INTERNATIONAL STANDARD

ISO 20349

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Personal protective equipment — Footwear protecting against thermal risks and molten metal splashes as found in foundries and welding — Requirements and test method

Équipement de protection individuelle — Chaussures de protection contre les risques thermiques et les projections de métal fondu comme rencontrés dans les fonderies et lors d'opérations de soudage — Exigences et méthode d'essai

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Foreword

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

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

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 20349 was prepared by the European Committee for Standardization (CEN) Technical Committee ISO/TC 161, *Foot and leg protectors in equipment*, in collaboration with ISO 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).

Personal protective equipment — Footwear protecting against thermal risks and molten metal splashes as found in foundries and welding — Requirements and test method

WARNING — This International Standard calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

1 Scope

This International Standard specifies requirements and test methods for footwear protecting users against thermal risks and molten iron or aluminium metal splashes such as those encountered in foundries, welding and allied process.

Footwear complying with this International Standard also offers other protection as defined in ISO 20345.

NOTE Gaiters, over boot and clothing intended to provide protection to the feet and legs against molten metal are addressed by ISO 11611 and ISO 11612.

2 Normative references

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

ISO 7000:2004, *Graphical symbols for use on equipment — Index and synopsis*

ISO 9185:2007, *Protective clothing — Assessment of resistance of materials to molten metal splash*

ISO 15025:2000, *Protective clothing — Protection against heat and flame — Method of test for limited flame spread*

ISO 17227:2002, *Leather — Physical and mechanical tests — Determination of dry heat resistance of leather*

ISO 20344:2004/Amd.1:2007, *Personal protective equipment — Test methods for footwear — Amendment 1*

ISO 20345:2004/Amd.1:2007, *Personal protective equipment — Safety footwear — Amendment 1*

EN 348, *Protective clothing — Test method: Determination of behaviour of materials on impact of small splashes of molten metal*

EN 702, *Protective clothing — Protection against heat and flame — Test method: Determination of the contact heat transmission through protective clothing or its materials*

3 Terms and definitions

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

3.1
large molten metal splash
large projections of molten metal such as found in foundries

3.2
small molten metal splash
small splashes of molten metal as produced during welding operations and allied processes

4 Requirements

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

Footwear shall conform to the requirements specified in Table 2. Assessment and testing shall be carried out on three samples of the footwear, one of the smallest, one of the middle and one of the largest size of the manufactured size range.

Table 2 — Performance requirements

Requirements		Standard clause		Foundry footwear	Welding footwear	
		ISO 20345	ISO 20349	Class I	Class I	Class II
Design	Height of upper		5.1	X	X	X
	Seat region	5.2.2		X	X	X
Whole footwear	Sole performance:	5.3.1				
	Construction	5.3.1.1		X	X	
	Upper/outsole bond strength	5.3.1.2		X	X	
	Toe protection:	5.3.2				
	General	5.3.2.1		X	X	X
	Internal length	5.3.2.2		X	X	X
	Impact resistance	5.3.2.3		X	X	X
	Compression resistance	5.3.2.4		X	X	X
	Behaviour of toecaps	5.3.2.5		X	X	X
	Leak-proofness	5.3.3				X
	Specific ergonomic features		5.2	X		
	Slip resistance	5.3.4 Amd.1:2007 Annex A			X	X
	Slip resistance on tile floor ceramic with SLS ▲[a]					
	Slip resistance on steel floor with glycerol ▲[b]			X	X	X
	Slip resistance on ceramic tile floor with SLS and on steel floor with glycerol ▲[c]					

Table 2 (*continued*)

Requirements		Standard clause		Foundry footwear	Welding footwear	
		ISO 20345	ISO 20349	Class I	Class I	Class II
Whole footwear	Penetration resistance (P)	6.2.1		*	*	*
	Conductive footwear (C)	6.2.2.1		not allowed		
	Antistatic footwear (A)	6.2.2.2		*	*	*
	Electrically insulating footwear (I)	6.2.2.3		*	*	*
	Cold insulation of sole complex (CI)	6.2.3.2		*	*	*
	Energy absorption of seat region (E)	6.2.4		*	*	*
	Water resistance (WR)	6.2.5		*	*	
	Metatarsal protection (M)	6.2.6		*	*	*
	Ankle protection (AN)	6.2.7		*	*	*
	Resistance to effects of molten metal (Fe or Al)		5.3	X		
	Molten metal splashes (WG)		5.4	*	X	X
	Resistance of upper to contact heat transmission		5.5	X		
	Burning behaviour of upper material		5.6	X	X	X
	Heat insulation of sole complex (HI1 or HI3)		5.7	X	*	*
Upper (all parts)	Design		5.1	X	X	X
	General	5.4.1		X	X	X
	Thickness	5.4.2				X
	Tear strength	5.4.3		X	X	
	Tensile properties	5.4.4		X	X	X
	Flexing resistance	5.4.5				X
	Water vapour permeability and coefficient	5.4.6		X	X	
	pH value	5.4.7		X	X	
	Hydrolysis	5.4.8				X
	Chromium VI content	5.4.9		X	X	
	Water penetration and water absorption (WRU)	6.3.1		X	X	
	Cut resistance (CR)	6.3.3		*	*	*
	Surface shrinkage		5.8	X		
Insole/ insock		Table 3		X	X	O

