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# Station uniform for firefighters

*Tenue de travail pour les pompiers*



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# Foreword

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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 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).

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. 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 — Personal protective clothing* , Subcommittee SC 14, *Firefighters' personal equipment*.

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

This document provides two levels of performance requirements for station uniforms that may be provided by agencies that should be worn under primary protection garments compliant with the relevant standards.

Level 1 is intended to provide limited protection and minimise harm through no melt and no drip performance of materials, when exposed to accidental heat or flame.

Level 2 is intended to provide minimum protection in case of flame impingement or heat exposure.

The level 2 garment can also be combined with additional garments to contribute to the primary protection, such as turn-out-gear described in ISO 11999-3. In this case, level 2 will fulfil the minimum heat and flame requirements of this document and the level 2 garment in combination with additional layers will fulfil the requirements of the specific primary protection garment for the specific higher level standard (e.g. turn out gear standards, wildland).

Station uniforms are intended to provide the highest comfort possible through the use of materials that meet required performance requirements and ergonomics of design.

This document is largely based on ISO 11612, which has been frequently used as a basis to develop and specify station wear.

Attention is drawn to ISO/TR 21808, which sets out guidelines for selection, use, care, and maintenance of protective clothing against heat and flame for firefighters.

The level of protection required should be determined using a risk assessment process (see Annex A).

# Station uniform for firefighters

## 1 Scope

This document sets out minimum performance requirements for station uniforms for firefighters that are provided by agencies to be worn under primary protective garments compliant with the relevant standards.

NOTE A station uniform, as defined by this document, is understood to not be a formal uniform or parade uniform, which are not likely to be worn under primary protective firefighting garments.

Garments developed in accordance with this document complement the performance built into primary protection firefighting garments in terms of minimising impact on hindrance, metabolic heat and comfort.

This document specifies two levels of requirements for station uniforms:

— Level 1 specifies minimum no melting nor dripping requirements that provide no additional protection but ensure the firefighter is not harmed by the melting of station uniform materials in cases where heat or flames impinge the station uniform.

— Level 2 specifies heat and flame requirements to provide minimum protection. It can be combined with additional layers or garments to meet the requirements of a standard for a specific primary protection garment, this combination should provide improved protection and comfort.

## 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 105-B02, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test*

ISO 105-C06, *Textiles — Tests for colour fastness — Part C06: Colour fastness to domestic and commercial laundering*

ISO 105-D01, *Textiles — Tests for colour fastness — Part D01: Colour fastness to drycleaning using perchloroethylene solvent*

ISO 105-E04, *Textiles — Tests for colour fastness — Part E04: Colour fastness to perspiration*

ISO 105-X12, *Textiles — Tests for colour fastness — Part X12: Colour fastness to rubbing*

ISO 3175-2, *Textiles — Professional care, drycleaning and wetcleaning of fabrics and garments — Part 2: Procedure for testing performance when cleaning and finishing using tetrachloroethene*

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

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

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

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 13937-2, *Textiles — Tear properties of fabrics — Part 2: Determination of tear force of trouser-shaped test specimens (Single tear method)*

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

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

ISO 14116, *Protective clothing — Protection against heat and flame — Limited flame spread materials, material assemblies and clothing*

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

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

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

EN 1149-1, *Protective clothing — Electrostatic properties — Part 1: Test method for measurement of surface resistivity*

EN 1149-3, *Protective clothing — Electrostatic properties — Part 3: Test methods for measurement of charge decay*

EN 1149-5, *Protective clothing — Electrostatic properties. Material performance and design requirements*



## 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 http://www.electropedia.org/

**3.1**
**hole**
opening, break, or discontinuity of any size not present in the original structure of the test specimen's fabric caused by application of the test challenge (e.g. flame, abradant or abrasion)

**3.2**
**primary protection**
level of protection afforded by garment(s) needed to protect against hazards related to the incident worn over the station uniform

**3.3**
**primary protective garment**
single item of clothing which may consist of single or multiple layers to provide protection against one or more hazards

EXAMPLE Protective coat, protective trouser, or protective coverall.

