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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 3:  
Clothing  
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*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 3: Vêtements*



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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](http://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](http://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, *Firefighters' 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 to flame while fighting fires occurring in structures*:

- *Part 1: General*
- *Part 2: Compatibility*
- *Part 3: Clothing*
- *Part 4: Gloves*

The following parts are under preparation:

- *Part 5: Helmets*
- *Part 6: Footwear*
- *Part 7: Face and eye protection*
- *Part 8: Hearing*
- *Part 9: Firehoods*
- *Part 10: Respiratory protection*

NOTE The number of this draft has been changed from ISO/DIS 11613-3 to ISO 11999-3. 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.

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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 3: Clothing

### 1 Scope

This part of ISO 11999 specifies the minimum design and performance requirements for clothing 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.

To assist with choice based on user risk assessment, a number of levels of protection are included.

The scope of this part of ISO 11999 does not include clothing for use in high-risk fire exposures where for example, reflective protective clothing according to ISO 15538 could be more appropriate, or for use in long-term firefighting operations in high ambient temperature, for example bush, wildland, or forest firefighting where clothing according to ISO 16073 or ISO 15384 could be more appropriate.

Similarly, this part of ISO 11999 does not include clothing to protect against chemical and biological hazards, other than against short-term and accidental exposure while engaged in firefighting and associated activities when fighting fires occurring in structures.

This part of ISO 11999 describes types, design, and performance of clothing, the specific requirements for clothing, marking, and manufacturer's instructions.

### 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 811:1981, *Textile fabrics — Determination of resistance to water penetration — Hydrostatic pressure test*

ISO 3146:2000, *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 4674-1, *Rubber- or plastics-coated fabrics — Determination of tear resistance — Part 1: Constant rate of tear methods*

ISO 4920:2012, *Textile fabrics — Determination of resistance to surface wetting (spray test)*

ISO 5077:2007, *Textiles — Determination of dimensional change in washing and drying*

ISO 6330:2012, *Textiles — Domestic washing and drying procedures for textile testing*

ISO 6530:2005, *Protective clothing — Protection against liquid chemicals — Test method for resistance of materials to penetration by liquids*

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ISO 6942:2002, *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 9151:1995, *Protective clothing against heat and flame — Determination of heat transmission on exposure to flame*

ISO 9227:2012, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 11092:1993, *Textiles — Physiological effects — Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test)*

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 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 12127-1, *Clothing for protection against heat and flame — Determination of contact heat transmission through protective clothing or constituent materials — Part 1: Contact heat produced by heating cylinder*

ISO 13688:2013, *Protective clothing — General requirements*

ISO 13934-1:2013, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method*

ISO 13935-2, *Textiles — Seam tensile properties of fabrics and made-up textile articles — Part 2: Determination of maximum force to seam rupture using the grab method*

ISO 13937-2, *Textiles — Tear properties of fabrics — Part 2: Determination of tear force of trouser-shaped test specimens (Single tear method)*

ISO 13994:2005, *Clothing for protection against liquid chemicals — Determination of the resistance of protective clothing materials to penetration by liquids under pressure*

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

ISO 15384:2003, *Protective clothing for firefighters — Laboratory test methods and performance requirements for wildland firefighting clothing*

ISO 15538:2001, *Protective clothing for firefighters — Laboratory test methods and performance requirements for protective clothing with a reflective outer surface*

ISO 16073:2011, *Wildland firefighting personal protective equipment — Requirements and test methods*

ISO 16604:2004, *Clothing for protection against contact with blood and body fluids — Determination of resistance of protective clothing materials to penetration by blood-borne pathogens — Test method using Phi-X 174 bacteriophage*

ISO 17491-4:2008, *Protective clothing — Test methods for clothing providing protection against chemicals — Part 4: Determination of resistance to penetration by a spray of liquid (spray test)*

