9g/cm^3.

5.8.3 Wear resistance

When measured in accordance with the methods specified in 8.3 of GB/T××××—200×, non-leather outsoles (with the exception of full rubber and full polymer) with a density ≤0.9g/cm^3 shall have a relative wear of no more than 250mm^3 per unit volume; those with a density > 0.9g/cm^3 shall have a relative wear of no more than 150mm^3 per unit volume.

When measured in accordance with the methods specified in 8.3 of GB/T××××—200×, full rubber and full polymer outsoles shall have a relative wear of no more than 250mm^3 per unit volume.

5.8.4 Flex resistance

When measured in accordance with the methods specified in 8.4 of GB/T××××—200×, elongation of the cut notch shall not exceed 4mm after 30,000 successive bendings.

5.8.5 Hydrolysis

When measured in accordance with the methods specified in 8.5 of GB/T××××—200×, elongation of the cut notch shall not exceed 6mm after 150,000 successive bendings of the polyurethane outsole and the polyurethane bottom outer layer of the footwear.

5.8.6 Binding strength in the intermediate binding layer

When measured in accordance with the methods specified in 5.2 of GB/T××××—200×, binding strength between the outer layer or non-slip layer and its subsequent layer shall be no less than 4.0N/mm; in the case of a rupture to the bottom of the footwear, the binding strength shall be no less than 3.0N/mm.

5.8.7 Oil resistance

When measured in accordance with the methods specified in 8.6.1 of GB/T××××—200×, volumetric increase shall not exceed 12%.

In the case of volumetric shrinkage of more than 0.5%, or an increase in hardness exceeding 10 units of type A Shore Hardness after testing in accordance with the methods specified in 8.6.1 of GB/T××××—200×, further sampling and testing shall be performed in accordance with the methods specified in 8.6.2 of GB/T××××—200×; the elongation of the cut notch shall not exceed 6mm after 150,000 successive bending cycles.

6 Additional Safety Footwear requirements

6.1 General requirements

Safety footwear applicable to different hazards found in the workplace shall comply with additional requirements and corresponding markings as listed in Table 15.

Table 15 Additional requirements with proper markings for specific uses

Requirement		Provision	Category		Marking
			I	II	
Finished Footwear	Resistance to penetration	6.2.1	×	×	P
	Electrical properties:	6.2.2			
	Conductive footwear	6.2.2.1	×	×	C
	Antistatic footwear	6.2.2.2	×	×	A
	Insulating footwear	6.2.2.3		×	I
	Resistance to severe environment conditions:	6.2.3			
	Thermal insulation of the sole	6.2.3.1	×	×	HI
	Protection of the sole against cold	6.2.3.2	×	×	CI
	Energy absorption in seat region	6.2.4	×	×	E
	Waterproof	6.2.5	×		WR
	Metatarsus protection	6.2.6	×	×	M
	Ankle protection	6.2.7	×	×	AN
Upper	Permeability and water absorption	6.3.1	×		WRU
	Structure	6.3.2	×		
	Resistance to cuts	6.3.3	×	×	CR

Outsole	Non-slip area:	6.4.1	×	×	
	Thickness of non-slip outsole	6.4.2	×	×	
	Height of cleats	6.4.3	×	×	
	Resistance to heat contact	6.4.4	×	×	HRO
Note: Note: the requirements listed in this table are applicable to a specific category as follows: × The requirement shall be complied with if the feature in question exists.					