**3.4**
**primary protective clothing**
clothing which covers or replaces personal clothing and which is designed to provide protection against one or more hazards

**3.5**
**station uniform**
form of clothing worn by firefighters whilst carrying out a range of tasks that do not require the protection provided by primary firefighting garments

Note 1 to entry: Other terms also used are station wear, work wear, but understood not to be a formal uniform or parade uniform, which are not likely to be worn under primary protective firefighter garments.

**3.6**
**structural seam**
seams that are necessary for the integrity of the garment

# 4 General and design requirements

## 4.1 General

General requirements which are not specifically covered in this document shall be in accordance with ISO 13688.

## 4.2 Innocuousness

Acceptability of materials shall be according to ISO 13688:2013, 4.2.

## 4.3 Station uniform

Station uniforms shall be designed to meet the needs of firefighters carrying out tasks that do not require protection against hazards related to incident activities. This document does not provide for protection of the hands, feet, or head of the firefighter.

It is essential that the station uniform is compatible with all items of clothing and PPE being worn. It shall not cause impairments to the wearer whilst being worn.

Station uniforms should be designed with the understanding that their performance and comfort are determined by the nature of the work being undertaken, the metabolic rate, ambient temperature and compatibility with primary protective clothing worn in conjunction with them.

Station uniforms may consist of the following:

— a single protective garment, e.g. one-piece coverall that conforms to either level 1 or level 2 of this standard;

— multiple protective garments, e.g. a two-piece combination (i.e. shirt/trouser) that conforms to either level 1 or level 2 of this standard.

Fire services shall determine the type of garment(s) to be worn as a station uniform based on the tasks to be undertaken whilst wearing it. To this effect, this document proposes two levels of requirements:

— Level 1: a level 1 garment provides limited protection and minimises wearer harm through no melt and no drip performance when exposed to accidental heat or flame.

— Level 2: meets minimum heat and flame requirements as indicated in Clause 6. It can be designed to be worn as part of the primary protection.

Clothing made from the following types of meltable fabrics, either alone or in blends, shall not be used by level 1 or level 2 garments, unless the manufacturer can demonstrate that the fabric has been treated to withstand the conditions that may be encountered in such a manner as to eliminate the melt or drip hazard involved, e.g. with acetate, nylon, polyester.

In the case of level 2, if, for example, separate garments (e.g. station uniforms) are combined in a multi-layer clothing assembly, to meet the minimum protection levels of the primary protection garment standard, they must be tested together and meet the minimum performance requirements.

This document contains the performance, design and testing requirements for station uniforms that may be issued by fire services to their firefighters. It specifies basic heat and thermal stability requirements of the material used to manufacture the garments.

This document is not applicable to a firefighter's private underwear which may be worn under station uniforms and/or primary protection firefighting garments. It also does not apply to the primary protection firefighting garments which may be worn over the top of these garments. Additionally, it does not refer to fire services formal uniform or parade uniform, which is different from a station uniform.

Nothing in this document shall restrict the manufacturer or the fire service from exceeding the requirements of this document.



## 5 Sampling and pre-treatment

### 5.1 Sampling

The number of samples and the size of the specimens of garment materials or garments presented to the different test methods, shall be in accordance with the respective test standards specified in the requirements Clauses 6 to 8. Samples for testing shall be taken from the original garment or shall be representative of the component assembly.

### 5.2 Pre-treatment

Before each test specified in Clause 6, except 6.6 and 6.7, the test materials and test specimens shall be pre-treated by washing. In addition, 6.2 and 6.4.2 require that the limited flame spread tests and heat transfer (radiation) test shall be carried out both before the pre-treatment and after the pre-treatment, if washing is allowed.

