
**Protective clothing for firefighters —
Laboratory test methods and performance
requirements**

*Vêtements de protection pour sapeurs-pompiers — Méthodes d'essai et
exigences de performance*

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11613 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*.

Annexes A, B, C, D and E form a normative part of ISO 11613. Annexes F and G are for information only.

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Introduction

The purpose of this International Standard is to provide minimum performance requirements for protective clothing designed to protect against injury in firefighting operations. It provides guidance on the selection of firefighters' protective clothing (see clause 1) and considerations for conducting a risk assessment of firefighting risks (see annex F).

Two alternative approaches to the design and performance requirements for firefighting clothing are provided.

- Approach A Clause 4 specifies design and performance requirements based on EN 469 *Protective Clothing for Firefighters — Requirements and test methods for protective clothing for firefighting* and its clarification documents.
- Approach B Clause 5 specifies design and performance requirements based on NFPA 1971 *Standard on Protective Clothing for Structural Firefighting*.

A comparison of the requirements in clauses 4 and 5 is given in annex G. The two approaches are not directly comparable as they use different test procedures.

This International Standard has been prepared to fulfil the requirements of a number of countries and it combines both European and North American approaches. It is agreed that a revision of this International Standard will start immediately after its publication in order to specify levels of performance on single test methods and to take into account any changes in revision of both EN 469 and NFPA 1971.

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

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Protective clothing for firefighters — Laboratory test methods and performance requirements

1 Scope

This International Standard specifies test methods and minimum requirements for protective clothing to be worn during firefighting and associated activities where there is a risk of heat and/or flame.

This International Standard covers the general clothing design, the minimum performance levels of the materials used, and the methods of test for determining these performance levels. Clauses 4 and 5 define two separate sets of design and performance requirements.

This International Standard does not cover special clothing for use in other high risk situations such as specialized firefighting, or clothing for use in long term firefighting operations in high ambient temperature, for example brush, wildland, or forest firefighting. It does not cover protection for the head, hands and feet or protection against other hazards, for example chemical, biological, radiation and electrical hazards. These aspects may be dealt with in other standards.

Selection of the appropriate system of clothing is dependent on carrying out 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. Details on one example of a recommended risk assessment approach and some factors for consideration are included in annex F.

NOTE Additional personal protective equipment to protect the head, hands, and feet should be worn with clothing specified in this International Standard and in majority of situations breathing apparatus is also required to be worn. Firefighters should be trained in the use and care of protective clothing covered by this International Standard including an understanding of its limitations and of the other items of personal protective equipment that may be required depending on the risks encountered.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 811:1981, *Textile fabrics — Determination of resistance to water penetration — Hydrostatic pressure test.*

ISO 3146:1985, *Plastics — Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers.*

ISO 3175-2:1998, *Textiles — Dry cleaning and finishing — Part 2: Procedures for tetrachloroethene.*

ISO 4674:1977, *Fabrics coated with rubber or plastics — Determination of tear resistance.*

ISO 4920:1981, *Textiles — Determination of resistance to surface wetting (spray test) of fabrics.*

ISO 5077:1984, *Textiles — Determination of dimensional change in washing and drying.*

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ISO 5081:1977, *Textiles — Woven fabrics — Determination of breaking strength and elongation (Strip method)*.

ISO 5082:1982, *Textiles — Woven fabrics — Determination of breaking strength — Grab method*.

ISO 6330:1984, *Textiles — Domestic washing and drying procedures for textile testing*.

ISO 6530:1990, *Protective clothing — Protection against liquid chemicals — Determination of resistance of materials to penetration by liquids*.

ISO 6942:1993, *Clothing for protection against heat and fire — Evaluation of thermal behaviour of materials and material assemblies when exposed to a source of radiant heat*.

ISO 9073-4:1997, *Textiles — Test methods for nonwovens — Part 4: Determination of tear resistance*.