6.2 Finished Footwear

6.2.1 Prevention against penetration

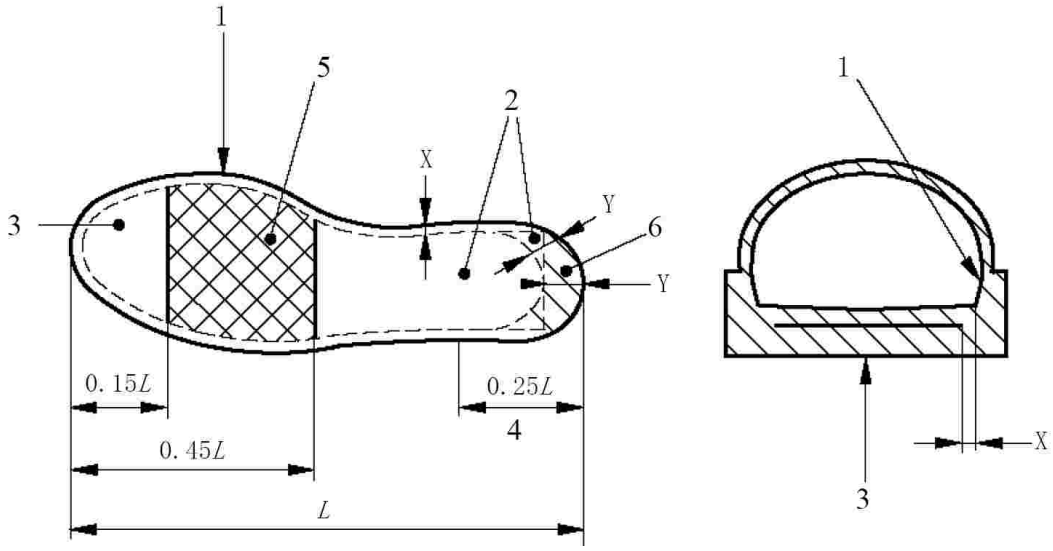
6.2.1.1 Penetrating force

When measured in accordance with the methods specified in 5.8.2 of GB/T××××—200×, the force required to penetrate the outsole shall be no less than 1,100N.

6.2.1.2 Structure

A penetration-resistant insert shall be placed inside the bottom of the footwear and shall not be moved unless the footwear is damaged. The penetration-resistant insert shall not be placed above the curled edge of the safety toecap, nor shall it touch the safety toecap.

6.2.1.3 Dimensions



1 - The bottom edge curve; 2 - Optional shapes for the penetration-resistant insert; 3 - Penetration-resistant insert;

4 - Seat region; 5 - Shaded area 1; 6 - Shaded area 2; *L* - Internal length of sole.

Fig. 4 Position of Penetration-resistant Insert

Dimensions of the penetration-resistant insert, measured in accordance with the methods specified in 5.8.1 of GB/T××××—200×.

The distance (X) between the curve representing the bottom edge and the edge of the penetration-resistant insert shall not exceed 6.5mm except within the seat region. In the seat region, the distance (Y) between the bottom edge curve and the edge of the penetration-resistant insert shall not exceed 17mm (see Fig. 4).

The number of openings (max. dia. 3mm) used to anchor the penetration-resistant insert shall not exceed 3.

The openings shall be placed so as to avoid the shaded area (see Fig. 4).

Opening shaded area 2 shall be omitted (see Fig. 4).

6.2.1.4 Flex resistance of the penetration-resistant insert

When tested in accordance with the methods specified in 5.9 of GB/T××××—200×, no visible trace of rupture shall occur after bending $1x10^6$ times.

6.2.1.5 Properties of Penetration-Resistant Insert

6.2.1.5.1 Corrosion resistance of the Penetration-Resistant Insert

When tested in accordance with the methods specified in 5.6.1 of GB/T××××—200×, no more than 5 corroded areas (each ≤2.5mm^2) of the metal penetration-resistant insert shall be permitted in all-rubber footwear. In other categories of footwear, when measured in accordance with the methods specified in 5.6.3 of GB/T××××—200×, no more than 5 corroded areas (each ≤2.5mm^2) of the metal penetration-resistant insert shall be allowed.

6.2.1.5.2 Resistance of non-metal penetration-resistant insert

For non-metal penetration-resistant inserts, when treated both with temperatures and chemically using the methods set out in Appendix B.1 and tested in accordance with the method set out in Appendix B.2, the force required to penetrate the insert shall be no less than 1,100N.

6.2.2 Electrical properties

6.2.2.1 Conductive footwear

When measured in accordance with the methods specified in 5.10 of GB/T××××—200×, after seasoning in a dry environment (GB/T××××—200×, 5.10.3.3a), the resistance shall be less than 100kΩ.

6.2.2.2 Antistatic footwear

When measured in accordance with the methods specified in 5.10 of GB/T××××—200×, after seasoning in a dry environment and a moisturised environment (GB/T××××—200×, 5.10.3.3a and b), resistance shall be ≥ 100kΩ or ≤ 1,000MΩ.

6.2.2.3 Electrically insulating footwear

When measured in accordance with the methods specified in 5.11 of GB/T××××—200×, the footwear shall comply with category 0 or category 00 requirements.

6.2.3 Resistance against severe environmental conditions

6.2.3.1 Thermal insulation of the sole

When measured in accordance with the methods specified in 5.12 of GB/T××××—200×, the temperature rise in the upper surface of the insole shall not exceed 22°C after a 30 minute test, and the sole shall have no deformation or brittling that may deteriorate the functions of the sole.

The thermal insulating layer installed inside the footwear shall not be moveable unless the footwear is damaged.

6.2.3.2 Protection of the sole against cold

When measured in accordance with the methods specified in 5.13 of GB/T××××—200×, the temperature drop on the upper surface of the insole shall not exceed 10°C.

The thermal insulating layer installed inside the footwear shall not be moveable unless the footwear is damaged.

6.2.4 Energy absorption at the seat region

When measured in accordance with the methods specified in 5.14 of GB/T××××—200×, energy absorption at the seat region shall be no less than 20J.