If the manufacturer's instructions indicate that cleaning is not allowed, i.e. single use garments, then testing shall be carried out on new material.

The tests shall be carried out after five washing cycles.

The samples shall be subjected to a washing with a normal load in a front loading horizontal drum machine using non-phosphate reference detergent n°3 in soft water in accordance with the procedures of ISO 6330 at 60 °C normal wash (6N). The drying procedure shall be F (machine Type A1) — tumble dry at normal temperature (max 80 °C) measured at the outlet temperature.

If the garment can be washed and dry-cleaned, it shall only be washed. If only dry-cleaning is allowed, the garment shall be dry-cleaned for five cleaning cycles in accordance with ISO 3175-2.

### 5.3 Conditioning

Specimens shall be conditioned for at least 24 h in an atmosphere having a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %.

Testing shall be carried out within 5 min of removal from this atmosphere.

## 6 General performance requirements

### 6.1 General

Protective garments that comply with this document shall meet the requirements of Clause 6 where specified. A summary of the requirements is given in Table 1.

**Table 1 — Summary of requirement for station uniforms**

| Performance category | Clause | Performance requirement | Level 1 | Level 2 |
|---|---|---|---|---|
| **Thermal requirements** | 6.2-6.3 | | | |
| Limited flame spread | 6.2 | according to ISO 14116 | Index 2 | Index 3 |
| Heat resistance | 6.3.1 | ISO 17493 (180 + 5/−0) °C for 5 min, no material shall melt, drip, ignite nor shrink >5 % | Required | Required |
| | 6.3.2 | ISO 17493 (260 + 5/−0) °C for 5 min, no materia shall melt, drip, ignite nor shrink >10 % | | Required |
| Heat transfer (convective) | 6.4.1 | ISO 9151, shall meet at least value of $HTI_{24}$ ≥ 4 s | | Required |
| Heat transfer (radiation) | 6.4.2 | ISO 6942 Method B, 20 kW/$m^2$,$RHTI_{24}$ ≥ 7 s | | Required |
| **Dimensional change** | 6.5 | ISO 5077, woven material (length or width direction) ≤5 % and for knitted materials ≤8 % | Required | Required |
| **Physical requirements** | 6.6 | | | |
| Tensile strength (woven materials) | 6.6.1 | ISO 13934-1 ≥ 300 N | Required | Required |
| Tear strength (woven materials) | 6.6.2 | ISO 13937-2 ≥ 10 N | Required | Required |
| Burst strength (knitted materials) | 6.6.3 | ISO 13938-1 or ISO 13938-2, ≥260 kPa, using a 7,3 $cm^2$ test area or ≥100 kPa when using a 50 $cm^2$ test area | Required | Required |
| Structural seam strength | 6.6.4 | ISO 13935-2 ≥225 N for coveralls and trouser, and ≥150 N for shirts | Required | Required |
| Abrasion resistance | 6.6.5 | ISO 12947-2, 12 kPa, ≥15 000 rubs | Optional | Optional |
| **Ergonomic and comfort requirements** | 6.7 | | | |
| Thermal resistance | 6.7.1 | ISO 11092, <0,055 $m^2$ K/W | Required | Required |
| Water vapour resistance or | 6.7.2 | ISO 11092, <7 $m^2$ Pa/W | Required | Required |

**Table 1** *(continued)*

| Performance category | Clause | Performance requirement | Level 1 | Level 2 |
|---|---|---|---|---|
| Colour fastness | 6.9 | ISO 105-B02, Method 1 (artificial light)<br>ISO 105-X12 (rubbing)<br>ISO 105-C06 (laundering) or ISO 105-D01(dry-cleaning)<br>ISO 105-E04 (perspiration) | Optional | Optional |
| Electrostatic resistance | 6.8 | EN 1149-5 or equivalent | Optional | Optional |

## 6.2 Limited flame spread

### 6.2.1 General

Testing of materials, except for seams, shall take place in accordance with ISO 15025, Procedure A. This test shall be carried out both before and after the pre-treatment specified in 5.2.1.

