INTERNATIONAL STANDARD

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Clothing for protection against heat and flame — Test methods and performance requirements for heat-protective clothing

Vêtements de protection contre la chaleur et les flammes — Méthodes d'essai et exigences de performance des vêtements de protection contre la chaleur

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.

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.

International Standard ISO 11612 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing.*

Annex A forms an integral part of this International Standard.

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Clothing for protection against heat and flame — Test methods and performance requirements for heat-protective clothing

1 Scope

This International Standard is applicable to protective clothing for workers exposed to heat. The clothing consists of outer garments made from flexible material to protect specific parts of the body. Hoods and gaiters are included but all other types of protection for the head, hands and feet are excluded.

This International Standard specifies the performance requirements and test methods for protective clothing materials and gives design recommendations for the clothing where necessary.

Protective clothing complying with this International Standard is intended to protect workers against brief contact with flame and against at least one type of heat. The heat may be in the form of convective heat, radiant heat, large molten metal splashes, or a combination of these heat hazards. Protective clothing complying with this International Standard may not be entirely suitable for certain types of activity carried out by firefighters and welders.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3175:1995, *Textiles — Determination of stability to machine dry-cleaning*.

ISO 6330:1984, *Textiles — Domestic washing and drying procedures for textile testing*.

ISO 6942:1993, *Clothing for protection against heat and fire — Evaluation of thermal behaviour of materials and material assemblies when exposed to a source of radiant heat*.

ISO 9151:1995, *Protective clothing against heat and flame — Determination of heat transmission on exposure to flame*.

ISO 9185:1990, *Protective clothing — Assessment of resistance of materials to molten metal splash*.

ISO 13688:—[1)] *Protective clothing — General requirements*.

ISO 15025:—[1)], *Protective clothing — Protection against heat and flame — Method of test for limited flame spread*.

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1) To be published.

3 Sampling

Samples for testing shall be representative of the material and/or materials as used in the complete garments. Samples may also be cut from garments. They may include features of construction such as seams, joints or fasteners, if covered by specific requirements.

4 Testing

All tests shall be carried out on material as received, unless otherwise specified (see 6.2.1).

5 General requirements

5.1 Sizes

The size of protective clothing shall be designated in accordance with ISO 13688.

5.2 Dimensional change

When tested in accordance with ISO 13688, the changes in dimensions of the material shall not exceed ± 3% in either length or width direction after a pretreatment with five cycles according to the manufacturers' instructions. If washing as well as dry cleaning is permitted, then only five washing cycles should be carried out.

6 Performance requirements

6.1 General

Protective clothing which is claimed to comply with this International Standard shall meet the limited flame spread requirement (Code letter A) and at least one other heat transmission performance requirement (Code letters B to E) at level 1 or above.

6.2 Limited flame spread (Code letter A)

6.2.1 Pretreatment

Before testing for limited flame spread, the test materials shall be washed five times in a front-loading washing machine using 1g/l IEC detergent in soft water and finally dried once in accordance with the procedures of ISO 6330. Washing shall be carried out by procedure 2A (at 60 °C) and drying by procedure E (tumble drying) unless otherwise specified in the care labelling.

Materials which are labelled as dry cleanable only shall be dry cleaned five times in accordance with ISO 3175. If the material or garment has no care label, separate samples shall be tested after five cycles of washing and five cycles of dry cleaning.

6.2.2 Testing and performance requirements

When tested in accordance with ISO 15025, procedure A, after the pretreatment specified in 6.2.1, all outer materials or clothing assemblies shall meet the following requirements:

— no specimen shall give flaming to the top or either side edge;

— no specimen shall give hole formation;

— no specimen shall give flaming or molten debris;

— the mean value of afterflame time shall be ≤ 2 s;

— the mean value of afterglow time shall be ≤ 2 s.

6.3 **Convective heat** (Code letter B)

When tested in accordance with ISO 9151, all clothing assemblies which are claimed to offer protection against convective heat shall meet at least the performance level B1 in table 1. The level of performance shall be indicated by the band number (B1 to B5) given in table 1.

Table 1 — Performance levels: Convective heat test

Performance levels	Range of HTI values	
	min.	max.
B1	3	6
B2	7	12
B3	13	20
B4	21	30
B5	31	

6.4 **Radiant heat** (Code letter C)

When tested in accordance with ISO 6942:1993, Method B, at a heat flux density of 20 kW/m^2, all clothing assemblies which are claimed to offer protection against radiant heat shall meet at least performance level C1 in table 2. Tests on metallized materials shall be carried out after pretreatment as specified in annex A. The level of performance shall be indicated by the band number (C1 to C4) given in table 2.

Table 2 — Performance levels: Radiant heat test

Performance levels	Mean time to level, t_2 s	
	min.	max.
C1	8	30
C2	31	90
C3	91	150
C4	151	

6.5 **Molten aluminium splash** (Code letter D)

When tested in accordance with ISO 9185 using molten aluminium, all clothing assemblies which are claimed to offer protection against molten aluminium splash shall meet at least performance level D1 in table 3. The level of performance shall be indicated by the band number (D1 to D3) given in table 3.