6.2.5 Waterproof

When measured in accordance with the methods specified in 5.15.1 of GB/T××××—200×, the total area of infiltration after walking through 100 lengths of the (test) tank, shall not exceed 3cm^2; or, when measured in accordance with the methods specified in 5.15.2 of GB/T××××—200×, no water penetration shall occur after 15min.

6.2.6 Metatarsus protection

6.2.6.1 Structure

Metatarsus protection shall be comprised of appropriate materials with appropriate shapes, so that the reaction force from an impact is distributed onto the sole, for protecting areas as large as that of the safety toecap and the surface of the foot.

The metatarsus protection device installed in the footwear shall be non-moveable unless the footwear is damaged.

The shape of the metatarsus protection device shall match the shape of the footwear on both the inside and outside of the foot; it shall be designed so as not to interfere with normal foot movement.

6.2.6.2 Impact Resistance of the metatarsus protection device

When tested in accordance with the methods specified in 5.16 of GB/T××××—200×, the minimum spacing of the metatarsus protection device, after the test, shall comply with the requirements set out in Table 16.

Table 16 Minimum spacing after impact

Footwear number	Minimum spacing after impact mm
≤225	≥37.0
230~240	≥38.0
245~250	≥39.0
255~265	≥40.0
270~280	≥40.5
≥285	≥41.0

6.2.7 Ankle Protection

When tested in accordance with the methods specified in 5.17 of GB/T××××—200×, the mean of the test results shall not exceed 20kN and each individual test result shall not exceed 30kN.

6.3 Upper

6.3.1 Permeability and water absorption

When measured in accordance with the methods specified in 6.13 of GB/T××××—200×, permeability (expressed as mass increase of the absorbing cloth after 60 min) shall not exceed 0.2g; water absorption ratio shall not exceed 30%.

6.3.2 Structure

Non-functional decorative stitching or perforations shall not be made on footwear whose upper has waterproof requirements.

6.3.3 Protection against cuts

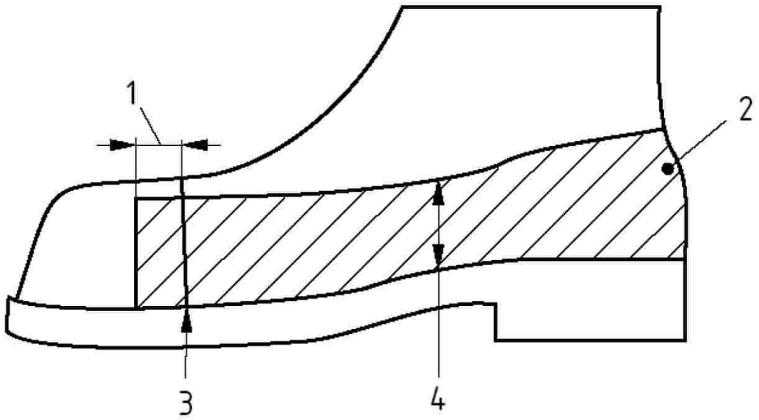
6.3.3.1 Style

Footwear style shall not be Style A as shown in Chapter 4 (see Fig. 3 for styles).

6.3.3.2 Structure

A protective area shall be provided for the footwear of at least 30mm up from the bottom rim of the upper, extended to the end of the heel. This protective area shall extend at least 10mm over the bottom rim of the upper.

No gap shall exist between the safety toecap and the protective material. The protective material shall be permanently attached to the footwear. If different materials are used for protection against cuts, they shall be jointed to or overlapping each other (see Fig. 5).



1 - 10mm overlapping above the safety toecap;

2 - Protected area;

3 - Rear edge of the safety toecap;

4 - Minimum height at 30mm above the bottom rim of the upper.

Fig. 5 Range of protected area

6.3.3.3 Protection against cuts

When measured in accordance with the methods specified in 6.14 of GB/T××××—200×, the index of protection against cut, I, shall be no less than 2.5.

6.3.3.4 Resistance against penetration

The footwear shall also comply with 6.2.1 requirements.

6.4 Outsole

6.4.1 Non-slip area

Beside the area underneath the curled rim of the safety toecap, the areas shown in Fig. 6 at a minimum shall be provided with cleats that run towards the sides.

