

ISO/~~DTR~~**DTR** 21808:2023(E)

ISO TC 94/SC 14/~~AWG~~

Secretariat: SA

Date: 2023-09-23~~xx~~

Guidance~~Best practices~~ on the selection and use of personal protective equipment (PPE)
designed to provide protection for firefighters

~~Lignes directrices~~Meilleures pratiques sur la sélection, l'utilisation, le soin et l'entretien des équipements de
protection individuelle (PPE) conçus pour pourvoir à la protection des pompiers

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ISO 20344, Personal protective equipment — Test methods for footwear

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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 are 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. 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 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 — Protective equipment*, Subcommittee SC 14, *Firefighters personal equipment*.

This ~~second~~ ^{third} edition cancels and replaces the ~~first~~ ^{second} edition (ISO/TR 21808:2009), which has been technically revised and completely rewritten.

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.

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ISO/TR 21808:2021, Guidance on the selection, use, care and maintenance of personal protective equipment (PPE) designed to provide protection for firefighters

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Introduction

The information in this document has been produced to assist firefighters, fire services and purchasers (or the person who advises the employer) in making the necessary decisions regarding the selection, use, care and maintenance of PPE for firefighters.

The purpose of this document is to establish a ~~guidance~~best practices document for PPE with the goal to evaluate and reduce the hazards and potential health risks associated with firefighting. This selection use, guideline provides basic answers, criteria, and options for the fire service personnel that are selecting or using PPE through its life cycle with respect to protection it provides related to heat and flame or damaged PPE.

The main topics that the fire service needs to consider are highlighted in this document. This ~~guidance~~best practices document goes through the various steps and considerations such as risk assessment, compatibility, testing, information to be provided with the PPE so that the right management choices can be made for each fire service. Many paragraphs of the document contain bullet-lists as thought provokers or options that may need to be considered. The annexes provide additional information that if included, would make the main body of this document too complicated to read, but are necessary to describe hazards and risks, the value of the test methods for the end user, for example ~~Annex E "Description of burn injury risks" and Annex F "Guidance on some of the items that may be addressed in labelling, subject to the required use of the PPE"~~ and Annex F provide importance guidance information.

The selection of appropriate PPE for heat and flame are based on your own risk assessment and procurement documents.

In the past 10 years, the world has experienced a rise in temperature due to climate change. As a result of this temperature rising, firefighters are facing the danger of heat stress, heat stroke and other fatal heat sicknesses. Many fire departments have begun considering heat stress management, taking into account the rising temperature and hot and humid climates, and have established new firefighting strategies, including tactics, training, equipment, and organization. Although some countries are placing more emphasis on heat and flame protection, the increased frequency and danger of heat stress and heat stroke incidents are estimated to result from the heavier and thicker PPE required. The risk of these newly generated risks, including dangerous heat stress/stroke, can not be underestimated. Risk assessments of firefighters' PPE(s) are to include the risks associated with heavier and thicker PPE(s) under various environmental conditions.

The compatibility in this document focused mainly on the physical compatibility between each element of PPE and the documentation.

This document is not intended for cleaning, inspection or repair of firefighter PPE. ~~Use ISO 23616~~ is used for cleaning, inspection and repair of firefighters personal protective equipment (PPE).

Currently, TC 94/WG1 works to establish a parent standard for the development of this document. In case of the parent standard publication, consider the consistency of this document ~~is to be considered~~.

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Guidance Best practices on the selection and use, of personal protective equipment (PPE) designed to provide protection for firefighters

1 Scope

This document sets out the ~~guidance~~best practices for the selection and use of PPE designed to provide protection for firefighters while carrying out their duties.

The PPE covered in this document is intended for firefighting personnel exposed to risks associated with but not necessarily limited to the following activities:

- structural firefighting;
- wildland firefighting;
- incidents involving hazardous materials;
- incidents involving motor vehicle;
- urban search and rescue.

The purpose of this document is to highlight the main areas that a ~~fire~~fire service needs to consider when providing PPE to its members. This document is a supplement to the information provided in the PPE standards or used in conjunction with them. Most paragraphs of the document contain bullet lists, these lists are provided for guidance only and they are not exhaustive.

Cleaning, inspection and repair of firefighters' personal protective equipment (including care and maintenance) are covered by ISO 23616.

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.

~~<std>ISO/TR 19591, Personal protective equipment for firefighters — Standard terms and definitions</std>~~

~~<std>ISO 23616, Cleaning, Inspection and Repair of firefighters' personal protective equipment (PPE)</std>~~

~~<std>ISO/TS 16975-1, Respiratory protective devices — Selection, use and maintenance — Part 1: Establishing and implementing a respiratory protective device programme</std>~~

~~<std>ISO/TS 20141:2022, Personal safety — Personal protective equipment — Guidelines on compatibility testing of PPE</std>~~

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO/TR 19591](#) and the following apply.

