INTERNATIONAL STANDARD

ISO 9185

Second edition
2007-07-01

Protective clothing — Assessment of resistance of materials to molten metal splash

Vêtements de protection — Évaluation de la résistance des matériaux aux projections de métal fondu

Reference number
ISO 9185:2007(E)

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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 9185 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 162, *Protective clothing including hand and arm protection and lifejackets*, in collaboration with Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 9185:1990), which has been technically revised.

This second edition includes the following significant technical changes compared to the first edition:

a) new PVC sensor film included;

b) Cryolite included as test metal.

Introduction

ISO 9185:1990 and EN 373:1995 have been used up until now with reasonable success as the principle test methods for materials used in the manufacture of clothing to protect against large splashes of molten metals. EN and ISO specifications cite these test methods and set levels of performance in terms of the mass of iron or aluminium that can be splashed onto test materials without producing damage to the heat sensor film.

The revision of the test methods contained within this International Standard incorporates changes based on experience that are intended to improve reproducibility and to respond to incident data from the aluminium smelter industry. A test procedure is therefore introduced to determine the protection provided by materials when splashed with molten cryolite. This revision also harmonises into one test procedure the previously slightly different procedures in ISO 9185 and EN 373 for testing with molten aluminium.

A new supply of PVC sensor film has been established together with a new world-wide distributor – see note in the text. One single specification for PVC film replaces the previously different ones in ISO 9185 and EN 373.

The test method in this International Standard is distinct from that in ISO 9150, which assesses the protective performance of materials intended to be manufactured into protective clothing for welding activities.

Protective clothing — Assessment of resistance of materials to molten metal splash

1 Scope

This International Standard specifies a method for assessing the heat penetration resistance of materials intended for use in clothing to protect against large splashes of molten metal. It provides specific procedures for assessing the effects of splashes of molten aluminium, molten cryolite, molten copper, molten iron and molten mild steel.

The principle of the test method is applicable to a wider range of hot molten materials than those for which specific procedures are set out, provided that appropriate measures are applied to protect the test operator. It is important to note that good resistance of a material to a pure molten metal does not guarantee a good performance against any slag that can be present in a manufacturing process.

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 683-1:1987, *Heat-treatable steels, alloy steels and free-cutting steels — Part 1: Direct-hardening unalloyed and low-alloyed wrought steel in form of different black products*

3 Terms and definitions

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

3.1
damage
⟨PVC sensor film⟩ any smoothing or modification to the embossing or pinholing of the PVC sensor film, extending in total for at least 5 mm across its width

NOTE Where the visual change in appearance is in discrete spots, damage occurs when the summation of the width of each spot exceeds 5 mm across any horizontal section. For cryolite, experience indicates that damage can be defined as less than 5 mm in width, but greater than 10 mm in length.

3.2
molten metal splash index
figure equal to the minimum mass of molten metal poured which just causes damage to the PVC sensor film

4 Principle

Materials are tested by pouring quantities of molten metal onto the test specimen supported at an angle to the horizontal on a pin frame. Damage is assessed by placing an embossed thermoplastic PVC sensor film directly behind, and in contact with, the test specimen and noting changes to the film after pouring. Any adherence of the metal to the test specimen surface is also noted. Depending on the result, the test is repeated, using a greater or smaller mass of metal, until the minimum quantity to cause damage to the film is observed.

5 Apparatus and materials

5.1 Metals and cryolite complying with the specifications set out in Annex A. Other metals or substrates appropriate to the end use.

NOTE It is advisable that coarse filings or small pieces cut from solid bar or sheet be used, because fine filings have proved difficult to melt. A range of pouring temperatures used in industry for different metals and for cryolite is given in Annex A.

5.2 PVC sensor film [1), comprising an embossed PVC sheet, of mass per unit area (300 ± 30) g/m^2, which when tested as described in Annex B shows no smoothing or modification of the embossing of the central area at a block temperature of (166 ± 2) °C but which shows smoothing or modification of the central area at a block temperature of (183 ± 2) °C. The procedure set out in Annex B shall be undertaken no more than 30 days before any one day of testing in accordance with this International Standard.

NOTE The reason for this continuous calibration of the PVC sensor film is that it is likely to change over time because of plasticizer loss. It is advisable that the PVC sensor film be stored in a cool and dark location so as to minimize such changes. Because of the economics and consistency of production, one batch of at least 1500 m is produced and then used by test laboratories over a period of several years.

5.3 Crucible, whose approximate external dimensions are a height of 97 mm, a top diameter of 80 mm, a bottom diameter of 56 mm and a capacity (brim full) of 190 ml (see Figure 1).