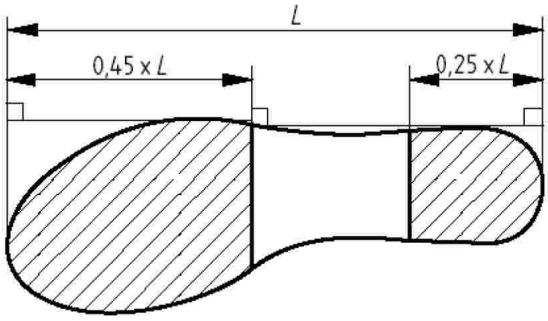


Fig. 6 Non-slip area

6.4.2 Thickness of the non-slip outsole

When tested in accordance with the methods specified in 8.1 of GB/T××××—200×, for direct injected, vulcanised or glued outsoles, the thickness d_1 shall be no less than 4mm; for multi-layer outsoles, the thickness d_1 shall be no less than 4mm; for all-rubber and all-polymer materials, the thickness d_1 shall be no less than 3mm and thickness d_3 shall be no less than 6mm.

6.4.3 Height of cleats

When measured in accordance with the methods specified in 8.1 of GB/T××××—200×, for direct injected, vulcanised or glued outsoles, the height of cleats d_2 shall be no less than 2.5mm; for all-rubber and all-polymer footwear the height of cleats d_2 shall be no less than 4mm.

Note: Cleats less than 2.5mm high are not considered to be non-slip.

6.4.4 Resistance against heat contact

When measured in accordance with the methods specified in 8.7 of GB/T××××—200×, rubber and polymer outsoles shall not melt; no rupture shall occur when bending the outsole along a round axle. When testing leather outsoles with the same method, no rupture shall occur, nor shall carbonisation extend to the inner skin layer when bent along a round axle.

7 Labelling

The following items shall be labelled with durable and legible markings, such as those made by impressing or stamping.

a) Footwear number;

b) Name of maker;

c) Production date (Year, Month);

d) Number and year of this Standard, i.e., GB××××—200×;

e) A symbol that indicates compliance to the protection as specified in Table 15; or, if applicable, similar applicable categories as set out in Table 17 (SB, S1…S5 etc.).

Note: Indications of d) and e) shall be placed adjacent to each other.

Table 17 Safety Footwear Label Categories

Categories	Basic requirements (Table 2 and Table 3)	Additional requirements
SB	I or II	
S1	I	Enclosed seat region Antistatic property Energy absorption in the seat region
S2	I	S1+ water absorption and

		hydrolysis properties
S3	I	S2 + penetration-resistance, non-slip outsole
S4	II	Antistatic property, energy absorption in the seat region
S5	II	S4 + penetration-resistance, non-slip outsole
Note: For facilitating verification, this table categorises most comprehensive combinations of basic and additional requirements of safety footwear.		

8 Provided information

8.1 General requirements

The following information shall be given:

a) Name and full address of the maker and/or its fully authorised agent;

b) Number and year of Standard

c) Description of any hieroglyph, label and performance level. Basic descriptions applicable to footwear tests (if any).

d) Instructions for use:

i. If necessary, tests by the wearer shall be performed and passed prior to use;

ii. If applicable, instructions on putting on and taking off the footwear;

iii. Basic information for use, and detailed sources of said information;

iv. Limitations for use (such as temperature range, etc.);

v. Instructions on storage and maintenance, the maximum period for maintenance and inspection (with detailed drying procedures if critical);

vi. Cleaning and/or sterilisation instructions;

vii. Expiry date or expiry period;

viii. If applicable, warnings for potential problems are provided (any alteration may void the certified category, such as footwear for cosmetic surgery);

ix. If of use, examples, sections, digits, etc. are included.

e) Parts and spare parts are referenced (if relevant);

f) Type of packaging suitable for transportation (if relevant).

8.2 Electrical properties

8.2.1 Electrically conductive footwear

An instruction with the following text shall be provided with every pair of electrically conductive footwear:

“If static electricity is required to be charged to a minimum in the shortest possible period of time, e.g. for handling explosives, conductive footwear shall be used. When all risks of electrical shock by any electrical appliance or equipment have been fully eliminated, then the conductive footwear is no longer required to be used. To ensure that the footwear is conductive, the new footwear must have a resistance of less than 100kΩ.

During the period of use, significant deviation in resistance may occur in footwear made of conductive material due to bending and pollution. The design function of static charge dispersion must therefore be maintained throughout the entire validity period. The user is therefore recommended to set up an internal resistance tester, at the required location, and to use it regularly. This test, together with the below-mentioned test, shall be incorporated as part of the routing procedures of the accident prevention programme in the working area.

If the footwear is worn in locations where the resistance of the sole material may be increased by pollutants, the wearer shall regularly check the resistance of his/her footwear every time he/she enters the risk area.

In locations where conductive footwear is used, the surface resistance of the ground shall not render the protection provided by the footwear ineffective.

When in use, no insulating part shall exist between the insole and the wearer’s foot, with the exception of an ordinary sock. If an insock exists between the insole and the wearer’s foot, the

resistance of the shoe/sole assembly shall be checked."