ISO and IEC maintain terminological 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 base-layer garment

the first layer of a textile structure that is in direct contact with the skin (i.e. briefs, t-shirts, bras, socks)

3.2 care

processes and procedures for cleaning, decontamination, and storage of protective clothing and equipment

[SOURCE: [ISO/TR 19591:2018, 3.30](#)]

3.3 cleaning

act of removing soils and contaminants from protective clothing and equipment by a mechanical, chemical, thermal, or combined processes

[SOURCE: [ISO/TR 19591:2018, 3.45](#)]

Note 1 to entry: See [ISO 23616](#) for further information

3.4 compatibility

capability of two or more items or components of personal protective equipment to exist or function in the same system without modification, adaption or mutual interference with respect to interfaces and performance

3.5 contaminant

undesirable solid, liquid, gaseous or particulate hazardous substance such as

- products of combustion (e.g. soot),
- body fluids,
- infectious micro-organisms, and
- chemicals (e.g. asbestos or respirable fibres, flammable, corrosive, carcinogenic, mutagenic, toxic or sensitizing substances)

Note 1 to entry: Same definition with [ISO 23616](#)

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

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3.6 overall
one-piece garment that completely covers the wearer's torso, together with arms, and legs, excluding the head, hands, and feet

3.7 deterioration
downgrading of the effectiveness or physical characteristics of PPE component due to use, care (3.2), maintenance or storage conditions

3.8 ensemble
combination or assembly of multiple items that are individually compliant with a standard that provide protection to the head, upper torso including arms and hands and the lower torso including feet

[SOURCE: ISO 11999-1:2015, 3.24]

3.9 ergonomics
scientific discipline concerned with the understanding of interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance

[SOURCE: ISO 26800:2011, 2.2, modified — The note has been omitted.]

3.10 flame resistance
property of a material whereby combustion is prevented, terminated, or inhibited following the application of a source of ignition, with or without subsequent removal of the ignition source

[SOURCE: ISO/TR 19591:2018, 3.114]

Note 1 to entry: Usually flame resistance materials for fire fighter are Index III of ISO 14116, but flame resistance is denoted by meeting one of the Index of ISO 14416 using the flame spread test method ISO 15025.

3.11 maintenance
the act of preserving PPE from loss or deterioration (3.8) and includes procedures for inspection, repair and ultimate removal from service, see ISO 23616 for further information

Note 1 to entry: See ISO 23616 for further information

3.12 risk
probability of a specific undesired event (e.g. injury) occurring so that a hazard is realized

[SOURCE: ISO/TR 11610:2004, 3.205]

3.13 risk assessment
overall process that identifies hazards, estimates the potential severity of injury or damage to health, estimates the likelihood of occurrence of injury or danger to health

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ISO 11610:2023, Protective clothing — Vocabulary

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3.14 selection

process determining/assessing what PPE is necessary for protection of fire and emergency services response personnel from an anticipated specific hazard or other activity, the procurement of the appropriate PPE, and the choice of the proper PPE for a specific hazard or activity at an emergency incident

3.15 use

application of PPE including its limitations

4 General

4.1 Responsibility of procedure development

Fire services develop procedures for selection and use (of SUCAM) for firefighters' PPE.

NOTE 1 ISO 23616 is a companion to this document which describes detail requirement of cleaning, inspection, and repair.

NOTE 2 ISO/TS 16975-1 is also a companion to this document which describes SUCAM of RPD.

NOTE 3 ISO/TR 18690 is an additional companion to this document which describes SUCAM of occupational footwear and other personal protective equipment offering foot and leg protection.

4.2 Ergonomics

Ergonomics for firefighting organizations is a matter of ergonomic approach that firefighters are to consider when conducting activities, and the main purpose is to reduce the burden and burden on humans.

The following items are to be taken into consideration.

The firefighting organization are to evaluate the compatibility and ergonomics of PPE by practical performance tests. In addition, the wearers are to try on and evaluate as necessary. Testing is to be performed by firefighting organizations, manufacturers or other competent organization.

Practical performance tests are conducted in accordance with ISO/TS-20141, ISO/TR 21808 Annex B, and other applicable standards.

When conducting trial fitting by the wearer, the following items are ~~to be~~ considered:

- ~~Ease~~ and time required for donning and doffing;
- ~~Ease~~ of adjustment and adjustable range;
- ~~Comfort~~ and weight tolerance;
- ~~Compatibility~~ with other PPE to be used at the same time;
- ~~Whether~~ or not all the expected tasks can be carried out without problems;
- ~~Protection~~ against all postures during the work;
- ~~Identification~~ of risks associated with attaching accessories to PPE.

