INTERNATIONAL STANDARD

**ISO 15383**

First edition
2001-09-01

# Protective gloves for firefighters — Laboratory test methods and performance requirements

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

Reference number
ISO 15383:2001(E)

**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.



ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed 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.

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 15383 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*.

Annexes A to C form a normative part of this International Standard. Annexes D and E are for information only.

# Introduction

This International Standard specifies three types of gloves with different performance requirements. Type 1 gloves provide the lowest level of performance. Criteria for these gloves were partly based on requirements considered suitable for wildland fire fighting with certain requirements consistent with the same level of protection provided by clothing as specified in ISO 15384. Type 2 gloves provide an intermediate level of performance. The performance requirements for Type 2 gloves are based partly on EN 659 but uses some of the criteria from EN 469 for thermal and heat protection. Type 3 gloves provide the highest level of performance. The performance requirements for Type 3 gloves have been adapted from NFPA 1971. Three levels of performance are established for all performance requirements except for flame resistance and ergonomic requirements. In some cases, two of the levels require the same performance. The intent of this International Standard is to specify a level of glove performance consistent with the performance of the garments worn, where practical.

This International Standard also provides guidance on selection of firefighter's protective gloves and considerations for conducting a risk assessment of protective gloves. The selection of firefighter gloves should be based on a risk assessment.

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

A list of standards related to this International Standard is given in the Bibliography.

# Protective gloves for firefighters — Laboratory test methods and performance requirements

## 1 Scope

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

The purpose of this International Standard is to provide minimum performance requirements for protective gloves designed to protect against injury in fire fighting operations.

This International Standard covers the general glove design, the minimum performance levels of the materials used and the methods of test for determining these performance levels. With the exception of flame resistance and ergonomic requirements, this International Standard establishes three levels of performance for all other performance requirements. Type 3 gloves provide a higher level of thermal insulation and physical protection, and require liquid penetration resistance (including synthetic blood) as compared to Type 2 gloves. Type 1 gloves are intended to provide minimum requirements for gloves in any fire fighting application, such as for wildland fire fighting. Annex E provides a comparison of the performance requirements for all three glove types.

This International Standard does not cover special gloves for use in other high risk situations such as specialized fire fighting. It does not cover protection for the head, torso, arms, legs and feet or protection of the hands against other hazards, e.g. chemical, biological, radiation and electrical hazards, except for limited, accidental exposure to fireground chemicals and contaminated blood or body fluids (Type 3 gloves). These aspects may be dealt with in other standards.

Selection of the appropriate system of clothing, including gloves, is dependant on carrying out an effective risk assessment which identifies the hazards to be faced, evaluates the likelihood of those hazards and provides the means of reducing or eliminating these hazards. Guidelines for conducting a risk assessment and some factors for consideration are included in annex D.

## 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 139, *Textiles — Standard atmospheres for conditioning and testing*.

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

ISO 5470-1, *Rubber- or plastics-coated fabrics — Determination of abrasion resistance — Part 1: Taber abrader*.

ISO 6330: 2000, *Textiles — Domestic washing and drying procedures for textile testing*.

ISO 6942:—[1)], *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 12127, *Clothing for protection against heat and flame — Determination of contact heat transmission through protective clothing or constituent materials*.

ISO 13688, *Protective clothing — General requirements*.

ISO 13994:1998, *Clothing for protection against liquid chemicals — Determination of the resistance of protective clothing materials to penetration by liquids under pressure*.

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

EN 388:1994, *Protective gloves against mechanical risks*.

EN 420:1994, *General requirements for gloves*.

## 3 Terms and definitions

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

**3.1**
**component assembly**
combination of all materials of a multi-layer glove presented exactly as the finished glove construction

**3.2**
**drip**, ver**b**
to run or fall in drops or blobs

**3.3**
**firefighters' protective gloves**
specific gloves providing protection for the firefighters' hands and wrists

**3.4**
**firefighters' protective clothing**
specific garments providing protection for the firefighters' upper and lower torso, neck, arms and legs, but excluding the head, hands and feet

**3.5**
**cuff**
that circular, flared or otherwise expanded part of the glove that extends beyond the opening of the glove body to cover the wrist area

1) To be published. (Revision of ISO 6942:1993)

**3.6**
**glove body**
that part of the glove that extends from the tip of the fingers to 25 mm beyond the wrist crease

**3.7**
**innermost lining**
lining of the innermost face of a component assembly closest to the wearer's skin

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

**3.8**
**melt**, verb
to liquefy a material 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.

**3.9**
**main seam**
seam that is necessary for the integrity of the glove

**3.10**
**moisture barrier**
that portion of the component assembly designed to prevent the transfer of liquids

NOTE Moisture barriers might not prevent the passage of chemical, biological or radiological agents through the glove. Such incidents should be handled with appropriate chemical protective clothing and procedures.

**3.11**
**outer material**
outermost material of which the protective glove is made

**3.12**
**seam**
any method of permanent fastening between two or more pieces of material

**3.13**
**wristlet**
circular, close-fitting part of the glove, usually made of knitted material, that extends beyond the opening of the glove body to cover the wrist area

NOTE May be contained within a cuff.