8.2.2 Antistatic footwear

An instruction with the following text shall be provided with every pair of antistatic footwear:

"If static electricity accumulation is required to be eliminated to a minimum by dispersing the static charge so as to prevent the risk of igniting flammable materials or vapour by a spark and, at the same time, if the risk of electric shock caused by any electrical appliance or equipment has not been fully eliminated, antistatic footwear must be used. However, it is reminded that antistatic footwear only forms a resistance between the foot and the ground; it does not guarantee adequate protection against electrical shock. If the risk of electrical shock has not been fully eliminated, additional measures to prevent such risks are crucial. Such additional measures, together with the below-mentioned additional tests, shall be incorporated as part of the routing procedures of the accident prevention programme in the working area.

Experience shows that for antistatic footwear a resistance of less than 1,000MΩ shall be measured in any discharging route of the product at any time during the entire validity period of the footwear. When operating at a voltage of up to 250V, the minimum resistance of new footwear for providing a limited amount of protection against electrical shock or fire in the case of failure of any electrical appliance is specified as 100kΩ. However, the wearer is made aware that in certain conditions the footwear may provide insufficient protection, and additional measures should always be provided to protect the wearer.

Significant deviation in resistance may occur in footwear of this kind due to bending and pollution. The footwear may not deliver the expected function if worn in wet conditions. Therefore the design function for dispersing the static charge must be maintained throughout the entire validity period, and at the same time provided with some protection. It is recommended that the user set up an internal resistance tester and use it regularly.

If the wearing period is extended, Category I footwear will absorb moisture and become conductive in wet conditions.

If the footwear is worn in locations where the sole material may be contaminated, the wearer shall regularly check the resistance of his/her footwear every time s/he enters the risk area.

In locations where antistatic footwear is used, the surface resistance of the ground shall not render the protection provided by the footwear ineffective.

During use, no insulating part shall exist between the insole and the wearer's foot, with the exception of an ordinary sock. If an insock exists between the insole and the wearer's foot, the resistance of the shoe/sole assembly shall be checked."

8.2.3 Electrically insulating footwear

Footwear with electrical insulation properties provides limited protection against accidental contact with faulty electrical appliances. Therefore an instruction with the following text shall be provided with each pair of electrically insulating footwear:

a) Electrically insulating footwear shall be used if there is a risk of electric shock, such as that caused by a damaged live instrument.

b) Electrically insulating footwear does not provide 100% protection against electric shock, and additional measures to prevent such risks are necessary. Such additional measures together with the below-mentioned additional tests shall be incorporated as part of the routing procedures of the accident prevention program in the working area.

c) During the validity period, electrical properties of the footwear shall comply at all times with the requirements set out in 6.2.2.3.

d) During the period of use, the level of protection may be impaired by scratches, cuts, wearing-out or chemical pollution. Regular checks shall be performed and damaged footwear shall no longer be used.

e) When used in locations in which the material of the sole may be contaminated, such as by chemicals, a warning shall be given when entering into such locations, stating that the area may affect the electrical properties of the footwear.

f) It is recommended that the user set up an appropriate means for checking and testing the use of electrically insulating footwear.

8.3 Insock

If a moveable insock is provided, the instructions shall explain that the test is to be performed with the insock appropriately positioned. A Warning shall be provided explaining that the footwear shall be used once the insock has been properly positioned, and that the insock shall only be replaced by an equivalent insock provided by the original footwear manufacturer.

If no insock is provided, the instructions shall explain that the test shall be performed with no insock. The instruction shall include the warning that installing an insock may affect the protective features of the footwear.

Appendix A
(Specification appendix)
Impact Tests of Non-Metal Safety Toecaps after Temperature Treatment and Chemical Treatment

A.1 (High/Low) Temperature Treatment and Chemical Treatment

A.1.1 High-temperature Treatment

Remove safety toecap, stick a thermocouple (with ±0.5°C accuracy) onto the surface of the safety toecap; place the safety toecap into an oven at (60±2) °C for 4 hours, then remove it from the oven and allow it to cool down to (40±2) °C. Test immediately using the method(s) set out in A.2.

A.1.2 Low-temperature Treatment

Remove safety toecap, stick a thermocouple (with ±0.5°C accuracy) onto the surface of the safety toecap; place the safety toecap into a refrigerating box at (-20±2) °C for 4 hours, then remove it. When the temperature reaches (-1±1) °C test immediately using the method(s) set out in A.2.

A.1.3 Acid Treatment

Immerse one safety toecap into l mol/l sulphuric acid solution at (20±2) °C for 24h; remove the safety toecap, rinse off the sulphuric acid with running water and place at (20±2) °C for 24h; test according to the method stipulated in A.2.