Table 3 — Performance levels: Molten aluminium splash

Performance levels	Molten aluminium splash index g	
	min.	max.
D1	100	200
D2	201	350
D3	351	

6.6 **Molten iron splash** (Code letter E)

When tested in accordance with ISO 9185 using molten iron, all clothing assemblies which are claimed to offer protection against molten iron splash shall meet at least performance level E1 in table 4. The level of performance shall be indicated by the band number (E1 to E3) given in table 4.

Table 4 — Performance levels: Molten iron splash

Performance levels	Molten iron splash index g	
	min.	max.
E1	60	120
E2	121	200
E3	201	

NOTE 1 The end-point of testing in accordance with ISO 9185 is when four successive tests on fresh specimens using the same mass of molten metal show no damage to the PVC film. Therefore, to ensure that a material meets the requirements for a particular grade in this International Standard, it is sufficient to conduct four tests using a mass of metal corresponding to the lower limit of the grade and to obtain no damage to the PVC film in all four tests.

NOTE 2 Acceptable performance in accordance with ISO 9185 against molten aluminium will normally ensure that a material will be acceptable against molten aluminium bronze and molten minerals.

NOTE 3 Acceptable performance in accordance with ISO 9185 against molten iron will normally ensure that a material will be acceptable against molten copper, molten phosphor bronze and molten brass.

7 Additional garment requirements

The following features are required on garments designed to offer protection against molten metal splash:

a) jackets shall be long enough to cover the tops of the trousers even when the wearer is bending over;

b) trouser bottoms shall be long and wide enough to overlap the top of the footwear and shall have no turn-ups;

c) external pockets on jackets and overalls, where provided, shall be covered by flaps at least 20 mm wider than the pockets to avoid the flap being tucked into the pocket;

d) overlapping seams on the outside of the garments shall be downward facing and overlocked;

e) any metal fasteners on the outside of the garments shall be covered or treated to avoid the adhesion of molten metal;

f) quick-release fastenings shall be provided to enable rapid removal in an emergency;

g) reinforced protection shall be considered for the crotch area, shoulders and collar.

8 Marking

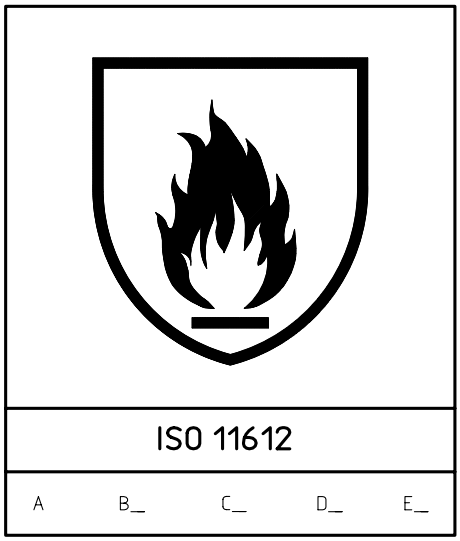
The marking shall be complete, clear and precise. All protective clothing which is claimed to comply with this International Standard shall be marked with the following information:

— name, trademark or other identification means of the manufacturer;

— type designation, tradename or code for clear identification;

— size designation in accordance with ISO 13688;

— pictogram as shown in figure 1, incorporating the number of this International Standard and the performance levels recorded for property A (limited flame spread) and at least one other property, B to E.



NOTE 1 The code letters A to E correspond to the various properties listed in 6.2 to 6.6.

NOTE 2 Limited flame spread properties (A) are always recorded. Only those additional properties which are appropriate and have been tested are included on the pictogram.

NOTE 3 Each letter used is followed by a number indicating the level of performance achieved. Number 1 indicates the lowest level of performance which is acceptable.

NOTE 4 A test method for contact heat transmission is under development. An additional code letter (F) will be introduced at a later stage to enable contact heat properties to be reported.

NOTE 5 The basic pictogram is ISO 7000-2417.[2)]

9 Instructions for use

9.1 General

The provision of protective clothing shall be accompanied by adequate information for proper use. All information shall be precise and understandable and shall be written in the language of the country or in the regional language.

9.2 Explanation of marking

The instructions shall include an explanation of the marking system (see clause 8). They shall provide basic information concerning areas of application, including detailed information on the performance levels achieved in clause 6, together with the source and significance of the test information. They shall also include a warning that the clothing should only be used for the purposes indicated.

9.3 Maintenance and use

Recommended procedures for cleaning and/or washing shall be given.

A warning shall be included as follows: "Dirty clothing may lead to a reduction in protection".

The following information shall be given, if appropriate:

— special storage requirements;

— instructions for putting on and taking off.

2) ISO 7000:1989, *Graphical symbols for use on equipment — Index and synopsis.*

Annex A
(normative)

Mechanical pretreatment for metallized materials

A.1 Principle

The effectiveness of metallized coatings in reflecting radiant heat can be drastically reduced by the effects of wear. This method is designed to simulate the effect of repeated use. Specimens are mechanically pretreated using a test device which simultaneously twists and compresses the specimen.