ISO 17492:2003, *Clothing for protection against heat and flame — Determination of heat transmission on exposure to both flame and radiant heat*

ISO 17493:2000, *Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven*

ISO 20471:2013, *High visibility clothing — Test methods and requirements*

ASTM F1868-12, *Standard test method for thermal and evaporative resistance of clothing materials using a sweating hot plate*



CIE 054.2:2001, Retroreflection: definition and measurement

NFPA 1971:2007, *Standard on protective ensembles for structural firefighting and proximity firefighting*

### 3 Terms and definitions

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

## 4 Clothing requirements

### 4.1 General

Design requirements for clothing are given in 4.1 to 4.13. Sampling and pre-treatment are given in 4.14 and 4.15. Performance requirements are as required in 4.16 to 4.20. Additional requirements are given in 4.21. A comparison of performance requirements for clothing is provided in Annex A.

### 4.2 Clothing configuration

Firefighters' protective clothing shall provide protection for the firefighter's upper and lower torso, neck, arms, and legs, but excluding the head, hands, and feet. It shall consist of an outer garment which can be, for example

- a one-piece protective cover all designed to cover the upper and lower torso including the neck, arms, and legs,
- a protective coat and a pair of protective trousers with an overlap of sufficient length to provide protection to the wearer (see ISO 11999-2), or
- a series of outer and undergarments designed to be worn together.

### 4.3 Multi-layer clothing assemblies

Where multi-layer clothing assemblies are used to achieve the specified performance levels, the layers shall be either permanently attached or the various layers shall be clearly labelled:

“IN ORDER TO ACHIEVE THE CLAIMED LEVEL OF PERFORMANCE FOR THE CLOTHING ASSEMBLY, ALL LAYERS BEARING THIS LABEL SHALL ALWAYS BE WORN TOGETHER.”

### 4.4 Component assembly

Protective garments shall consist of a component assembly that provides the necessary number and type of layers for achieving the performance specified in this part of ISO 11999.

Any component assembly reinforcement or padding used in high-wear or load-bearing areas, such as pockets, cuffs, knees, elbows, and shoulders shall meet the requirements of at least flame resistance and heat resistance contained in 4.17 equivalent to the level achieved by the garment. Padding can include additional thermal barrier material, meeting the requirements as specified in this part of ISO 11999.

### 4.5 Attachment of interlining and innermost layers

Component assemblies shall have a means of securing the interlining and innermost lining where present to the outer material.

#### 4.6 Extension of interlining and innermost layers

In performance level A2 coats, the interlining and innermost layers shall extend, as a minimum, to the neckline seams, to within 75 mm of the bottom outer material hems, and to within 25 mm of the sleeve end of the outer material. The interlining and innermost layers shall be configured to overlap at all closures.

In performance level A1 coats, the interlining and innermost layers shall extend, as a minimum, to the neckline seams, to the bottom of the outer materials hems, and to within 25 mm of the sleeve end of the outer material.

The interlining and innermost layers shall be configured to overlap at all closures.

In all trousers, the interlining and innermost layers shall extend, as a minimum, to the waistline seam, and to within 75 mm of the bottom outer material hems of the legs.

The ends of the interlining and innermost layers shall be attached at or adjacent to the coat sleeves or the trouser legs. The distance between the attachment points of any mechanism used to attach the liner shall not be greater than 25 mm, and the mechanism shall not be expandable.

#### 4.7 Garment closure systems

Closures that breach the protective integrity of the garment shall be constructed in a manner that provides secure and complete moisture and thermal protection to the requirements of this part of ISO 11999. If non-positive fasteners, such as snaps or hook and pile tape, are utilized in these closures, except where used in the collar and pocket closure system (4.11), a positive locking fastener, such as hooks and eyes or zippers, shall also be utilized.

NOTE A positive locking fastener cannot be opened by inadvertently pulling on it.

#### 4.8 Hardware

Hardware penetrating the outer material shall not be exposed on the innermost surface of the component assembly.