A.1.4 Alkaline Treatment

Immerse one safety toecap into l mol/l sodium hydroxide solution and place at (20±2) °C for 24h; remove the safety toecap, rinse off the sodium hydroxide with running water and place for 24h at (20±2) °C; test according to the method stipulated in A.2.

A.1.5 Oil Treatment

Immerse 1 safety toecap into 2,2,4 - trimethylpentane (isooctane) solution, place at (20±2) °C for 24h; remove the safety toecap, rinse off the solution with running water and place at (20±2) °C for 24h; test according to the method stipulated in A.2.

A.2 Impact Testing

A.2.1 Device

A.2.1.1 Impact Tester

As for 5.4.1.1 of GB/T××××—200×.

A.2.1.2 Holding device

The holding device is comprised of steel plates of at least 19mm thick, with an area of 150mm x 150mm and 60HRC hardness. A device is provided to hold the safety toecap, so as the safety toecap is not constrained for any lateral expansion when subjected to the test impact. See Fig. A1 for suitable holding device.

The front tip of the safety toecap is controlled by a fork shaped jig; a screw is inserted in 1 of the 4 screw holes, according to the size of the safety toecap, to fix the fork shaped jig. A round-angled plate fixes the rear edge of the safety toecap; the round-angled plate is fixed to the sliding rail by screw(s). The round-angled plate presses the safety toecap on its curled edge at the rear, making the safety toecap lean tightly against the fork shaped jig. The sliding rail is supported on a spring; when the impact hammer hits the safety toecap, the sliding rail recoils along the axis. When replacing the safety toecap, the holding shaft should be loosened and the round-angled plate should be retracted.

A.2.1.3 Cylinder

Sculpting clay of (25±2)mm diameter. For number 5 or smaller safety toecaps, the height shall be (25±2)mm; for those safety toecaps larger than number 5, the height shall be (30±2)mm.

A.2.1.4 Dial Gauge

With a semi-spherical test foot of (3.0±0.2)mm radius with flat base; the exerted force shall not exceed 250mN.

A.2.2 Procedures

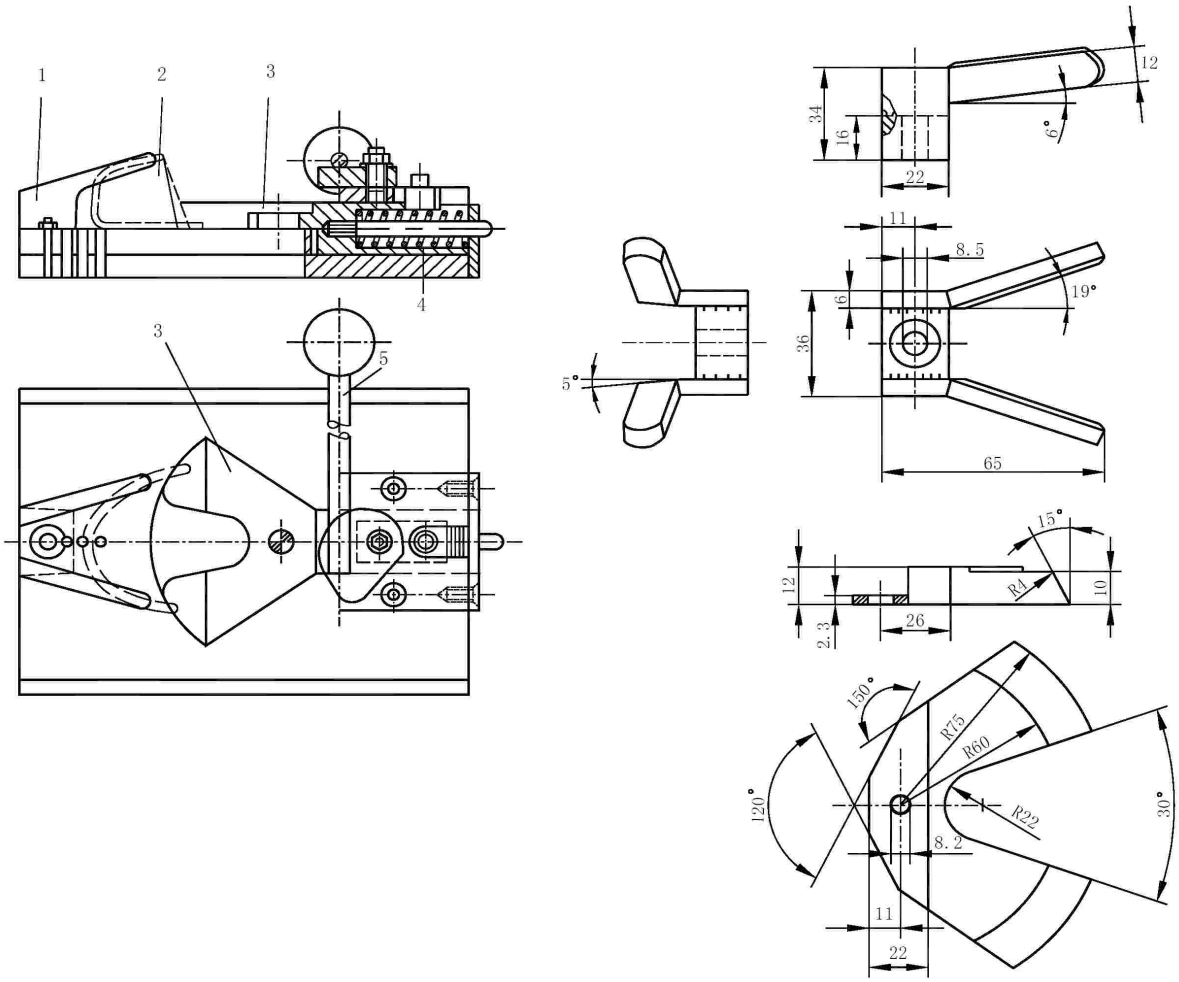
Test axis shall be decided according to the methods outlined in 5.3.2 of GB/T××××—200×.