NOTE For most molten metals, including iron, a graphite impregnated material (if an induction furnace is used) has been found suitable for the crucible.

5.4 Detachable crucible holder, to enable the crucible containing the molten metal to be moved quickly and safely from the furnace to the test apparatus.

5.5 Furnace, capable of operating at a temperature 100 °C above the pouring temperature specified in Annex A. The furnace type may be either a muffle furnace or an induction type furnace.

NOTE Muffle furnaces are capable of holding at least four crucibles (i.e. internal furnace size is typically 135 mm × 190 mm × 780 mm), but they take several hours to melt metals such as steel, iron and copper. Induction furnaces melt a single crucible of these metals in less than half an hour.

5.6 Temperature probe, either a small thermocouple [2) or an optical non-contact temperature device, capable of measuring molten metal temperatures up to 1 650 °C to an accuracy of ± 10 °C.

5.7 Pouring apparatus, shown in Figure 1, consisting of the pouring device, a means of rotating the pouring device at constant angular velocity, a specimen holder with supporting frame and a sand tray.

The pouring device, consisting of crucible holder and drive shaft, shall be designed and constructed so that the point at which the molten metal pours from the crucible lies on the axis of rotation of the drive shaft. The pouring device shall be manufactured from steel.

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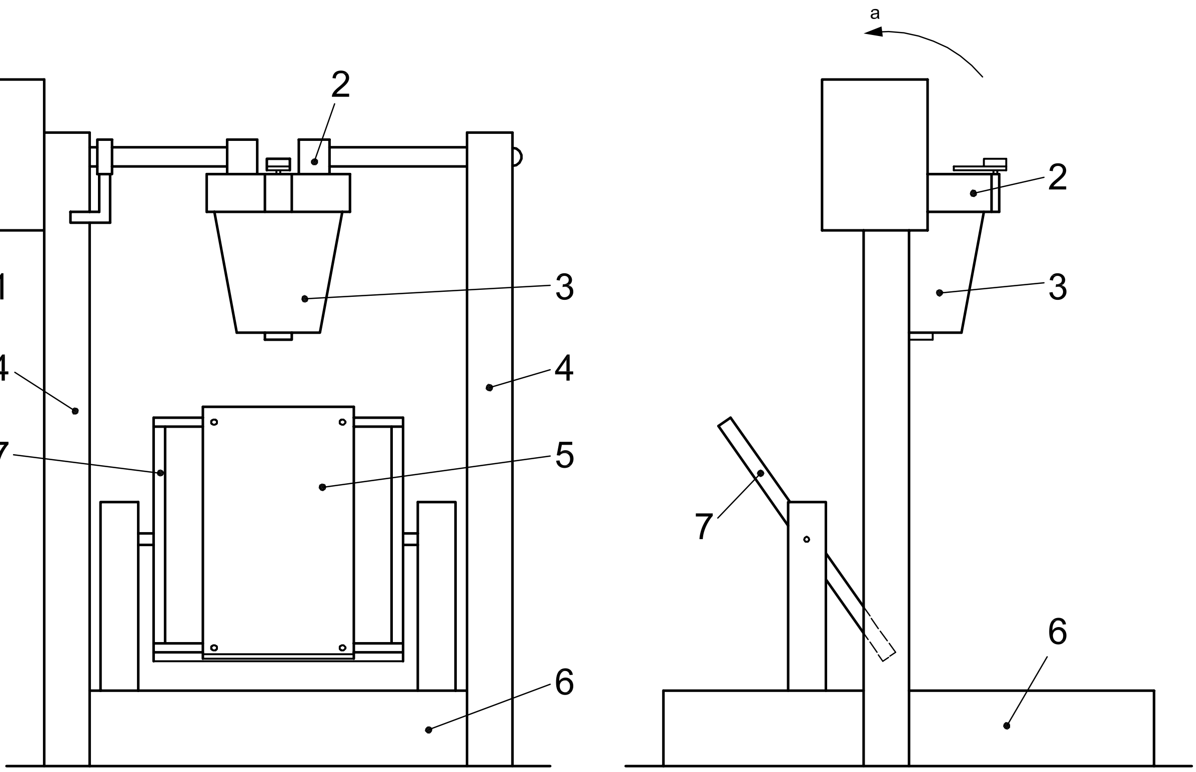
1) The PVC sensor film is supplied by Health & Safety Laboratory, Harpur Hill, Buxton, SK17 9JN, England. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO. Equivalent products may be used if they can be shown to lead to the same results.