A.2 Sampling

Specimens measuring 280 mm by 280 mm shall be taken from the material or garment. Specimens may include a seam if it is not possible to take a specimen of the specified size without one.

NOTE — This specimen size is just sufficient to wrap around the circumference of the discs, but overlaps the discs at each end. Only the central portion of the specimen is used for subsequent testing. Thus, two specimens (230 mm by 70 mm) may be taken from each flexed specimen for subsequent testing by ISO 6942.

A.3 Apparatus (see figure A.1)

The test device consists of two discs, (90 ± 1) mm in diameter and (12 ± 0,5) mm thick. One disc is fixed and the other is mounted on a grooved shaft so that it moves towards the fixed disc in two stages:

a) forward movement of (90 ± 5) mm accompanied by rotation of (450 ± 10) °; followed by

b) forward movement with no rotation.

When the initial disc separation is set at (190 ± 1) mm, the disc separation at the completion of the forward motion shall be (35 ± 2) mm.

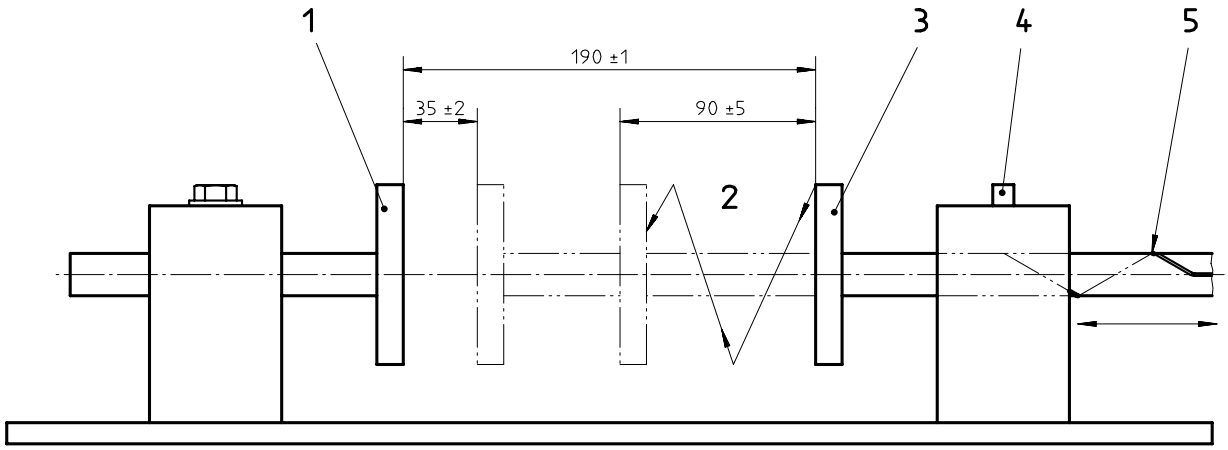
The movement of the revolving disc shall be uniform, except during the change from rotary to forward motion and *vice versa*. One cycle shall comprise one forward and one reverse movement. The device shall complete (40 ± 4) cycles per minute.

A.4 Procedure

Adjust the distance between the two discs to (190 ± 1) mm. Attach the specimen to the discs without tensioning it, with the coating facing outwards and the specimen protruding over the edges of the two discs.

Subject the specimen to 2 500 cycles. Remove the specimen after every 500 cycles (approx. 12,5 min), rotate it through 90° and reclamp it.

Dimensions in millimetres



a) Disc movement

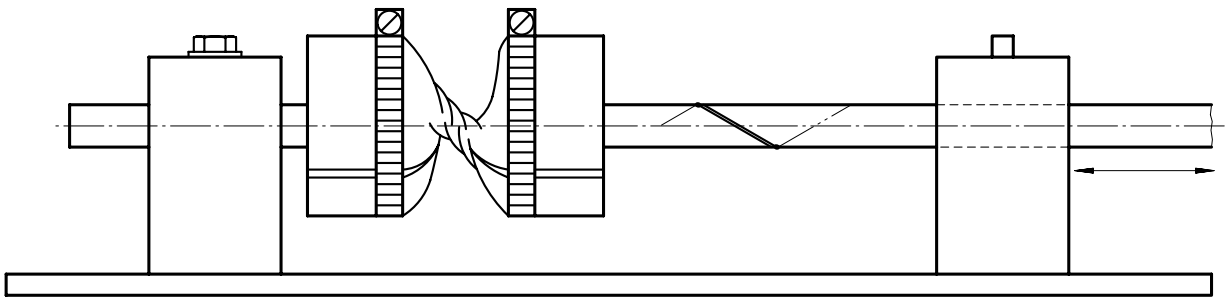
Key

1 Fixed disc
2 Rotation of 450°
3 Moving disc
4 Peg
5 Grooved shaft

b) Initial specimen position

Key

1 Specimen
2 Clamp onto disc



c) Specimen fully compressed

Figure A.1 — Mechanical pretreatment apparatus