### 6.2.2 Testing in accordance with ISO 15025, Procedure A

**6.2.2.1** When tested in accordance with ISO 15025, Procedure A, all specimens shall meet the following requirements in ISO 14116 as reproduced in Table 2:

**Table 2 — Limited flame spread performance**

| Properties | Level 1 requirement – index 2 | Level 2 requirement – index 3 |
|---|---|---|
| Flame spread | No specimen shall permit any part of the lowest boundary of any flame to reach the upper or either vertical edge. | No specimen shall permit any part of the lowest boundary of any flame to reach the upper or either vertical edge. |
| Flaming debris | No specimen shall give flaming or molten debris. | No specimen shall give flaming or molten debris. |
| Hole formation | No specimen shall give hole formation of 5 mm or greater in any direction, except for an interlining that is used for specific protection other than heat and flame protection. | No specimen shall give hole formation of 5 mm or greater in any direction, except for an interlining that is used for specific protection other than heat and flame protection. |
| Afterglow | Afterglow time shall be ≤2 s.<br>A glowing inside the charred area is defined in ISO 15025 as afterglow without combustion and for the purpose of this clause is not regarded as afterglow. | Afterglow time shall be ≤2 s.<br>A glowing inside the charred area is defined in ISO 15025 as afterglow without combustion and for the purpose of this clause is not regarded as afterglow. |
| Afterflame | Afterflame time shall be ≤2 s. | Afterflame time shall be ≤2 s. |

For seams, three specimens containing a structural seam shall be tested in accordance with ISO 15025, Procedure A. Specimens shall be oriented with the seam running up the centreline of the outer surface of the test specimen so that the burner flame impinges directly upon the seam. Seams shall not separate. Seams shall be tested only after pre-treatment according to 5.2.1.

**6.2.2.2** Hardware, whether it is exposed or covered when all closure systems in the garment are in the closed position, shall be tested separately, using ISO 15025, Procedure A, after the pre-treatment specified in 5.2. Samples shall be taken in combination with the garment layer(s) to make it possible to have samples with the dimensions as indicated in ISO 15025, Procedure A. Three specimens containing the hardware shall be tested.

When the hardware is covered, the flame shall be applied to the outer surface of the component assembly containing hardware exactly as designed in the garment so that the burner flame impinges

directly upon where the hardware is located. When the hardware is directly exposed, the flame shall be applied directly upon the hardware.

When the hardware is covered when all closure systems in the garment are in the closed position, the assembly shall meet the requirements of 6.2.2.1. At 5 min after completion of the test, it shall be verified that the closure system can be opened at least once.

When the hardware is directly exposed, it shall comply with: no specimen shall melt or give flaming or molten debris; the afterglow time shall be ≤2 s, and the after flame time shall be ≤2 s. At least 5 min after completion of the test, it shall be verified that the closure system can be opened at least once.

**6.2.2.3** Items like labels, badges, high visibility materials, and transfers which are applied to the outer surface of the garment, shall be tested in combination with the outer layer to make it possible to take samples with the dimensions as indicated in ISO 15025, Procedure A. Three specimens containing the item shall be tested. The items shall be oriented with the longer dimensions running up the centreline of the test specimen so that the burner flame impinges directly upon the middle surface of the item, not the edge. The combination with the surface layer of the garment shall meet the requirements of 6.2.2.1. This requirement is not applicable for labels, embroideries, or other added decorations with a surface area of less than 10 $cm^2$.

## 6.3 Heat resistance

### 6.3.1 Heat resistance at a temperature of (180 + 5/−0) °C

All materials and hardware, including high visibility materials used in the garment and/or clothing assembly shall be tested according to ISO 17493 at a temperature of (180 + 5/−0) °C for an exposure time of 5 min. Materials can be either tested separately or as assembled in the garment. Test samples shall not ignite or melt and shall not shrink by more than 5 %. At least 5 min after completion of the test, it shall be verified that the closure system can be opened at least once.