2) A suitable device is a long U-tube thermocouple unit known as a dipstick, which can be obtained from Heraeus Electro – Nite Ltd., Chesterfield, S41 9ED, England. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO. Equivalent products may be used if they can be shown to lead to the same results.



Key

1 motor

2 crucible holder

3 crucible

4 adjustable support

5 test specimen

6 sand tray

7 specimen holder

[a] Direction of tip.

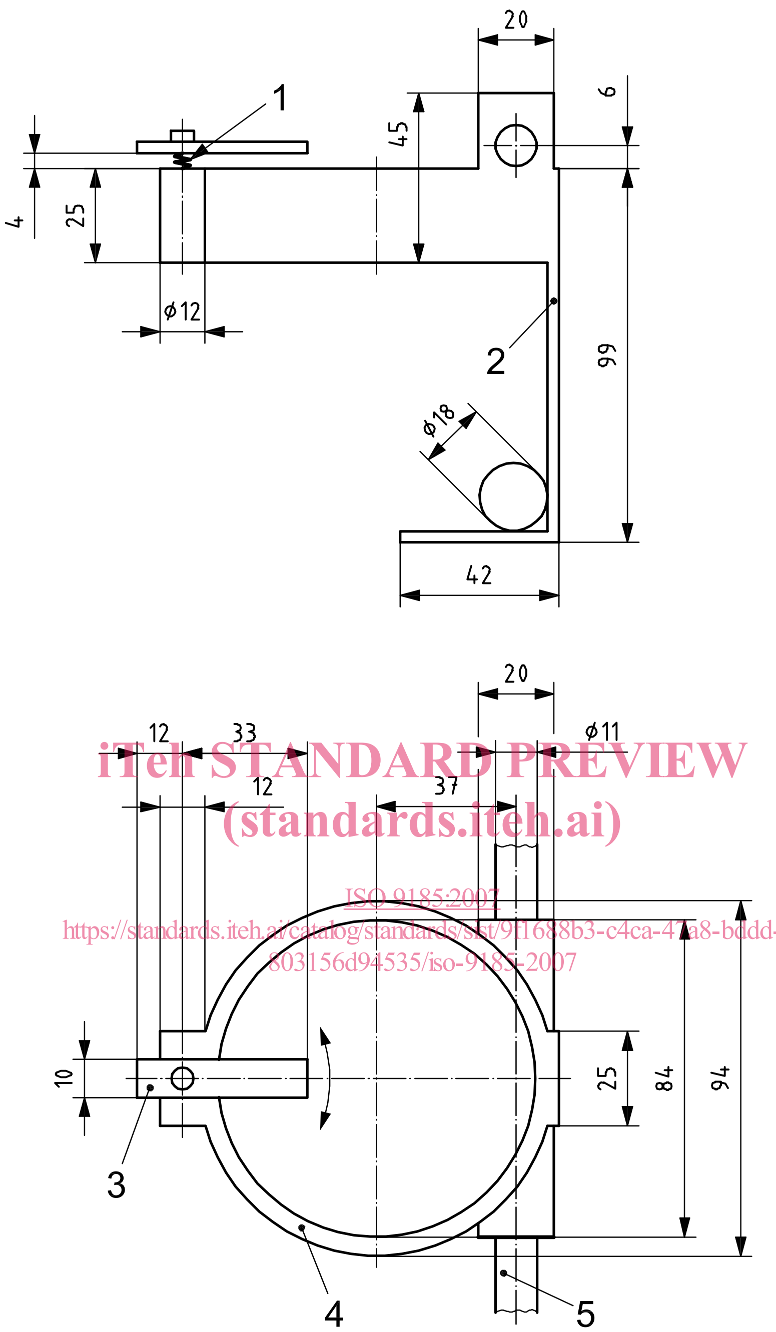
Figure 1 — Motor driven crucible

Figure 2 shows an example of a suitable design, using a straight drive shaft and a crucible holder into which the crucible fits with its top almost flush to the top surface of the crucible holder.

Figure 3 shows an example of equipment that incorporates a cranked drive shaft with a crucible holder into which the crucible fits with its top on the pivot axis. Thus, in this equipment, the top of the crucible does not fit flush with the top surface of the crucible holder.

However, in both these pouring devices, the axis of rotation passes through the pouring edge of the crucible, as required.