Fix the specimen to the holding device (A.2.1.2) and adjust the device so that the impact hammer may hit both the front and rear parts of the safety toecap. Place the cylinder (A.2.1.3) inside the safety

toecap, with the centre of the cylinder on the testing axis, and the rear edge of the cylinder level with the rear edge of the safety toecap (see Fig. A2). Drop the impact hammer from an appropriate height and allow it to fall onto the test axis, so that the impact energy is (200±4) J.

Within the 10mm range of the indent on the rear edge of the safety toecap, measure the minimum height of the impacted cylinder with the dial gauge (A.2.1.4), to a precision of 0.5mm. This height is the spacing after impact.

In mm



1 - Fork shaped jig;

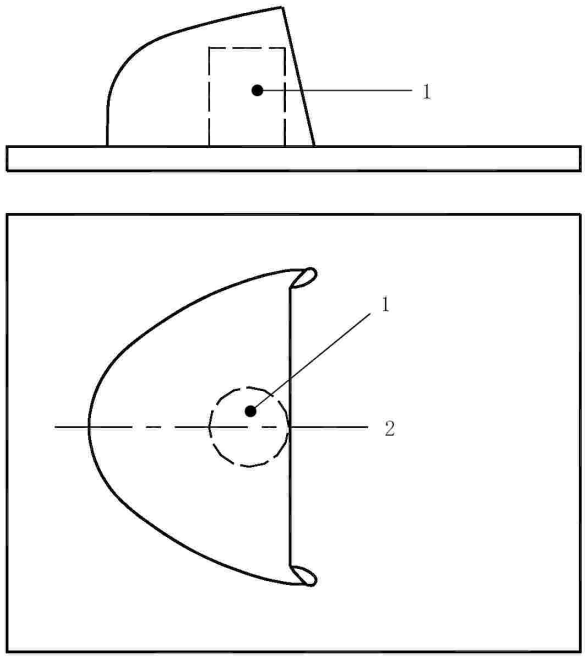
2 - Safety Toecap;

3 - Round-angled plate;

4 - Spring;

5 - Holding shaft.

Fig. A1 Holding device



1 - Cylinder;

2 - Testing axis.

Fig. A2 Position of the cylinder during impact

Appendix B
(Specification appendix)
Penetration Tests on Penetration-resistant Non-metal Insert after Temperature Treatment and Chemical Treatment

B.1 (High/Low) Temperature Treatment and Chemical Treatment

B.1.1 High-temperature Treatment

Remove the penetration-resistant insert and stick a thermocouple (with ±0.5°C accuracy) onto the surface of the insert; place the insert into an oven at (60±2) °C for 4 hours, then remove it from the oven and allow it to cool down to (40±2) °C. Test immediately using the method(s) depicted in B.2.

B.1.2 Low-temperature Treatment

Remove a penetration-resistant insert and stick a thermocouple (with ±0.5°C accuracy) onto the surface of the insert; place the insert into a refrigerating box at (-20±2) °C for 4 hours, then remove it. Test immediately using the method(s) depicted in B.2 when the temperature reaches (-1±1) °C.

B.1.3 Acid Treatment

Immerse one penetration-resistant insert into l mol/l sulphuric acid solution at (20±2) °C for 24h; remove the insert and rinse the sulphuric acid off with running water and place for 24h at (20±2) °C; then test using the method stipulated in B.2.

B.1.4 Alkaline Treatment

Immerse one penetration-resistant insert into l mol/l sodium hydroxide solution and place for 24h at (20±2) °C; remove the insert, rinse the sodium hydroxide off with running water and place for 24h at (20±2) °C; then test according to the method stipulated in B.2.