Table 2 (*continued*)

Requirements		Standard clause		Foundry footwear	Welding footwear	
		ISO 20345	ISO 20349	Class I	Class I	Class II
Vamp lining	Tear strength	5.5.1		X	X	O
	Abrasion resistance	5.5.2		X	X	O
	Water vapour permeability and coefficient	5.5.3		X	X	O
	pH value	5.5.4		X	X	O
	Chromium VI content	5.5.5		X	X	O
Quarter lining	Tear strength	5.5.1		O	O	O
	Abrasion resistance	5.5.2		O	O	O
	Water vapour permeability and coefficient	5.5.3		O	O	O
	pH value	5.5.4		O	O	O
	Chromium VI content	5.5.5		O	O	O
Tongue	Tear strength	5.6.1		O	O	
	pH value	5.6.2		O	O	
	Chromium VI content	5.6.3		O	O	
Outsole	Thickness of non-cleated outsoles	5.8.1		X	X	X
	Cleated area	6.4.1		*	*	*
	Thickness of cleated outsoles	6.4.2		*	*	*
	Cleat height	6.4.3		*	*	*
	Tear strength	5.8.2		X	X	X
	Abrasion resistance	5.8.3		X	X	X
	Flexing resistance	5.8.4		X	X	X
	Hydrolysis	5.8.5		O	O	O
	Interlayer bond strength	5.8.6		O	O	O
	Resistance to fuel oil (FO)	5.8.7		X	X	X
	Resistance to hot contact (HRO)	6.4.4		*	*	*

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.

* Means that if the property is claimed, the requirement given in the appropriate clause shall be met.

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

▲ Means that it is mandatory that one of the three slip resistance requirements shall be chosen.

[a] Marking symbol “SRA”.

[b] Marking symbol “SRB”.

[c] Marking symbol “SRC”.

5 Specific requirements

5.1 Footwear design

The requirements given in Table 3 shall be fulfilled.

Table 3 — Performance requirements for upper design

Requirements	Foundry footwear	Welding footwear
Height of upper (when tested in accordance with ISO 20345:2004, 5.2.1)	⩾design C	⩾design B
There shall be no features on the outer surface of the footwear that could trap molten metal.	X	X
All seams shall have an overlap of ⩾10 mm.	X	
With the exception of the seam around the counter, no seams shall be upward facing.	X	X
The vamp shall comprise a single piece.	X	X
All metal fittings (e.g. buckles or rivets) on the exterior surface of the footwear shall be covered or coated.	X	
The top of the boot shall be fitted with a feature to permit adjustment to give a close fit to the wearer's leg.	X	

5.2 Ergonomic performance and compatibility

When the footwear is assessed in accordance with Annex B, the following requirements shall be met.

a) It shall be possible for the top of the boot to be adjusted to give a snug fit against the leg.

b) The footwear shall remain in place during the activities listed in B.2.3.

c) The removal time shall be <5 s.

d) There shall be no “NO” answers.

5.3 Resistance to the effects of molten metal

Testing shall be carried out in accordance with Annex A and the results shall be as follows.

a) There shall be no penetration of molten metal to inner surface within 10 s of start of pouring.

b) After-flame time shall be ⩽ 5 s after cessation of pouring.

c) No melting or ignition of inner surface.

d) No metal shall stick to the surface of the footwear.

5.4 Small molten metal splash test

Testing shall be carried out in accordance with the procedure described in EN 348.

The whole upper assembly shall be tested, 4 samples shall be taken and these shall be from different items of footwear.

The number of droplets required to produce a temperature rise of 40 °C shall be at least 25.

5.5 Resistance of upper to contact heat transmission

Testing shall be carried out in accordance with the procedure described in EN 702 with a contact temperature of 500 °C.

The threshold time shall be ⩾6 s and there shall be no melting of the inner surface.

5.6 Burning behaviour of upper material

Testing shall be carried out in accordance with Annex C.

After-flame time shall be ⩽2 s and the afterglow time shall be ⩽5 s. The upper shall not form holes and the inner surface of the lining shall not melt.

5.7 Heat insulation of sole complex

The footwear shall meet one of the requirements detailed below. Testing shall be carried out in accordance with the procedure described in 5.12 of ISO 20344:2004 with the following modifications:

a) Sand bath temperature 150 °C, exposure time of 30 min.

The temperature inside the footwear shall be ⩽42 °C; Marking code HI-1.

b) Sand bath temperature of 250 °C, exposure time of 40 min.

The temperature inside the footwear shall be ⩽42 °C; Marking code HI-3.

5.8 Surface shrinkage of leather

Testing shall be carried out in accordance with ISO 17227:2002, 7.6. The test temperature should be 180 °C ± 5 °C and the testing time 5 min ± 10 s.

The area dimensional change shall not be more than 10 %.

6 Marking

Each item of footwear shall be clearly and permanently marked with at least the following information:

a) the name or trademark of the manufacturer;

b) a product code that uniquely identifies the footwear;

c) the size of the footwear;

d) the number and date of this International Standard (i.e. ISO 20349:2010); note that d) and e) should be adjacent to each other, as specified in ISO 20345:2004;