International Standard

ISO 11999-1

Second edition
2024-10

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

Équipement de protection individuelle pour pompiers — Méthodes d'essai et exigences pour les équipements de protection individuelle utilisés par les pompiers qui risquent d'être exposés à des niveaux élevés de chaleur et/ou de flamme lorsqu'ils combattent des incendies dans des structures —

Partie 1: Généralités

Reference number
ISO 11999-1:2024(en)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

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.

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 94, *Personal safety — Personal protective equipment*, Subcommittee SC 14, *Firefighters' personal equipment*.

This second edition of ISO 11999-1, together with ISO/TS 11999-2 to ISO 11999-10, cancels and replaces ISO 11999-1:2015, which has been technically revised.

The main changes are as follows:

— the content has been revised with a focus on single performance requirements;

— performance requirements for respiratory protection are covered in ISO 17420-5.

A list of all parts in the ISO 11999 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In a world where there is an ever-increasing focus on worker occupational health and safety, Fire services are faced with the dilemma of trying to provide firefighters with as safe a work environment as is reasonably possible whilst also having to deal with the known and unknown risks our firefighters face whilst fighting fires in both the urban and wildland environments.

In the course of their duty's firefighters are exposed to many hazardous chemicals that include smoke, soot, carcinogens and the biproducts of combustion such as heavy metals, benzene and per-fluorinated compounds which are regularly inhaled and/or deposited on the skin of firefighters.

With the recent statement by the World Health Organization (WHO) elevating the classification of occupational exposure as a firefighter to Group 1, ISO TC94/SC 14 Working Group on contaminants are taking all possible steps to reduce the exposures to firefighters by reviewing all standards pertaining to PPE used by firefighters and making recommendations to address identified shortfalls.

The following is an extract from the statement released by the WHO:

"— International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization (WHO), has evaluated the carcinogenicity of occupational exposure as a firefighter.

— A Working Group of 25 international experts, including 3 Invited Specialists, from 8 countries was convened by the IARC Monographs program for a meeting in Lyon.

— After thoroughly reviewing the available scientific literature, the Working Group classified occupational exposure as a firefighter as carcinogenic to humans (Group 1), on the basis of sufficient evidence for cancer in humans."

This document specifies minimum design and performance requirements for personal protective equipment (PPE) worn by firefighters to reduce injury and loss of life whilst fighting fires occurring in structures. Amongst other hazards faced by firefighters is exposure to high thermal loads, including flames, particulates, and other hazardous chemicals. Additional information may also be found in ISO 20345 and ISO 21420.

This document details minimum design and performance requirements for the various items of PPE covered in each part and provides information regarding compatibility between these items of PPE when worn together.

ISO 11999-2, specifies design and performance requirements to achieve compatibility across the PPE covered in ISO 11999-3 to ISO 11999-10 when all the items are worn together, thereby creating a PPE ensemble, whether sold by a manufacturer or composed by a user. In either case, the PPE ensemble should meet the requirements of ISO 11999-2. This becomes significantly important when considering the issue of particulate protection and potential health risks posed to firefighters from exposure to products of combustion.

All items are also required to meet general requirements for marking and manufacturer's instructions (this document), as well as specific marking and manufacturer's instructions within each of the respective parts of ISO 11999. In the case of an ensemble, each item of PPE should also be marked according to ISO 11999-2.

ISO/TR 21808 provides guidance on how to carry out a risk assessment, the guideline was developed previously based on the work of CEN Technical Committee TC 162, Joint Working Group for firefighters Personal Protective Equipment and has been modified to encompass PPE worn by all emergency service personnel. (CEN/TC 162/JWG FFPPE N 52 "Risk assessment guidelines for choosing the PPE for firefighters")".

During incidents being undertaken by emergency service personnel, many different hazards may be encountered, including exposures to a range of chemicals that are biproducts of fires occurring in the urban and wildland environment. Where possible, the level of risk that each hazard presents to firefighters should be eliminated or reduced to an acceptable level. The guidance given in ISO/TR 21808 indicates how to carry out a Risk Assessment by acknowledging the hazards that may be present, the likelihood of the firefighters becoming exposed to them and possible consequence of such exposure if not addressed. Where hazards are identified and cannot be removed from a workplace, the items of PPE selected to protect personnel should be fit for their intended use while allowing personnel to carry out the work required of them. In environments

where firefighters may be required to work, not only should the PPE protect the firefighters while enabling them to achieve their objectives at an incident, it should also safeguard them and allow safe escape. The PPE should also allow firefighters to carry out their duties without undue physiological stress being caused by the PPE itself.

