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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 2:  
Compatibility**

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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 2: Compatibilité*

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## Foreword

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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)).

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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 to flame while fighting fires occurring in structures*:

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

NOTE The number of this draft has been changed from ISO/DIS 11613-2 to ISO 11999-2. 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 2: Compatibility

### 1 Scope

This part of ISO 11999 describes compatibility for ensembles of firefighters' personal protective equipment (PPE) to be used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures.

This part of ISO 11999 includes methods for compatibility testing in laboratories and procedures for compatibility testing to be performed by wearers.

NOTE Where the presence of more than one risk to health and safety makes it necessary to wear or use more than one item of PPE simultaneously, it is important that such equipment is compatible and continues to be effective against the risk(s) in question.

### 2 Normative references

[ISO/FDIS 11999-2](#)

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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 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 17491-5, *Protective clothing — Test methods for clothing providing protection against chemicals — Part 5: Determination of resistance to penetration by a spray of liquid (manikin spray test)*

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

### 3 Terms and definitions

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

#### 3.1

##### **compatibility**

ability of a part of an ensemble of PPE to be used in conjunction with other parts of PPE

#### 3.2

##### **human interface**

interaction between PPE and the wearer

#### 3.3

##### **PPE interface**

interaction between different PPEs adjacent to other components

### 3.4

#### **practical performance test**

test procedure with wearers of PPE ensembles moving under specified conditions

### 3.5

#### **performance test**

test procedure with PPE ensembles in laboratories under specified conditions

## **4 Compatibility**

### **4.1 General**

Compatibility becomes an issue when different types of PPE of an ensemble are worn at the same time. This is because each type of PPE may interfere with another type of PPE. This may lead to a reduction of protection provided by the PPE and/or other restrictions, which may cause a limitation of the tactical mission. The main hazards of structural firefighting are impacts of heat and flame. Furthermore the penetration of water may cause severe injuries during structural firefighting.

For items of PPE to be marked as compatible according to ISO 11999-1, they shall also meet the relevant performance requirements specified in this part of ISO 11999. Practical performance testing should be carried out in accordance with [Annex A](#).

NOTE Additional information on compatibility can be found in ISO/TR 21808.

### **4.2 Minimum requirements of compatibility**

Compatible items of PPE (of the types described in ISO 11999-3 and ISO 11999-4) shall meet the performance requirements of [Clause 4](#).

Compatible items of PPE shall meet the relevant requirements of this Clause, thereby showing that they fit together and function together.

Compatible items of PPE shall not cause impairments for the wearer while being worn.

Compatible items of PPE shall not cause restrictions of the protection level when used in an ensemble.

### **4.3 Fit and function tests demonstrating compatibility**

Test subjects perform a series of practical tests (practical performance tests) that demonstrate the compatibility of items of PPE and ensembles measured against a set of performance criteria.

#### **4.3.1 Test subjects**

A minimum of three test subjects shall be chosen, one male, one female. Each subject shall be an experienced firefighter, appropriately trained, and medically checked. The items of PPE evaluated shall be the appropriate size and correctly fitted for the firefighter.

It is important that a test subject is wearing all items of PPE when testing the compatibility for fit and interface of only a few specific items. These may not be directly adjacent to a specific item being considered in the test; however, this item of PPE may have an influence on the fit and interface with other items being tested.

EXAMPLE The compatibility between jacket and trousers, when tested according to a practical performance test like the testing sequence proposed in [Annex A](#), can be different in case the test subject is wearing not only jacket and trousers but also a respiratory protective device. The amount of overlap between the jacket and trousers will be different when wearing a respiratory protective device or not.

#### 4.3.2 Compatibility for helmet/fire hood/jacket/RPD interface

After donning the coat jacket, RPD, and the fire hood in the ready position (down around the neck), with the helmet within easy reach while standing, the test subject shall be able to don the full face mask, the fire hood, and the helmet and to properly turn up and secure the jacket collar in position in 60 s.

At the end of the donning, the following checks shall be carried out:

- a check confirming the face seal;
- a check confirming all items are donned correctly and securely;
- a check confirming the fire hood lays flat;
- a check confirming a 25 mm overlap of the jacket collar and helmet (or helmet ear covers);
- a check confirming there are no protective gaps.

If any of these checks fail, the test shall be repeated until the donning is done correctly and an accurate donning time is recorded. Observe and report the procedures that are time consuming and that are caused by items of PPE interfering with each other.

