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PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures —

Part 9: Fire hoods

Équipement de protection personnelle pour pompiers — Méthodes d'essai et exigences pour les équipements de protection personnelle utilisés par les pompiers qui sont à risque d'une exposition à des niveaux élevés de chaleur et/ou de flamme quand la lutte contre les incendies survient dans les structures —

Partie 9: Hottes de feu

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 14, *Fire-fighters' personal equipment*.

ISO 11999 consists of the following parts, under the general title *PPE for Firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures*:

— *Part 1: General*

— *Part 2: Compatibility* [Technical Specification]

— *Part 3: Clothing*

— *Part 4: Gloves*

— *Part 5: Helmets*

— *Part 6: Footwear*

— *Part 9: Fire hoods*

NOTE The number of this draft has been changed from ISO 11613-9 to ISO 11999-9. The committee agreed a new number for this project was appropriate given the scope publication of the ISO 11999 series was to cover ensemble standards. It was further agreed that ISO 11613:1999 would remain current.

PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures —

Part 9: Fire hoods

1 Scope

This part of ISO 11999 specifies the minimum design and performance requirements for a fire hood as part of personal protective equipment (PPE) to be used by firefighters, primarily but not solely to protect against exposure to flame and high thermal loads.

2 Normative references

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

ISO 3146, *Plastics — Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods*

ISO 3175–1, *Textiles — Professional care, drycleaning and wetcleaning of fabrics and garments — Part 1: Assessment of performance after cleaning and finishing*

ISO 5077, *Textiles — Determination of dimensional change in washing and drying*

ISO 6942, *Protective clothing — Protection against heat and fire — Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat*

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

ISO 11999–1, *PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures — Part 1: General*

ISO/TS 11999–2, *PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures — Part 2: Compatibility*

ISO 13688, *Protective clothing — General requirements*

ISO 13938-1, *Textiles — Bursting properties of fabrics — Part 1: Hydraulic method for determination of bursting strength and bursting distension*

ISO 13938-2, *Textiles — Bursting properties of fabrics — Part 2: Pneumatic method for determination of bursting strength and bursting distension*

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

ISO 17492, *Clothing for protection against heat and flame — Determination of heat transmission on exposure to both flame and radiant heat*

ISO 17493, *Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven*

EN 960, *Headforms for use in the testing of protective helmets*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11999-1 apply.

4 General design requirements

Fire hoods shall be classified as type FH1 and FH2, following the requirements specified in Clause 5 to Clause 7, with type FH2 providing higher protection. The fire hood shall be close fitting and able to be worn without discomfort or significant restriction to head movement. General requirements which are not specifically covered in this International Standard shall be in accordance with ISO 13688 and ISO 11999-1.

Overstretching will reduce the heat protective performance of the hood and should be avoided by design.

Where a helmet with shikoro provides coverage to the neck, ears, chin, and facial area not protected by a face shield, the use of a fire hood is not required.

4.1 Facial opening

The fire hood shall have a facial opening creating an interface with the breathing apparatus facemask. The design requirements specified shall be verified by visual inspection during the procedure laid out in ISO/TS 11999-2.

4.2 Yoke interface area

The fire hood shall have a yoke creating an interface with the protective garment. The design requirements specified shall be verified by visual inspection during the procedure laid out in ISO/TS 11999-2.

4.3 Sizing

The firehood shall be manufactured in various sizes or be sufficiently elastic to be compatible with various head sizes and shapes. Assess by visual inspection.

4.4 Flexibility

The fire hood shall have flexibility to take up the shape of the wearer's head without discomfort and shall not restrict head movement.

4.5 Seam construction

Seams shall be constructed to give the minimum loss of strength and protection and to maintain the temperature resistance and integrity of the hood.

5 Sampling and pre-treatment

5.1 The number and size of specimens for the different tests shall be in accordance with the respective standard.

5.2 Where specified, the test samples shall be pre-treated by cleaning. The cleaning shall be in line with the manufacturer's instructions on the basis of standardized processes. If the number of cleaning cycles is not specified, the tests shall be carried out after five laundering cycles (one laundering cycle consisting of one washing and one drying) when laundering is specified, or after five cycles of dry cleaning when dry cleaning is specified. This shall be reflected in the information supplied by the manufacturer. If the manufacturer's instructions indicate that both cleaning methods are allowed, the test specimen shall undergo the laundering procedure only.

The test specimen shall undergo the laundering or dry cleaning procedure, respectively depending on the extent and kind of dirt involved.

Materials that are labelled as dry cleanable only shall be dry cleaned five times in accordance with ISO 3175-1.

A laundry bag shall not be used.

5.3 Unless otherwise specified in the specific test methods, all specimens shall be conditioned for a minimum of 24 h by exposure to a temperature of 20 °C ± 2 °C and a relative humidity of 65 % ± 5% prior to testing.

6 Performance requirements

6.1 General

Performance requirements are as specified in Table 1.

