
**Wildland firefighting personal protective
equipment — Requirements and test
methods**

*Équipement de protection individuelle pour la lutte contre les feux
d'espaces naturels — Exigences et méthodes d'essai*

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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.

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.

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.

ISO 16073 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 14, *Fire-fighters' personal equipment*.

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Introduction

This International Standard provides minimum performance requirements for wildland firefighters' personal protective equipment (PPE) designed for use for extended periods during wildland firefighting.

Wildland firefighting involves work carried out mostly in summer temperatures and for many hours, during which the firefighter can develop high levels of metabolic heat. As a consequence, the PPE is required to be light, flexible and commensurate with the risks to which the firefighter can be exposed in order to be effective without introducing excessive heat stress to the wearer.

It is very important to train firefighters in the selection, use, care and maintenance of the PPE covered by this International Standard, including an understanding of its limitations.

Nothing in this International Standard is intended to restrict any jurisdiction, purchaser or manufacturer from exceeding these acceptable performance requirements.

A number of Member bodies have raised issues regarding harmonization of test methods for different items of PPE, e.g. radiant heat tests on footwear and apparel. This has been extensively discussed, but requires considerable testing and validation before it can be addressed in this International Standard. Technical Committee ISO/TC 94/SC 14 has agreed that this will be a priority for the next revision. Similarly, the issue of testing of complete assemblies of PPE has been only slightly addressed and will be further explored in the next revision.

It is intended that a risk assessment be undertaken to determine if the PPE covered by this International Standard is suitable for its intended use and the expected exposure. It is intended that the risk assessment be used to determine what types of PPE are necessary for head, face, hands, body and feet.

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Wildland firefighting personal protective equipment — Requirements and test methods

1 Scope

This International Standard specifies the minimum performance requirements and methods of test for personal protective equipment (PPE) covering the torso, neck, arms, hands, legs, feet, head, eyes and hearing for wildland firefighting.

This International Standard covers the general design of the PPE, the minimum levels of performance for the materials employed and the methods of test used. This PPE is not intended to provide protection during fire entrapment.

This International Standard does not cover PPE for structural firefighting (see ISO 11613), for use against chemical, biological, radiological and nuclear hazards, or for use where a reflective outer surface is required (see ISO 15538).

Activities in support of wildland firefighting, such as the cutting of trees and the use of a chainsaw can require additional protection to that provided in this International Standard. Users are directed to those relevant standards for the requirements associated with such protection.

NOTE Performance requirements for respiratory protective devices (RPD) for wildland firefighting are not available at the time of publication. An International Standard for RPD is under development.

2 Normative references

The following referenced documents are indispensable for the application 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 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 3071, *Textiles — Determination of pH of aqueous extract*

ISO 3146, *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 4045, *Leather — Chemical tests — Determination of pH*

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

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

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

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

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

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

ISO 12947-2, *Textiles — Determination of abrasion resistance of fabrics by the Martindale method — Part 2: Determination of specimen breakdown*

ISO 13506, *Protective clothing against heat and flame — Test method for complete garments — Prediction of burn injury using an instrumented manikin*

ISO 13688, *Protective clothing — General requirements*

ISO 13934-1, *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 13938-2, *Textiles — Bursting properties of fabrics — Part 2: Pneumatic method for determination of bursting strength and bursting distension*

ISO 13996, *Protective clothing — Mechanical properties — Determination of resistance to puncture*

ISO 13997, *Protective clothing — Mechanical properties — Determination of resistance to cutting by sharp objects*

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

ISO 17075, *Leather — Chemical tests — Determination of chromium(VI) content*

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

EN 167:2001, *Personal eye-protection — Optical test methods*

EN 168:2001, *Personal eye-protection — Non-optical test methods*

EN 170, *Personal eye-protection — Ultraviolet filters — Transmittance requirements and recommended use*

EN 172, *Personal eye protection — Sunglare filters for industrial use*

EN 388:2003, *Protective gloves against mechanical risks*

EN 420:2003 + A1:2009, *Protective gloves — General requirements and test methods*

EN 471:2003 + A1:2007, *High-visibility warning clothing for professional use — Test methods and requirements*

EN 13087-1:2000 + A1:2001, *Protective helmets — Test methods — Part 1: Conditions and conditioning*

EN 13819-1:2002, *Hearing protectors — Testing — Part 1: Physical test methods*

EN 13819-2:2002, *Hearing protectors — Testing — Part 2: Acoustic test methods*

EN 15090, *Footwear for firefighters*

ASTM F 1868-02, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate*

CIE 54.2, *Retroreflexion — Definition and measurement*

NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1

behind-the-head headband earplug

earplug designed to be worn with the headband passing behind the head

3.2

behind-the-head earmuff

earmuff designed to be worn with the headband passing behind the head

3.3

brim

(helmet) ridge protruding outwards from the basic shape of the shell, forming the lower edge of the shell and including its associated fairings and radiusing

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3.4

char

brittle residue that results when material is exposed to thermal energy

3.5

cleaning cycle

washing and drying cycle or a dry cleaning cycle

3.6

closure system

method of fastening the openings in the garment including combinations of more than one method of achieving a secure closure

NOTE This term does not cover seams.