ISO 9151:1995, *Protective clothing against heat and flame — Determination of heat transmission on exposure to flame*.

ISO 9227:1990, *Corrosion tests in artificial atmospheres — Salt spray tests*.

ISO 13688:1998, *Protective clothing — General requirements*.

ISO 15025:—¹⁾, *Protective clothing — Protection against heat and flame — Method of test for limited flame spread*.

ISO 17492:—¹⁾, *Clothing for protection against heat and flame — Determination of heat transmission on exposure to both flame and radiant heat*.

ISO 17493:—¹⁾, *Clothing for protection against heat and flame — Determination of convective heat resistance using a hot air circulating oven*.

EN 532:1994, *Protective clothing — Protection against heat and flame — Test method for limited flame spread*.

ASTM E 809:1981, *Standard Practice for Measuring Photometric Characteristics of Retroreflectors*.

3 Terms, definitions and symbols

For the purposes of this International Standard, the following terms, definitions and symbols apply.

3.1 Terms and definitions

3.1.1

cargo pockets

pockets located on the protective garment exterior

NOTE As used in clause 5.

3.1.2

char

formation of a brittle residue when material is exposed to thermal energy

3.1.3

collar lining

that part of the collar fabric composite that is next to the skin when the collar is closed in the raised position

¹⁾ To be published.

3.1.4**composite**

layer or layers that provide protection required of outer shell, moisture barrier, and thermal barrier

3.1.5**closure system**

method of fastening openings in the garment including combinations of more than one method of achieving a secure closure, for example a slide fastener covered by an overlap fastened down with a touch and close fastener

NOTE This term does not cover seams.

3.1.6**component assembly**

material combination found in a multilayer garment arranged in the order of the finished garment construction and including any inner liner

3.1.7**drip**

to run or fall in drops or blobs

3.1.8**firefighters' protective clothing**

specific garments providing protection for the firefighter's upper and lower torso, neck, arms, and legs, but excluding the head, hands, and feet

3.1.9**garment**

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

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3.1.10**hardware**

non-fabric components of protective clothing including those made of metal or plastic material

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NOTE Examples include fasteners, rank markings, buttons, etc.

3.1.11**innermost lining**

lining found on the innermost face of a component assembly

3.1.12**integral melting**

liquefaction of a material when exposed to heat to the extent of causing a hole in its structure, either by shrinking and/or dripping away under specified test conditions

NOTE See 5.1 and 5.5.

3.1.13**interface area**

area of the body not protected by a protective garment, helmet, gloves, footwear, or self-contained breathing apparatus (SCBA) facepiece; the area where the protective garments and the helmet, gloves, footwear, or SCBA facepiece meet, i.e., the protective coat/helmet/SCBA facepiece area, the protective coat/glove area, and the protective trouser/footwear area

3.1.14**interface component**

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

3.1.15

interlining

layer found between the outermost layer and the innermost lining in a multilayer garment, not next to the wearer's skin

3.1.16

manufacturer

entity that assumes the liability and provides the warranty for the compliant product

NOTE As used in clause 5.

3.1.17

material combination

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

EXAMPLE A quilted fabric.

3.1.18

melt

to change from solid to liquid form, or become consumed by action of heat

3.1.19

moisture barrier

that portion of the protective garment designed to prevent the transfer of liquid water from the environment to the thermal barrier

NOTE As used in clause 5.

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3.1.20

moisture barrier

fabric or membrane used in a component assembly to enable the properties of the assembly to comply with the manufacturer's claims concerning hydrostatic pressure and water vapour permeability

NOTE As used in clause 4.

3.1.21

multilayer clothing assembly

series of layers of garments arranged in the order as worn

NOTE It may contain multilayer materials, material combinations or separate layers of clothing material in single layers.

3.1.22

outer material

outermost material of which the protective clothing is made

3.1.23

outer shell

outside facing portion of the composite with the exception of trim, hardware, reinforcing material, and wristlet material

NOTE As used in clause 5.