Table 1 — Fire hood performance requirements

Performance property	FH1	FH2
Flame resistance	6.2	6.3
Heat resistance	6.4	6.4
Heat transfer (flame)[a]	6.5 or 6.7	6.5 or 6.7
Heat transfer (radiant)[a]	6.6 or 6.7	6.6 or 6.7
Residual strength after radiant heat exposure	6.8	6.8
Seam burst strength	6.9	6.9
Opening size retention	6.10	6.10
Dimensional change	6.11	6.11
Thread heat resistance	6.12	6.12

[a] Heat transfer on exposure to flame or radiant heat may be evaluated separately according to 6.5 and 6.6 or simultaneously according to 6.7.

The performance requirements shall be met after sampling and pre-treatment according to Clause 5 unless otherwise stated.

6.2 Flame resistance (surface ignition) for FH1 fire hoods

Flame resistance of the test specimen shall be tested in accordance with ISO 15025 Procedure A, using commercial grade propane at least 95 % purity, and shall satisfy the following requirements:

a) no specimen shall give flaming to top or either side edge;

b) no specimen shall give flaming or molten debris;

c) mean value of afterflame time shall be ≤2 s;

d) mean value of afterglow time shall be ≤2 s; any afterglow shall not spread from the carbonized area to the undamaged area after the cessation of flaming.

e) no specimen shall give hole formation in any layer.

Each layer of the fire hood shall be tested individually.

Elastic, seams and hook and pile fasteners shall be tested only when used in locations where they will directly contact the wearer's body.

Small specimens that are not large enough to meet the specimen size requirement in ISO 15025 shall be sewn or attached onto a layer of the component assembly as represented in the clothing construction and shall not be consumed and shall satisfy requirement b), c), and d) only.

6.3 Flame resistance (bottom edge ignition) for FH2 fire hoods

Flame resistance of the bottom edge of the test specimen shall be tested in accordance with ISO 15025 Procedure B, using commercial grade propane at least 95 % purity, both before and after pre-treatment by laundering as specified in 5.2, and shall satisfy the following requirements:

a) no specimen shall give flaming to top or either side edge;

b) no specimen shall give flaming or molten debris;

c) mean value of afterflame time shall be ≤2 s;

d) char length shall be ≤100 mm when measured as specified in ISO 15025:2000, Annex C;

e) any afterglow shall not spread from the carbonized area to the undamaged area after the cessation of flaming.

Each layer of the fire hood shall be tested individually.

Elastic, seams and hook and pile fasteners shall be tested only when used in locations where they will directly contact the wearer's body.

Small specimens that are not large enough to meet the specimen size requirement in ISO 15025 shall be sewn or attached onto a layer of the component assembly as represented in the clothing construction and shall not be consumed and shall satisfy requirement b), c), and d) only.

6.4 Heat resistance

Each fire hood when tested in accordance with ISO 17493 shall not melt, drip, separate, or ignite, or shrink more than the permissible percentage at the respective test temperatures for FH1 or FH2 fire hoods as specified in Table 2. The fire hood shall be exposed to the test temperature for at least 5 min.

Table 2 — Heat resistance

Test parameter or measurement	FH1	FH2
Test temperature	180 °C +5/-0°C	260 °C +5/-0°C
Permissible shrinkage	≤5 %	≤10 %

For FH2 fire hoods, the following requirements shall also apply:

a) materials shall be tested before and after pre-treatment by laundering as specified in 5.2;

b) material shall not char.

6.5 Heat transfer (flame exposure)

The fire hood when tested in accordance with ISO 9151, shall achieve the respective performance for FH1 or FH2 as specified in Table 3.

Table 3 — Heat transfer (flame exposure)

Heat transfer index	FH1	FH2
HTI_{24}	≥8 s	≥11s
$HTI_{24} - HTI_{12}$	≥3 s	≥4s

6.6 Heat transfer (radiant exposure)

The fire hood when tested in accordance with ISO 6942, Method B at a heat flux density of 20 kW/m^2 shall achieve the respective performance for FH1 or FH2 as specified in Table 4.

Table 4 — Heat transfer (radiant exposure)

Heat transfer factor	FH1	FH2
$RHTI_{24}$	≥11 s	≥14 s
$RHTI_{24} - RHTI_{12}$	≥3 s	≥4s

6.7 Heat transfer (combined flame and radiant exposure)

As an alternative to 6.5 and 6.6, the component assembly or multilayer hood assembly when tested in accordance with ISO 17492, using the TTI analysis procedure, before and after pre-treatment by laundering as specified in 5.2 shall achieve the performance levels as specified in Table 5.

Table 5 — Heat transfer (combined flame and radiant exposure)

Performance measurement	FH1	FH2
TTI (kJ/m^2)	≥700	≥ 900

6.8 Residual strength of material following radiant heat exposure

The fire hood shall be tested in accordance with ISO 13938-2 after pre-treatment of the complete assembly by method A of ISO 6942 at the respective heat flux density and shall achieve the respective performance for FH1 or FH2 as specified in Table 6.

Table 6 — Residual strength following radiant exposure

Test parameter or measurement	FH1	FH2
Heat flux density	10 kW/m^2	20 kW/m^2
Burst strength	≥200 kPa	≥200 kPa

Testing shall be performed on a minimum of three specimens, using a test area of 7,3 cm^2, and a testing time to burst of 30 s ± 10 s.

The average burst strength for each direction shall be calculated and used to determine compliance with this requirement.