#### 4.9 External pocket requirements

External pockets, where provided, shall have a means of drainage of water, of fastening them in the closed position, and of preventing entry of burning debris, excluding radio pockets.

#### 4.10 Garment sizing

Garment sizes shall fit to the measures indicated in ISO 13688.

#### 4.11 Neck protection

Protective clothing shall have a collar no less than 75 mm in height at any point, with a closure system. Collar and closure system shall meet at least the flame and thermal requirements specified in 4.17, equivalent to the level achieved by the garment.

#### 4.12 Wrist protection

Each protective garment sleeve shall have a protective wristlet or other means of protection at the wrist which is so designed with the intention of preventing the ingress of both water and burning debris.

## 4.13 High-visibility materials

### 4.13.1 General

Firefighter's clothing shall have high-visibility materials fitted which shall meet the following requirements in either [4.13.2](#) or [4.13.3](#).

### 4.13.2 Option 1 — Placement based on minimum area of coverage

The minimum area requirements for high-visibility materials shall be as specified in [4.13.2.1](#) for retroreflective materials and as specified in [4.13.2.2](#) for fluorescent or combined retroreflective/fluorescent materials.

#### 4.13.2.1 Retroreflective material

Retroreflective material shall be attached to the outermost surface of the protective clothing with a minimum area of not less than 0,13 m<sup>2</sup>. All-around visibility shall be ensured by having at least one band encircling each of the arms, legs, and torso regions of the garments.

#### 4.13.2.2 Fluorescent material or combined retroreflective/fluorescent material

When fluorescent or combined retroreflective and fluorescent material is applied, the minimum area of fluorescent material shall not be less than 0,2 m<sup>2</sup>. All-around visibility shall be ensured by having at least one band encircling each of the arms, legs, and torso regions of the garments.

### 4.13.3 Option 2 — Placement based on standard pattern

#### 4.13.3.1 General

The minimum pattern requirements for high-visibility materials shall be as specified in [4.13.3.2](#) to [4.13.3.6](#).

#### 4.13.3.2 Type of high-visibility materials

High-visibility trim utilized to meet retroreflectivity and fluorescence requirements shall be permanently attached to the outermost surface of protective garments and shall have both retroreflective and fluorescent surfaces. The width of the retroreflective surface of trim shall not be less than 16 mm. Fluorescent and retroreflective areas of trim shall appear to be continuous for the length of the trim with gaps between areas of retroreflectivity of no more than 3 mm.

#### 4.13.3.3 Minimum amount of fluorescence for standard pattern

High-visibility materials used to meet the standard pattern shall have a minimum fluorescent surface of 50 mm<sup>2</sup>/linear mm.

#### 4.13.3.4 High-visibility materials exceeding standard pattern

High-visibility material affixed to protective garments exceeding the standard pattern requirements illustrated in [Figures 1](#) and [2](#) shall be permitted to be obscured by components such as, but not limited to, pockets, storm flaps, and reinforcing patches as long as the minimum high-visibility material required in [4.13.3.5](#) and [4.13.3.6](#) is not obscured.