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NOTE Consider the location (e.g. in high risk areas) and material (e.g. flame retardant) of the accessories.

4.3 Compatibility

4.3.1 General

Compatibility is the capability of two or more items or components of personal protective equipment to exist or function in the same system without modification, adaption or mutual interference with respect to interfaces and performance. ISO/TS 20141 provides general information of Compatibility. This document refers to ISO/TS 20141 for basic references and understandings of compatibility. In some specific cases specified for ER purpose, following information is provided.

This table shows necessity of consideration about compatibility between PPE combinations. For new equipment, there are cases where it does not apply to the classification of this table, so careful attention is paid to the compatibility with related equipment.

Table 1 below shows the interactivity with the various parts of PPE, with in addition underwear.

Table 1 — Compatibility of PPE

Compatibility with	Helmet	Fire hood	Eye protection	Hearing protection	RPD	Neck protection	Clothing	Base layer garment	Over garment	Gloves	Foot protection	Fall protection	Others
Helmet		X	X	X	X	X	X	X	X			X	X
Fire hood	X		X	X	X	X	X	X	X				X
Eye Protection	X	X		X		X	X		X				X
Hearing protection	X	X	X		X	X	X		X				X
RPD	X	X		X		X	X	X	X	X		X	X
Neck protection	X	X	X	X	X		X	X	X			X	X
Clothing	X	X	X	X	X	X		X	X	X	X	X	X
Base layer garment	X	X			X	X	X		X	X	X	X	X
Over garment	X	X	X	X	X	X	X	X		X	X	X	X
Gloves	X				X		X	X	X				X
Foot protection							X	X	X				X
Fall Protection	X				X	X	X	X	X				X
Others	X	X	X	X	X	X	X	X	X	X	X	X	

NOTE PPE samples which are widely used in the current work field include, but are not limited to the following:

- helmet: fire helmet, Safety (mechanical protective and electric shock) helmet;
- fire hood: fire hood for firefighting;
- eye protection: safety glasses, goggle, face shield, RPD type;
- hearing protection: earmuff, ear plug;

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- RPD: breathing apparatus, non-powered respirator;
- neck protection: SHIKORO, fire hood, stand collar type apart of clothing;
- clothing: firefighting clothing (structural, wildland), rescue activity clothing (RTC, USER);
- base layer garment: briefs, t-shirts, bras, socks, station uniform, radiation protection (head protector), FR underwear, protective undergarment for cold atmosphere (including foot protection), body cooling device for heat stroke prevention;
- over garment: chemical (biological) protection, radioactive particle protection, mechanical risk protection (elbow guard, knee guard, chaps), including partial protective devices for each hazard;
- gloves: firefighting glove, mechanical risk protection (cut resistance), thermal risk protection (low temperature resistance), chemical (biological) protective glove, including over glove style;
- footwear: chemical (biological) protection, radioactive particle protection, mechanical risk protection, including partial protective devices for each hazard;
- others: protective equipment excluding above group, multi-functional protective equipment.

4.3.2 Physical compatibility

Physical interactions between the various PPE such that the various pieces of PPE don't hinder each others protection properties and reduce/jeopardise the level of protection: In addition, ensuring the overlaps between the various pieces of PPE are sufficient. Ensure the overlaps, freedom of movement and potential hindrance are evaluated using practical performance test movements (see Annex B) in addition to specific ones such as firehoods and gloves that may have specific movements between respectively with respiratory protective device (RPD) or glove dexterity for handling various tools and PPE. For optimum protection garments are selected for having a level of ease, or not too tight fitting (air provides additional layer of protection).

NOTE Guidance for structural firefighters gear can be found in ISO/TS 11999-2.

4.3.3 Thermal protection compatibility

The thermal protective properties of different layers will not have a negative impact on each other, e.g. by reduction of air layers between different items of PPE. Different items of PPE will not increase the thermal physiological impact of the PPE on the wearer. Wearers are aware of the materials of the underclothing when using protective clothing against heat and flame to consider the melting possibility of underwear.

4.3.4 Chemical protection compatibility

The chemical thermal protective properties of the outer layer of is critical to providing chemical protection of the fire fighter whether this is for structural clothing or hazardous materials incidents.

Repellency, in garment such as for structural fire fighting, station wear, rescue clothing, needs to be ensured after washing through re-impregnation. If not the garment could absorb or let through chemicals during an incident or cleaning operations. These chemicals (e.g. solvent, oil) may have a negative impact the heat and flame protection of the garment, glove, boot, etc.

Wear and tear, and specifically abrasion, can negatively impact the chemical protection of boots, gloves and garments. Helmets may lose their robustness if exposed to chemicals (e.g. solvents, acids).

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