Workplace hazards for firefighters are varied but can be common from workplace to workplace; therefore firefighters PPE can be somewhat multipurpose. The significant change in this document is the establishment of a harmonised approach to a single level of performance for heat and flame within each part by setting single minimum design and performance requirements for PPE, including optional requirements where identified. This does not mean that the same heat and flame level will be required for each part, but a coherent approach to provide an overall minimum level of protection for firefighters engaged in fighting fires occurring in structures without neglecting other tasks required to be performed by firefighters wearing this PPE across different regions of the world. This can include fires in domestic and commercial buildings, fires in industry, including aviation, petrochemical, transportation, chemical, pharmaceutical, land-based marine incidents, rescue, etc. The emergence of alternative energy storage systems and associated risks to firefighters requires proper research, review and consideration to inform the development and revision of performance based PPE standards.

The proper cleaning, inspection and repair of PPE should be addressed in ISO 23616 currently being developed in response to growing concerns about contamination and potential health hazards for firefighters. It is the responsibility of the firefighter, both initially and ongoing, to undertake regular inspections of their PPE, and there should also be a reliable system or mechanism in place to ensure that this can be effectively achieved and supported by appropriate training.

As PPE necessary to protect each part of the body can be complex, this document draws from the expertise of other Technical Committees in ISO which specialize in such protection.

PPE covered in the ISO 11999 series will not protect from all possible exposures. Nothing in this document is intended to restrict any jurisdiction, purchaser, or manufacturer from exceeding the minimum performance requirements specified in this document series.

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

1 Scope

This document specifies minimum design and performance requirements for personal protective equipment (PPE) to be used by firefighters whilst engaged in fighting fires occurring in structures, primarily but not solely to protect against exposure to flame and high thermal loads.

The scope of this document does not include PPE for use in high risk fire exposures where, for example:

— protective clothing with reflective surface according to ISO 15538 might be more appropriate,

— where exposure to lower levels of heat or flame may be encountered by firefighters engaged in support activities where PPE according to ISO 11613 might be more appropriate,

— or for use in firefighting operations in high ambient temperature (for example bush, wildland or forest firefighting) where PPE according to ISO 16073 series might be more appropriate.

Similarly, this document does not include PPE to protect against chemical and biological hazards, other than against short term and accidental exposure while engaged in firefighting and associated activities.

This document provides an approach of a single minimum design and performance requirements for PPE, including optional requirements where identified, and for product markings and manufacturer's instructions.

Selection of an appropriate system of protective equipment is dependent upon an effective risk assessment which identifies the hazards to be faced, evaluates the likelihood of those hazards, and provides the means to reduce or eliminate these hazards (see ISO/TR 21808).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11610, *Protective clothing — Vocabulary*

ISO 11999 (all parts), *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*

ISO 13688, *Protective clothing — General requirements*

ISO 13688:2013/Amd.1:2021, *Protective clothing — General requirements — Amendment 1*

ISO/TR 19591, *Personal protective equipment for firefighters — Standard terms and definitions*

ISO/TS 20141, *Personal safety — Personal protective equipment — Guidelines on compatibility testing of PPE*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11610, ISO/TR 19591 and ISO/TS 20141 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
combination of PPE
two or more items of PPE fulfilling the requirements of this International Standard

3.1.2
ensemble
combination or assembly of multiple items, individually and/or in combination, compliant with the respective parts of this document that provide protection to the head, upper torso together with arms and hands, the lower torso together with feet, and respiratory protection

3.2 Abbreviated terms

CCHR	conductive compressive heat resistance
DRD	drag rescue device
HTI_{12}	heat transmission index (mean time (s) to 12 °C temperature rise)
HTI_{24}	heat transmission index (mean time (s) to 24 °C temperature rise)
HTI(DE)	heat transfer index (dual exposure)
HTI(DE)-12	time (s) to 12 °C temperature rise
HTI(DE)-24	time (s) to 24 °C temperature rise
TPI	thermal protective index [exposure energy to cause 2nd degree burn]
TTI	thermal threshold index
m	mass
PPE	personal protective equipment
R'	coefficient of retroreflection
$RHTI_{12}$	radiant heat transmission index (mean time (s) to 12 °C temperature rise)
$RHTI_{24}$	radiant heat transmission index (mean time (s) to 24 °C temperature rise)
RPD	respiratory protective device
SCBA	self-contained breathing apparatus
t_t	threshold time (average of all specimens rounded to the nearest 0,1 s)

W_w mass fraction of water absorbed

3.3 Subscripts

12 at 12 °C temperature rise

24 at 24 °C temperature rise

w water

4 Design and performance requirements for PPE items and ensembles

4.1 General

Each individual item shall meet relevant product standard specified in ISO 11999-3 to ISO 11999-10. In addition, each individual item or PPE ensemble applicable in condition of 4.2, 4.3 also shall meet the requirement in each clause.

4.2 Innocuousness

PPE shall not adversely affect the health or hygiene of the user. The materials shall not, in the foreseeable conditions of normal use, release substances generally known to be toxic, carcinogenic, mutagenic, allergenic, toxic to reproduction or otherwise harmful.

NOTE For more detail either see specific parts of ISO 11999 or see more detail in either ISO 13688 or ISO 21420 used respectively for garment and gloves.