B.1.5 Oil Treatment

Immerse 1 penetration-resistant insert into 2,2,4 - trimethylpentane (isooctane) solution and place for 24h at (20±2) °C; remove the insert and rinse the solution off with running water and place for 24h at (20±2) °C; then test according to the method stipulated in B.2.

B.2 Penetration Tests

B.2.1 Device

B.2.1.1 Testing equipment

Capable of testing pressure of at least 2,000N.

B.2.1.1.1 Test pin

As for 5.8.2.1.2 of GB/T××××—200×.

B.2.1.1.2 Holding device

The holding device is composed of a jig that holds the specimen in an appropriate position and guides the movement of the test pin (see Fig. B1). The test pin is installed in a solid metal cylinder of $24.8^{+0.00}_{-0.05}$ mm diameter, and the specimen is clamped between 2 plates; a round opening of (25.00±0.05)mm diameter is provided on the plates. One of the plates is furnished with a cylindrical ring with an inner diameter of (25.00±0.05)mm; the cylinder glides inside the ring, enabling the tip of the test pin to point against the centre of the specimen.

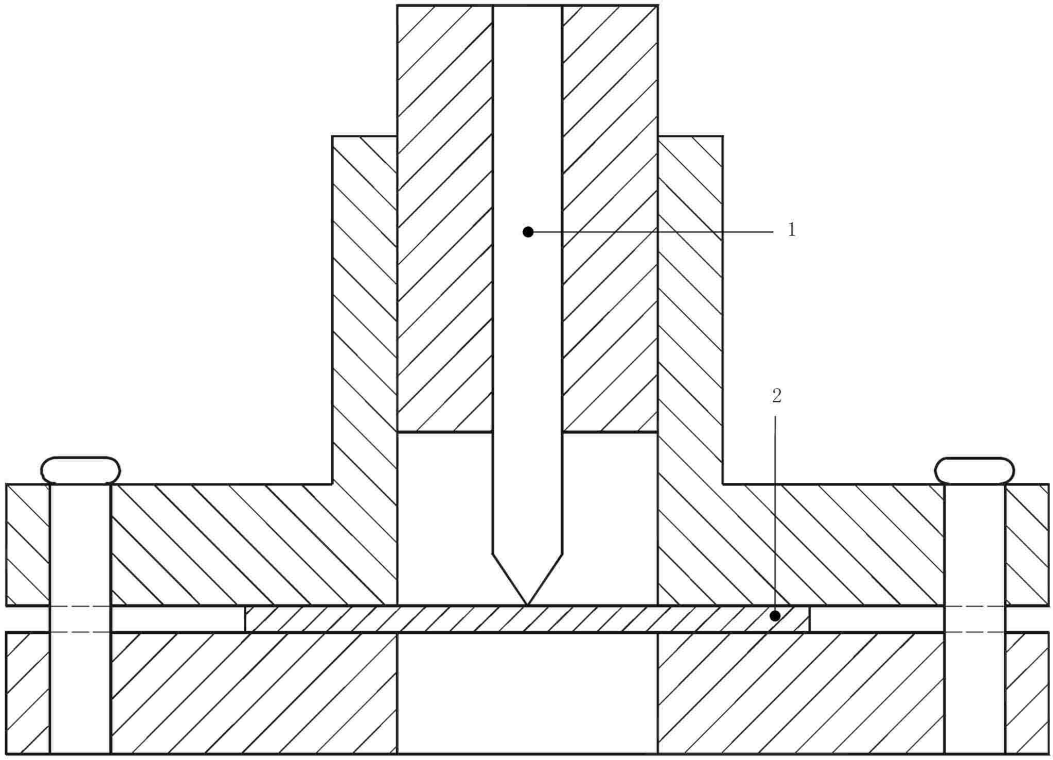
B.2.1.2 Procedures

As shown in Fig. B1, clamp the specimen between the plates then place the device into the testing equipment. Start the equipment, allowing the test pin to penetrate the specimen at a speed of (10±3)mm/min, record the maximum force (in N) required to penetrate the penetration-resistant insert. The test should not penetrate the specimen with its entire length.

Tests shall be performed at 4 different points of the penetration-resistant insert. The spacing between any two penetration points must be at least 30mm.

B.2.1.3 Representation of results

The minimum value out of the 4 tests of each insert is taken as the test result of said insert.



1 - Test pin;

2 - Specimen.

Fig. B1 Holding Device

References

[1] prEN ISO 19952, Footwear — Vocabulary

[2] EN12568: 1998, Foot and leg protectors — Requirements and test methods for toecaps and metal penetration resistant inserts

[3] EN50321: 2000, Electrically insulating footwear for working on low voltage installations