3.7

clothing assembly

garments designed to always be worn together

NOTE If several garments are used to achieve the performance levels, they are clearly labelled to this effect.

3.8

component assembly

combination of all materials of a multilayer item presented exactly as the finished item's construction

- 3.9**
coverall
overall
one-piece garment that completely covers the wearer's torso, arms and legs
- 3.10**
cuff
<garment> finished edge of the sleeve opening
- 3.11**
cuff
<glove> circular, flared or otherwise expanded part of the glove that extends beyond the opening of the glove body to cover the wrist area
- 3.12**
cup
hollow component that is mounted on the headband of a hearing protector and to which a cushion and a liner are usually fitted
- 3.13**
cushion
deformable component, usually containing a foam plastic or fluid filling, fitted to the rim of the cup to improve the comfort and fit of the earmuffs on the head
- 3.14**
drip, verb
to run or fall in drops or blobs
- 3.15**
dripping, noun
softening with material movement and consequent detachment
- 3.16**
ear flap
part or accessory of the helmet which protects at least the ears of the wearer
- 3.17**
earmuff
hearing protector consisting of a cup that is pressed against each pinna or of a circumaural cup that is pressed against the head around each pinna
- NOTE The cups can be pressed against the head with a headband or by means of a device attached to a helmet or other equipment.
- 3.18**
earplug
hearing protector worn within each of the external ear canals (aural) or in the concha, against the entrance to each of the external ear canals (semi-aural)
- 3.19**
facial opening
opening in the front of the fire hood interfacing with the eye protectors/respiratory protective device facemask
- 3.20**
firefighter's protective clothing
specific garments providing protection for the firefighter's torso, neck, arms and legs, but excluding the head, hands and feet

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3.21**firefighter's protective glove**

specific gloves for protection of the firefighter's hands and wrists

3.22**fire hood**

item worn directly in contact with the head to protect exposed parts of the head and neck not covered by other PPE

3.23**fluorescence**

process by which radiant flux of certain wavelengths is absorbed and reradiated non-thermally in other, usually longer, wavelengths

3.24**garment**

single item of clothing which may consist of single or multiple layers

3.25**glove body**

part of the glove that extends from the tip of the fingers to 25 mm beyond the wrist crease

3.26**hardware**

non-fabric items used in protective clothing, including those made of metal or plastics

EXAMPLE Fasteners, rank markings, buttons and zippers.

3.27**harness**

complete assembly by means of which the helmet is maintained in position on the head, and which may provide a means of absorbing energy

3.28**headband**

(helmet) part of the harness surrounding the head

3.29**headband**

(earmuffs) band, usually of metal or plastics, designed to enable the earmuffs to fit securely around the ears by exerting force against the cups and pressure through the cushions

3.30**headband**

(earplugs) band, usually of metal or plastics, designed to enable the earplug (disposable or re-usable) to be held within (aural) or against (semi-aural) the entrance to the external ear canals by exerting force against the earplug elements

3.31**headband**

(eye protection) part of the eye protector that is fitted around a head to hold the eye protector in position

3.32**headform**

shape replacing the head for testing

NOTE 1 The headform used for testing helmets is designed according to EN 960.

NOTE 2 The headform used for testing eye protection is designed according to EN 168.

NOTE 3 The headform used for testing hearing protection is designed according to EN 13819 (all parts).

**3.33
headstrap**

(earmuffs) flexible strap fitted to each cup or to the headband close to the cup

NOTE The headstrap is designed to support behind-the-head and under-the-chin earmuffs by passing over, and resting on top of, the head.

**3.34
helmet accessory**

additional device approved by the manufacturer, which may be attached to the helmet and which is intended to be removable by the user, but which provides no protection to the wearer

EXAMPLE Lamp bracket and cable clip.

**3.35
helmet for wildland firefighting**

headgear intended to ensure protection of the wearer's head (and optionally the wearer's neck) against hazards that might occur during operations of wildland firefighting

NOTE Hereinafter, the helmet for wildland firefighting is referred to as "helmet".

**3.36
helmet shell**

component in hard material with smooth finish, which gives the helmet its general shape and on which may be fixed various accessories

**3.37
high visibility material
trim**

retroreflective, fluorescent or combination retroreflective and fluorescent material attached to the outer material for visibility enhancement

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NOTE Retroreflective materials enhance night-time visibility and fluorescent materials improve daytime visibility.

**3.38
horizontal clearance**

horizontal distance between the headband and the inside of the shell or any protruding part of the inside of the shell

**3.39
innermost lining**

lining on the innermost face of a component assembly of a garment closest to the wearer's skin

NOTE Where the innermost lining forms part of a material combination, the material combination is regarded as the innermost lining.