4.3 Items of PPE, combinations and ensembles

A combination or ensemble of PPE items is classified as meeting the requirements as described below. The selection of the PPE and the needs of the organisation shall be based on the risk assessment. Users have a right to choose the appropriate condition of PPE based on their organization needs and risk assessment.

Based on ISO 11999-3 to ISO 11999-10, an individual item or combinations of items designated is classified as meeting the requirements of the appropriate standards of this series and may be used as part of an ensemble. The combination of PPE items shall meet the guidance requirement of ISO/TS 11999-2 and ISO/TS 20141 to confirm the compatibility and effectiveness of protection of that combination of PPE continuity in use.

For example, the individual items of a PPE ensemble, which are intended to provide protection for the firefighter's upper and lower torso, head, neck, arms, hands, legs and feet, shall conform to the requirements of ISO 11999-3 to ISO 11999-10 and meet the compatibility requirements detailed in ISO 11999-2.

Nevertheless, any item of PPE, which conforms to the requirements of one of ISO 11999-3 to ISO 11999-10, can individually be designated and marked in accordance with the requirements for that part of ISO 11999.

NOTE A combination is more than a single item of PPE but less than an ensemble, i.e. it does not offer protection to the firefighter.

5 Marking

5.1 General

Marking requirements shall meet at least the relevant part of ISO 11999-3 through ISO 11999-10 in addition to the requirements below Where relevant these will refer to the relevant clause of ISO 13688, ISO 21420 or ISO 20345.

Any marking in the form of labels shall not adversely affect the performance of any item to which they are attached or present a hazard to the wearer."

5.2 Compliance marking requirements for an item of PPE

Each item of PPE, for which compliance with this document is claimed, shall have a label permanently and conspicuously attached in accordance with ISO 13688:2013 and ISO 13688:2013/Amd.1:2021, 7.2 and upon which the following information is printed in letters at least 2 mm high:

a) where practical, the pictogram given in Figure 1

b) identification of product standard — ISO 11999-Y:XXXX where Y is part and XXXX is year.

c) the name, trademark, or other means of identifying or tracing back to the manufacturer.

d) the manufacturer's model number and/or user's specified number.

Figure 1 — Pictogram ISO 7000-2418

5.3 Additional marking for compatibility

All items of PPE, which are intended to be worn together in order to form a specific combination of PPE items or a specific mixed ensemble, and which are intended to be certified together and put together on the market, are to be tested together according to the respective compatibility requirements of ISO 11999-2. An additional marking is to be added to the items' individual markings, stating each item that it is "Compatible with [using information in 5.2 c) and d)]".

6 Information supplied

6.1 Information to be supplied by the manufacturer

The manufacturers shall at least meet the requirements below and additional requirements in the relevant parts of this series

a) the name, trademark or other means of identifying the manufacturer or its authorized representative;

b) the manufacturer's type number, identification, or model number

c) a list of any additional separable components or parts, including but not limited to, RPDs, outer garments, outer gloves, and separate boots, which shall be worn for compliance with this document;

d) the number and date of this document;

e) the year of manufacture and a lot or trace number;

f) the size range as defined in the parts of this series

g) description and explanation of any pictogram used

6.2 Manufacturer instructions for use

The manufacturer shall provide user information including, but not limited to, data in accordance with the relevant part(s) of 11999 series, any additional data required by this standard, the results of any optional tests undertaken, warnings, information, and instructions with each PPE.

Instructions shall be supplied in the official language(s) of the country of destination.

The manufacturer shall provide at least the following instructions and information with each PPE:

a) safety considerations;

b) information about the markings;

c) limitations of use;

d) preparation for use;

e) sizing and details if gender specific;

f) recommended storage practices;

g) inspection frequency and details;

h) donning and doffing procedures;

i) maintenance and cleaning;

j) retirement and disposal, if relevant;

k) known shelf life limitations;

l) information about the use of integrated devices.

The manufacturer shall attach the manufacturer's instructions, or packaging containing this information, to the relevant item of PPE in such a manner that it is not possible to use the item of PPE without being aware of the availability of the information and that a deliberate action is necessary to remove it.

Where the manufacturer supplies the instructions for use in a digital format, a physical permanent marking on the PPE that can be linked to that digital format shall be attached to each item of PPE. Where the instructions for use is provided in a digital format, a physical copy shall be made available to the user upon request.

"The manufacturer shall provide, as a minimum, the results of the thermal performance levels, Thermal comfort performance levels and an explanation of the meaning of these performance level."

The manufacturer shall provide notice that the information is to be removed ONLY by the end User.

7 Compatibility instructions

Combination of PPE items which are intended to be worn together and or assembled together, shall be tested together according to the respective compatibility requirements of ISO 11999-2 and meet the requirements of the individual parts of the ISO 11999 series.

For the compatible items of PPE, the manufacture shall provide a declaration for each item of compatible PPE, additional information on the conformance to the requirements of ISO 11999 2, and any additional checks or warnings, such as but not limited to:

— compatible with [using information in 5.2 c) and d)]

— testing and classification of performance for items of PPE, for combinations of items of PPE for ensembles