#### 4.3.3 Compatibility for glove/jacket interface

The test subject shall don the jacket and glove according to manufacturer's instructions. The test subject shall perform the following practical performances:

- a) standing, hands together (flat palm to flat palm), reaching overhead as high as possible;
- b) standing, hands together (flat palm to flat palm), reaching forward as far as possible, body bent at the waist;
- c) standing, hands together (flat palm to flat palm), reaching to the right as far as possible, body bent at the waist;
- d) standing, hands together (flat palm to flat palm), reaching to the left side as far as possible, body bent at the waist;
- e) standing, hands together (flat palm to flat palm), reaching overhead toward the back as far as possible, body bent backward at the waist.

At no time shall the glove cuff or wristlet cover any trim on the jacket.

At no time shall there be a gap between the glove and the jacket sleeve.

#### 4.3.4 Compatibility for the jacket/trousers interface

The test subject shall don the trousers and the jacket according to manufacturer's instructions. The test subject shall perform the following practical performances:

- a) standing, hands together (flat palm to flat palm), reaching overhead as high as possible;
- b) standing, hands together (flat palm to flat palm), reaching forward as far as possible, body bent at the waist;
- c) standing, hands together (flat palm to flat palm), reaching to the right as far as possible, body bent at the waist;
- d) standing, hands together (flat palm to flat palm), reaching to the left side as far as possible, body bent at the waist;
- e) standing, hands together (flat palm to flat palm), reaching overhead toward the back as far as possible, body bent backward at the waist.

During the practical performance test (and also in use), an overlap shall be maintained at all times.

### 4.3.5 Compatibility for the footwear/trousers interface

The test subject shall don the footwear and the trousers according to manufacturer's instructions. The test subject shall perform the following practical performances:

- a) standing, hands together (flat palm to flat palm), reaching overhead as high as possible;
- b) standing, hands together (flat palm to flat palm), reaching forward as far as possible, body bent at the waist;
- c) standing, hands together (flat palm to flat palm), reaching to the right as far as possible, body bent at the waist;
- d) standing, hands together (flat palm to flat palm), reaching to the left side as far as possible, body bent at the waist;
- e) standing, hands together (flat palm to flat palm), reaching overhead toward the back as far as possible, body bent backward at the waist.

During the practical performance test and also in use, an overlap shall be maintained at all times.

NOTE There is a need to consider the width of the trousers and potential for flame entry between the leg and the trousers, when the height and width of the boot is insufficient.

### 4.3.6 Performance tests

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#### 4.3.6.1 Compatibility for entire ensemble

In addition to meeting the requirements of 4.3.1 to 4.3.5, the PPE items that collectively cover the test subject entirely (thus forming an ensemble) shall also meet the requirements of 4.3.6.3.

#### 4.3.6.2 Whole ensemble thermal protection test

ISO 13506-1 and ISO 13506-2 (under preparation) specify testing of the thermal envelope of the ensemble.

#### 4.3.6.3 Whole ensemble liquid penetration resistance test

The test should only be required for ISO 11999 Type 2 ensemble.

After 5 cycles of washing and drying the washable items in accordance with procedure 2N for washing and procedure E for drying of ISO 6330:2012, all the items used to complete the ensemble shall be tested together in accordance with ISO 17491-5, and shall show no liquid penetration.

The use of a test subject shall be allowed in place of the manikin, assuming all necessary safety and health precautions are taken. The test subject shall conform to the size, shape, posture, and practical performances of the manikin.

The test will be conducted for 60 min with the arms up and 60 min with the arms down.

## 5 Marking

Marking shall be in accordance with ISO 11999-1.

## 6 Manufacturer's instructions

Manufacturer's instructions shall be in accordance with ISO 11999-1.



## Annex A (informative)

### Practical performance test — Practical performance for compatibility of firefighters' PPE ensemble

#### A.1 General

Test subjects perform a series of practical performance tests for compatibility of each firefighter PPE ensemble and evaluate aspects of using the ensemble to a set of performance criteria.

#### A.2 Test subjects

A minimum of three test subjects shall be chosen, with at least one male and one female. Each subject shall be an experienced and competent firefighter, well trained, medically checked, with at least 5 years experience.

#### A.3 Documentation

The following information shall be noted for each test subject:

- name;
- age;
- gender;
- weight;
- height.

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#### A.4 Test conditions

Each test should be carried out in a range of conditions which reflect the environment in which the PPE will be worn. At least, each test shall be carried out in dry weather (without precipitation), at an ambient temperature.

#### A.5 Practical performance test elements

At a minimum, the following shall be carried out:

- walking a distance of 20 m;
- stairs climbing a height of 10 m;
- ladder climbing a height of 20 m;
- bending over five times;
- crawling on the level for a distance of 10 m;
- crawling through a narrow section 5 m in length;
- laying out a fire hose;