PD ISO/TS 11999-2:2015

BSI Standards Publication

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

bsi.

...making excellence a habit.™

National foreword

This Published Document is the UK implementation of ISO/TS 11999-2:2015.

The UK participation in its preparation was entrusted to Technical Committee PH/14, Firefighters' personal protective equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 85362 3

ICS 13.340.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 June 2015.

Amendments issued since publication

Date	Text affected

PD ISO/TS 11999-2:2015

TECHNICAL SPECIFICATION

ISO/TS 11999-2

First edition
2015-06-01

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**

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

Reference number
ISO/TS 11999-2:2015(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

ISO/TS 11999-2 was prepared by Technical Committee 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*

— *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*

Introduction

This International Standard provides minimum design and performance requirements for personal protective equipment (PPE) worn by firefighters to reduce injury and/or the loss of life. Amongst other hazards faced by firefighters is exposure to high thermal loads and to flames.

This International Standard details the design and performance requirements for the various items of PPE covered in all parts and for the compatibility of items of PPE when worn together.

This International Standard specifies design and performance requirements for the compatibility of ISO 11999-3, ISO 11999-4, ISO 11999-5, ISO 11999-6, ISO 11999-7, ISO 11999-8, ISO 11999-9, and ISO 11999-10 when all items covered in this International Standard are worn together, thereby creating an ensemble standard. All items have to meet the general requirements for marking and manufacturer's instructions (ISO 11999-1), as well as the specific marking and manufacturer's instructions of the respective parts of ISO 11999.

Under best practice for health and safety procedures, prior to choosing any PPE, a risk assessment of the workplace is carried out. Where hazards are identified and cannot be removed from a workplace, the items of PPE chosen to protect the personnel need to be fit for their intended use while allowing the personnel to carry out the work required of them. In environments where firefighters may be required to work, not only must the PPE protect the firefighters while enabling them to achieve their objectives at an incident, but it must also safeguard them and allow a safe escape. The PPE chosen must also allow firefighters to carry out their duties without undue stress being caused by the PPE.

Some PPE, particularly PPE to protect against mortal danger, can have failure levels far above the limit of exposures of human beings. On sites where such PPE is being used, it is important to ensure that proper and suitable safety procedures are in place which can identify when personnel should be withdrawn from dangerous or potentially dangerous situations and which can ensure that the relevant medical support is available for firefighters.

Since the decision on which PPE ensemble to use following risk assessment will dictate the parameters for protection of the persons who have to wear it, it is critical that decision-makers have knowledge of the risks against which the PPE is supposed to protect and its limitations. It is recommended that those who make the decision on the choice of PPE for particular workplaces should be competent in their knowledge and understanding of both the workplace hazards and the PPE from which to choose, prior to making these decisions, to ensure that informed decisions are taken.

Further detail on carrying out risk assessment to ascertain the type of PPE required to protect personnel working in specific areas is included in ISO 11999-1:2015, Annex A.

Hazards in the workplaces of firefighters are varied but can be common from workplace to workplace; therefore, some uses of PPE for firefighters can be multipurpose. Because this International Standard has been developed on a risk assessment approach, a number of different types, levels, or classes are given for certain performance requirements of various parts of a PPE ensemble. Based on their risk assessment, users of this International Standard can make a choice of which levels or classes are required for the particular workplace where their personnel are expected to work. This can include fires in domestic and commercial buildings, fires in industry, including aviation, petrochemical, chemical, pharmaceutical, land-based marine incidents, rescue, etc.

This International Standard includes separate parts for each item of a firefighter's ensemble. As PPE to protect each part of the body can be complex, this International Standard draws from the expertise of other Technical Committees in ISO which specialize in such protection.

The results of the user risk assessment for certain workplaces can require the use of PPE with higher and/or different levels or classes of performance than those in this International Standard. PPE covered in this part of ISO 11999 will not protect from all possible exposures. Nothing in this International Standard is intended to restrict any jurisdiction, purchaser, or manufacturer from exceeding the minimum performance requirements specified in this International Standard.

Another objective in the Business Plan of ISO/TC 94/SC 14 is to provide guidance on the selection, use, care, and maintenance for firefighters' PPE. Such activities are critical to the lifespan and continuing protective ability of any PPE and policies covering these aspects should be implemented as soon as the PPE is introduced into use. ISO/TC 94/SC 14 has developed a Technical Report on this subject, ISO/TR 21808. Firefighters should be trained in the selection, use, care, and maintenance of their PPE. Firefighters should also be trained in the performance and limitation of their PPE.

TECHNICAL SPECIFICATION **ISO/TS 11999-2:2015(E)**

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 Technical Specification 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 Technical Specification includes methods for compatibility testing in laboratories and procedures for compatibility testing including the identification of any limitations 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 simultaneously more than one item of personal protective equipment, such equipment is compatible and continues to be effective against the risk or risks in question.

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

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)*

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
performance test
test procedure with PPE ensembles in laboratories under specified conditions

3.5
practical performance test
test procedure with wearers of PPE ensembles moving under specified conditions

3.6
trim
retro-reflective and fluorescent material attached to the outer shell for visibility enhancement. Retroreflective materials enhance night time visibility, and fluorescent materials improve daytime visibility

4 Compatibility

4.1 General

Compatibility becomes an issue when different types of PPE of an ensemble or combinations 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 f lame. 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 technical specification. 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 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 with at least one male and 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. There shall be three repetitions for each test subject

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

— a check confirming a minimum of 25mm overlap of the jacket collar and helmet (or helmet ear/neck covers) in case of no firehood. The head is in the vertical position throughout this check. The helmet shall not push down the protection provide by the jacket collar;

— a check confirming an overlap with the neck regardless of the position of the head;

— a check confirming the face seal (with air flow turned on) and no leakage occurs;

— 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 or neck);

— 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 subject shall perform the following practical performance tests:

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 retro reflective 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 subject shall perform the following practical performance tests:

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 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 subject shall perform the following practical performance tests:

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 an overlap shall be maintained at all times.

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

4.3.6 Performance tests

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 or combinations) shall also meet the requirements of 4.3.6.2.

4.3.6.2 Whole ensemble liquid penetration resistance test

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

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, all the items used to complete the ensemble or combinations 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 or combinations

A.1 General

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

A.2 Test subjects

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

A.3 Documentation

The following information should be noted for each test subject:

— name;

— age;

— gender;

— weight;

— height.

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 should 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;

— reading a pressure gauge (SCBA);

— handling a tool (e.g. wrench).

A.6 Evaluation

Each subject should evaluate the ensemble or combinations under test to the following criteria:

— donning, doffing (very easy, easy, restricted, impossible);

— fitting, adjustment (very easy, easy, restricted, impossible);

— malfunctions (yes, no);

— inadvertent operations (yes, no);

— security of fastening and retention (yes, no);

— controlling options (unrestricted, restricted);

— handling of tools (unrestricted, restricted);

— operation of machinery (unrestricted, restricted);

— communication without voice amplification means (very good, good, restricted, impossible);

— movement (unrestricted, restricted);

— wearing comfort, including weight, balance, thermal (pleasant, unpleasant);

— skin kindness (yes, no);

— body surface covering (given, not given);

— cognition/vision (unrestricted, restricted);

— breathing resistance (easy, restricted).

A.7 Report

The test report should include the evaluation of the tested firefighter PPE ensemble or combinations for each subject, especially noting the points of incompatibility of the tested items of PPE.

ICS 13.340.10
Price based on 7 pages

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™