### 6.3.2 Heat resistance at a temperature of (260 + 5/−0) °C (optional)

The material of a single layer garment, which is intended to be worn next to the skin, shall be tested according to ISO 17493 at a temperature of (260 + 5/−0) °C for an exposure time of 5 min. The material shall not ignite, melt or drip and shall not shrink by more than 10 % in addition to meeting the requirements of 6.3.1.

NOTE Heat shrinkage has the potential to reduce the thermal protection level of the garment as it reduces the insulating air pocket between the garment and the body. Therefore, heat shrinkage in heat and flame protective garments is limited, especially in cases where a heat or flame hazard exists that could impinge a large percentage area of the garment.

## 6.4 Heat transmission performance requirements (required for level 2 only)

### 6.4.1 Convective heat

When tested in accordance with ISO 9151, all specimen clothing shall meet $HTI_{24} \geq 4$ s.

### 6.4.2 Radiant heat

When tested, before and after pre-treatment according to 5.2.1, in accordance with ISO 6942 Method B at a heat flux density of 20 kW/$m^2$, all specimens shall meet $RHTI_{24} \geq 7$ s.

## 6.5 Dimensional change of textile materials

Dimensional change shall be measured after samples have undergone pre-treatment according to 5.2.1.

The change in dimensions of woven shall not exceed ±5 %, for each specimen, in either length or width direction when measured in accordance with ISO 5077.

The change of dimensions of knitted materials shall not exceed ±8 %, for each specimen, in either length or width direction when measured in accordance with ISO 5077.

Dimensional change shall be measured after the specimen has been uncreased and flattened on a plane surface.

## 6.6 Physical requirements

### 6.6.1 Tensile strength of woven materials

When tested in accordance with ISO 13934-1, woven materials, without pre-treatment according to 5.2.1, shall have a minimum tensile strength of 300 N in both the machine and cross directions.

### 6.6.2 Tear strength of woven materials

When tested in accordance with ISO 13937-2, woven materials, without pre-treatment according to 5.2.1, shall have a mean tear strength of ≥10 N in both the machine and cross directions.

### 6.6.3 Bursting strength of knitted materials

When tested in accordance with ISO 13938-1 or ISO 13938-2, the burst strength of knitted material, without pre-treatment according to 5.2.1, shall have a minimum strength of 260 kPa using a 7,3 $cm^2$ test area, or shall have a minimum strength of 100 kPa using a 50 $cm^2$ test area.

### 6.6.4 Structural seam strength

When tested in accordance with ISO 13935-2, structural seams of woven materials, without pre-treatment according to 5.2.1, shall have a minimum seam strength of 225 N for coveralls and trousers, and minimum seam strength of 150 N for shirts.

### 6.6.5 Abrasion resistance (optional)

The outer layer when tested in accordance with ISO 12947-2 at 12 kPa with crossbred worsted abradant shall achieve a minimum of 15 000 abrasion rubs to end point. This test shall only be carried out on woven fabric. Knitted fabric is exempted from abrasion test.

Checks of the sample material shall be carried out every 500 rubs above 10 000 rubs.

## 6.7 Ergonomic and comfort requirements

### 6.7.1 Thermal resistance

When tested in accordance with ISO 11092, the mean thermal resistance of the material or material combination shall give a thermal resistance: <0,055 $m^2$ K/W (in line with ISO 15384:2018 also a single layer garment).

### 6.7.2 Water vapour resistance

When tested in accordance with ISO 11092, the mean water vapour resistance of material or material combination shall give a water vapour resistance: <7 $m^2$ Pa/W.

NOTE This test is only valid for base materials and not applicable for areas such as knee pads and retroreflective material.