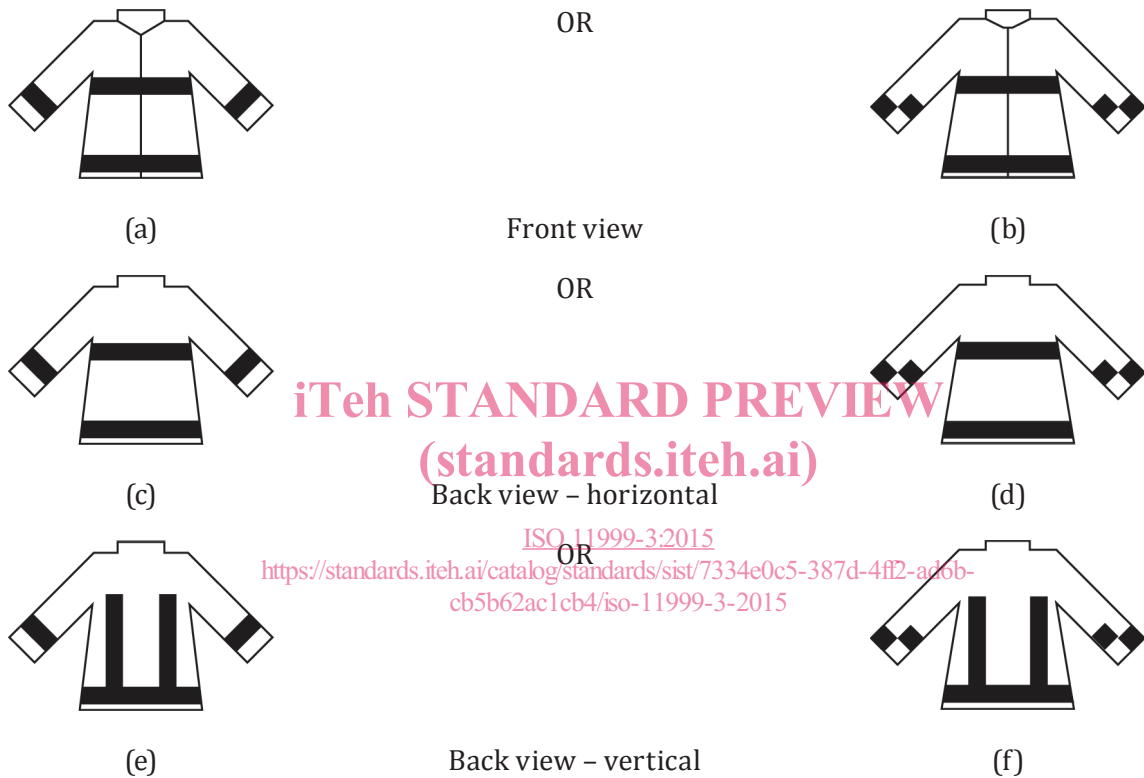
#### 4.13.3.5 Standard pattern for garments covering the upper torso including arms

The configuration for high-visibility materials on garments covering the upper torso including the arms shall be as illustrated in [Figure 1](#). The standard pattern of high-visibility material for the garments covering the upper torso including the arms shall have one circumferential band of high-visibility material or a staggered 360-degree visibility pattern meeting or exceeding the surface areas of a continuous circumferential band around the bottom of the coat. The lower edge of the circumferential

band on the lower part of the coat shall be within 25 mm of the coat hem's highest point. The front of the coat shall also have at least one horizontal band of high-visibility material at the chest level. No vertical strips of high visibility shall be permitted on the front of the coat.

The back of the coat shall also have a minimum of either two vertical strips of high-visibility material perpendicular to the bottom band with one strip located on both the left and right sides of the back of the coat or a minimum of one horizontal band of high visibility material at the chest/shoulder blade level.

The minimum high-visibility material configuration for each sleeve, between the wrist and elbow area, shall be one circumferential band or a staggered 360-degree visibility pattern meeting or exceeding the surface area of a continuous circumferential band. Where trim on the garment covering the upper torso including the arms intersects a zipper, a maximum gap in the trim of 25 mm shall be permitted.



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**Figure 1 — Minimum pattern for placement of high-visibility materials on garments covering the upper torso including the arms**

NOTE Diagrams (a) and (b) represent alternative placement for the front of the coat; Diagrams (c), (d), (e), and (f) represent alternative placement for the back of the coat.

#### 4.13.3.6 Standard pattern for garments covering the lower torso including the legs

The minimum high-visibility material pattern for garments covering the lower torso including the legs shall consist of one circumferential strip of high-visibility material around each leg at least 50 mm from the bottom hem in accordance with [Figure 2](#).