**3.40
insertion loss**

mean algebraic difference in decibels between the one-third octave band sound pressure level, measured by the microphone of the acoustic test fixture in a specified sound field under specified conditions, with the hearing protector absent, and the sound pressure level with the hearing protector on, with other conditions identical

**3.41
interface area**

area where items of PPE meet or overlap

EXAMPLE The protective coat/helmet/eyewear/respiratory protective device face piece area, the protective coat/glove area and the protective trouser/footwear area.

3.42**interface component**

item(s) designed to provide limited protection to interface areas

EXAMPLE Fire hood and protective wristlets.

3.43**interlining**

layer between the outermost layer and the innermost lining in a multilayer garment

3.44**liner**

acoustically absorptive material contained within the cup, intended to increase the attenuation of the earmuffs at certain frequencies

3.45**lining**

innermost layer of a component assembly

3.46**main seam**

seam that is necessary to maintain the integrity of the item

3.47**material combination**

material produced from a series of separate layers, intimately combined prior to the item's manufacturing stage

EXAMPLE A quilted material.

3.48**means of fixing**

means by which the ocular of the visor is supported and interfaced with the designated helmet(s)

NOTE This means can be an integral part of the helmet, fixed permanently or temporarily to it, or worn separately, but at the same time as the helmet.

3.49**melt, verb**

to liquefy a material, usually by exposure to heat resulting in a non-reversible change

NOTE For the purposes of this International Standard, melting is observed as the response to heat as evidenced by flowing or dripping.

3.50**mesh**

woven or perforated, metal mesh; moulded, woven or perforated plastic mesh

3.51**mesh face screen**

mesh-type eye protector with mesh face protection that can be worn with a support, directly on the head or in conjunction with a helmet

See Clause 8.

3.52**mesh face screen with additional or alternative ocular(s)**

mesh face screen incorporating one or two additional or alternative protective oculars

3.53

mesh goggle

eye protector with mesh ocular(s), which tightly encloses the orbital area and sits on the face

NOTE Mesh goggles are usually held in position by a headband.

3.54

mesh spectacle

eye protector with mesh oculars mounted in a spectacle-type frame with or without side shield

NOTE Mesh spectacles are usually held in place by temples.

3.55

mesh-type eye protector

mesh spectacles, mesh goggles, mesh face screens or mesh face screens with one or two oculars

3.56

mesh-type eye protector resistant to high-speed particles

mesh-type eye protector that is able to withstand the impact of high-speed particles

NOTE Such a mesh-type eye protector can be used in applications where there exists a risk of impact by high-speed particles together with the need for good ventilation.

3.57

mesh visor

part of a mesh face screen covering the eye area and all or parts of the face, which can be removed from the frame or housing and be replaced

3.58

ocular area

part of a mesh-type eye protector other than the frame, which permits vision

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3.59

ocular

generic term for the light-transmitting part of an eye-protector (made of mesh, mineral or organic material) permitting vision

EXAMPLE Lens, visor and screen.

3.60

ocular additional

ocular used in front of or behind the mesh ocular area to provide supplementary protection

3.61

ocular alternative

ocular replacing the mesh ocular area to provide specific protection

3.62

outer material

outermost material of which the protective clothing is made

3.63

over-the-head earmuff

earmuff designed to be worn with the headband passing over the top of the head

3.64

over-the-head headband earplug

earplug designed to be worn with the headband passing over the top of the head

3.65**peak**

permanent extension of the shell of a helmet above the eyes

3.66**protective coverall**

protective garment designed and configured to provide protection to the neck, torso, arms and legs, excluding the head, hands and feet

3.67**protective garment**

single item of clothing consisting of single or multiple layers

EXAMPLE Protective coat, protective trousers or protective coverall.

3.68**protective hood**

interface component that provides limited protection to the head

See 3.34 and Clause 10.

3.69**protective trousers**

trousers that provide protection to the lower torso and legs, excluding the feet

3.70**protective wristlet**

interface component that provides limited protection to the protective garment/glove interface area

3.71**retention system**

assembly responsible for securing the helmet in position on the head, including items which enable adjustment or improved comfort

3.72**retroreflection**

reflection of light in which the reflected rays are preferentially returned in the direction close to the opposite of the direction of the incident rays, with this property being maintained over wide variations of the direction of the incident rays

3.73**seam**

any method of permanent joining of two or more pieces of textile material

3.74**shell**

helmet shell component in hard material with smooth finish, which gives the helmet its general shape and on which may be fixed various accessories

See 3.36.

3.75**sound attenuation**

for a given test signal, the mean difference in decibels between the threshold of hearing, with and without the hearing protector in place, for a panel of test subjects

3.76**suit**

upper and lower garment worn together that completely cover the wearer's torso, arms and legs