3.1.24

protective clothing

protective garments, configured as a coat and trousers or as a coverall, and interface components that are designed to provide protection to the firefighter's body

3.1.25**protective coat**

protective garment designed and configured to provide protection to upper torso and arms, excluding the hands and head

3.1.26**protective overall**

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

3.1.27**protective garment**

single item of clothing which may consist of single or multiple layers, for example protective coat, protective trouser, or protective overall

3.1.28**protective hood**

interface component that provides limited protection to the protective coat/helmet/SCBA facepiece interface area

3.1.29**protective trouser**

provides protection to lower torso and legs excluding the feet

3.1.30**protective uniform garment**

garment designed and configured to be both the thermal barrier or portion of the thermal barrier of a protective garment, and a station/work uniform

NOTE 1 As used in clause 5.

NOTE 2 The term refers specifically to station/work uniform garments that satisfy the applicable requirements of NFPA 1975, *Standard on Station/Work Uniforms for Firefighters*, and that also satisfy in part or in full the thermal barrier requirements of this International Standard.

3.1.31**protective wristlet**

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

3.1.32**removable inner liner**

inner garment designed to be attached or to be worn separately under an outer garment in order to provide thermal insulation

3.1.33**seam**

junction of two edges of material which are permanently attached in the garment by sewing or any other method

3.1.33.1**major A seams**

outer-shell seam assemblies where rupture could reduce the protection of the garment by exposing the moisture barrier, thermal barrier, the wearer's station/work uniform, other clothing, or skin

NOTE As used in clause 5.

3.1.33.2**major B seams**

moisture barrier or thermal barrier seam assemblies where rupture could reduce the protection of the garment by exposing the next layer of the garment, the wearer's station/work uniform, other clothing, or skin

NOTE As used in clause 5.

3.1.33.3

minor seams

remaining seam assemblies that are not classified as major A or major B seams

3.1.34

thermal barrier

that portion of the composite designed to provide thermal protection

3.1.35

trim

retroreflective and fluorescent material attached to the outer shell for visibility enhancement; retroreflective materials enhance night-time visibility, and fluorescent materials improve daytime visibility

3.1.36

undergarment

garment which is worn under an outer garment

3.1.37

winter liner

optional composite layer designed to provide added insulation against cold

3.2 Symbols and subscripts

3.2.1 Symbols

A_r total retroreflective trim surface area

A_p total surface area of the plate

C_l coefficient of luminous intensity

C_r coefficient of reflectivity

H heat power input

I_m permeability index

I_Q heat transmission index

I_T thermal protection index

m mass

p water pressure

p_a water pressure of the ambient environment

p_p water pressure at the plate surface

Q_{tot} total heat loss

R_e evaporative resistance

$R_{e,in}$ intrinsic evaporative resistance of the test specimen

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$R_{e,p}$	evaporative resistance of the bare plate
$R_{e,tot}$	total evaporative resistance
R_T	thermal resistance
$R_{T,in}$	intrinsic thermal resistance of the test specimen
$R_{T,p}$	thermal resistance of the bare plate
$R_{T,tot}$	total thermal resistance
T	temperature
T_a	temperature of the ambient environment
T_p	temperature of the bare plate
t_1, t_2	time necessary to reach the levels 1 and 2
w	mass fraction expressed as a percentage
w_w	mass fraction of water absorbed

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3.2.2 Subscripts

a	ambient environment
f	final
i	initial
in	intrinsic
p	plate or bare plate
tot	total
w	water

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4 Design and performance requirements — Approach A

4.1 General

This clause specifies test methods and minimum requirements for protective clothing to be worn during firefighting and associated activities where there is a risk of heat and/or flame.

It covers the general clothing design, the minimum performance levels of the materials used, and the methods of test for determining these performance levels. Performance levels in this clause are based on EN 469^[1].