Dimensions in millimetres

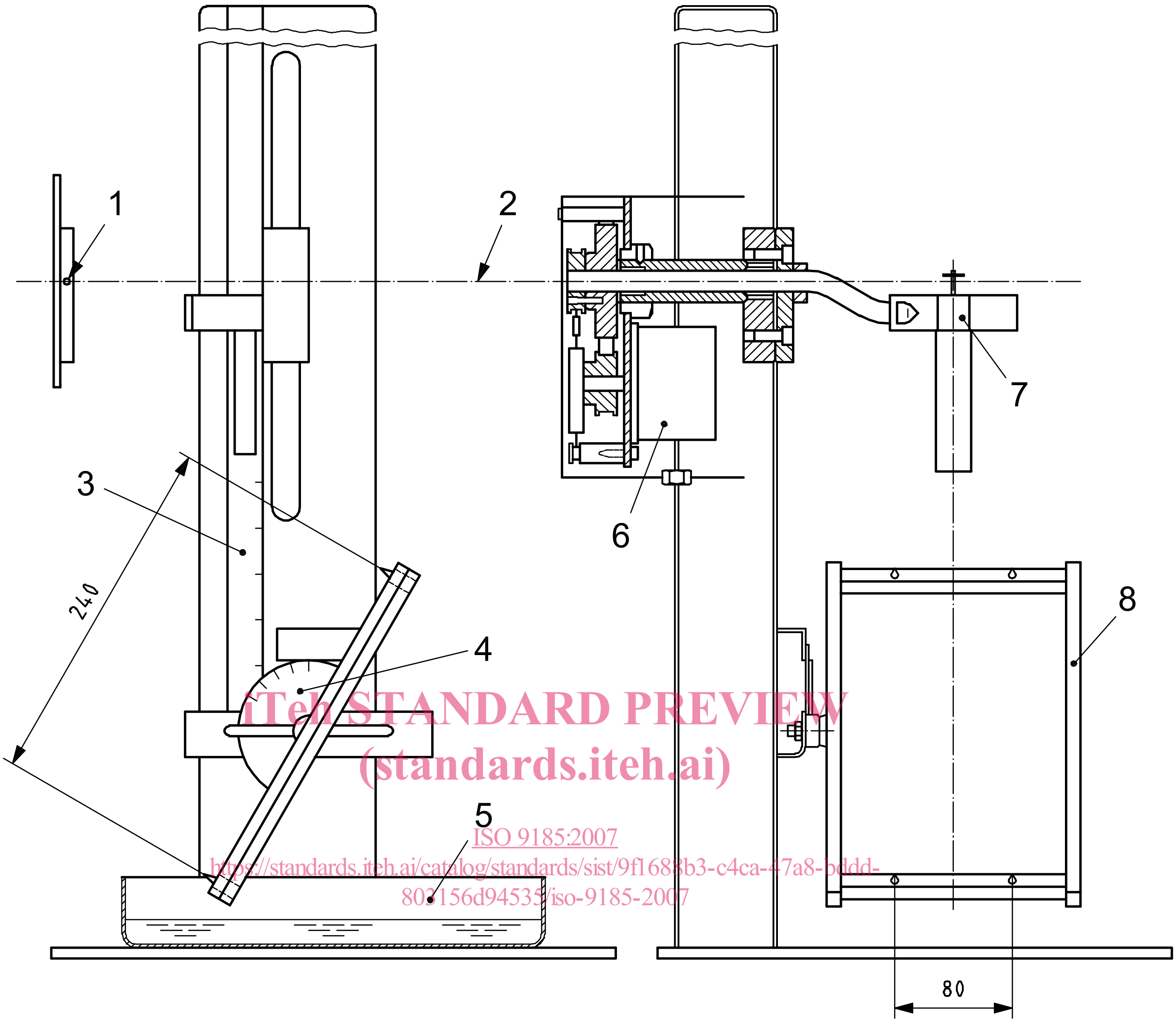


Key

1 coil spring
2 crucible support
3 retaining clip
4 ring
5 shaft

Figure 2 — Pouring device

Dimensions in millimetres



Key

1 pin as indicator
2 pivot
3 scale for pour height
4 scale for test specimen angle
5 sand tray
6 stepper motor
7 crucible holder
8 specimen holder

Figure 3 — Alternative pouring device with cranked shaft drive

The specimen holder shall consist of a rectangular pin frame, (160 ± 2) mm x (248 ± 2) mm external dimension from 8 mm square steel. It shall have four pins, two on the centreline of the top of the frame and two on the centreline of the bottom of the frame, spaced (80 ± 2) mm apart in the width direction, (240 ± 2) mm in the length direction and (40 ± 2) mm from the respective corners.

The pin frame shall be supported on a suitable frame which enables the angle of the specimen to the horizontal to be varied (see Annex A) and the position of the test specimen relative to the pouring device to be adjusted. It is recommended that the initial impact of molten metal or cryolite be not below the centre of the test specimen. This initial impact shall not be within the upper 25 mm of the test specimen.