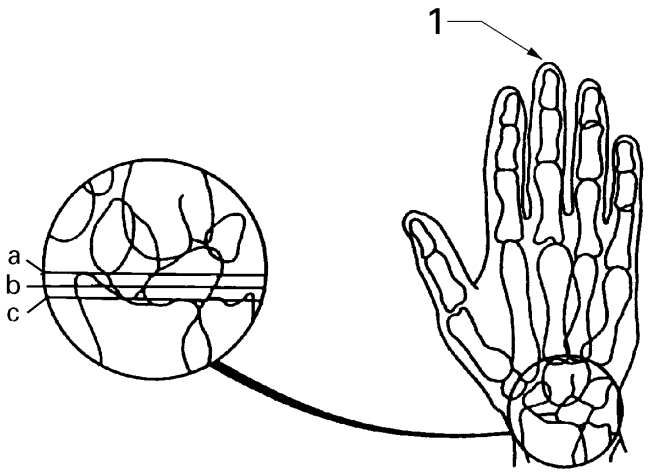
## 4 Design requirements

### 4.1 Component assembly

Gloves shall consist of a component assembly meeting the performance requirements of this International Standard. This component assembly shall be permitted to be configured as a continuous or joined single layer, or as continuous or joined multiple layers.

### 4.2 Glove body length

The glove body shall extend circumferentially beyond the wrist crease not less than 25 mm. The location of the wrist crease shall be determined as shown in Figure 1.




**Key**

1 Dactylion III

a Stylion

b Wrist crease

c Proximal edge of navicular

**Figure 1 — Anatomical landmarks at base of hand**

## 4.3 Wristlet or cuff

Gloves shall be permitted to be provided with either a cuff or a wristlet or both. Where gloves are provided with a cuff or a wristlet, the sample glove body and the cuff or wristlet shall extend circumferentially at least 50 mm beyond the wrist crease, taking into consideration the requirement specified in 4.2. Where gloves are not provided with a cuff or a wristlet, the sample glove body shall extend circumferentially at least 50 mm beyond the wrist crease which is a 25 mm addition to the requirement specified in 4.2.

## 4.4 Glove sizing

### 4.4.1 Minimum sizing

Gloves shall be provided in a minimum of 6 unique and distinct sizes. The manufacturer shall indicate the range in hand circumference and hand length for wearers of each glove size as determined in 4.4.2.

NOTE The intent of this requirement is to allow manufacturers to report information to the user that assists in their selection of the appropriate size. Standard sizes are not defined by this International Standard.

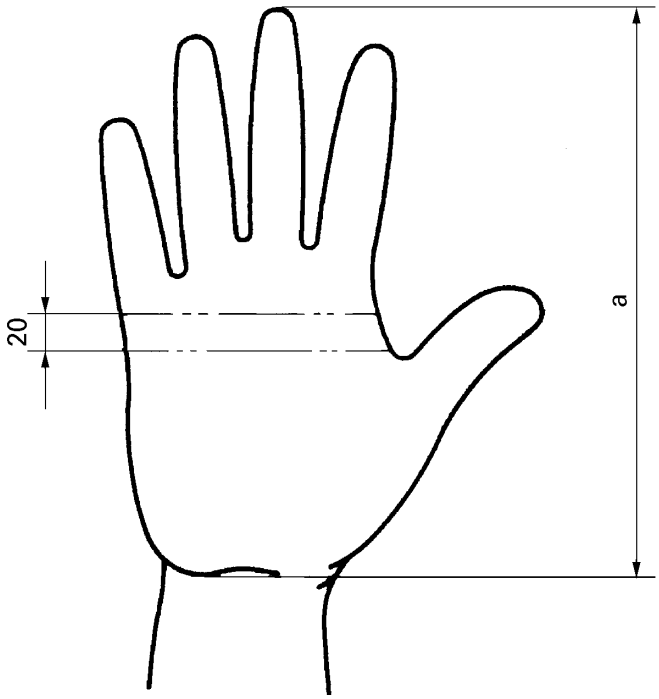
### 4.4.2 Hand dimensions

Hand dimensions for selection of proper glove size shall consist of measuring two dimensions, hand circumference and hand length, as shown in Figure 2.

Hand circumference shall be measured by placing the measuring tape on a table or other flat surface with the numerals facing downward. The subject shall place the right hand, palm down and fingers together, in the middle of the tape so that the tape can pass straight across the knuckles (metacarpals). The circumference shall be measured to the nearest millimetre, 20 mm from the crotch between thumb and index finger as shown in Figure 2.

Hand length shall be measured by placing the subject's hand, palm down, on a piece of paper with the fingers together and the hand and arm in a straight line. The thumb shall be fully abducted, extended away from the palm as far as possible. The paper shall be marked at the tip of the third, or middle, finger. A pencil mark shall be placed in the notch at the base of the thumb where the thumb joins the wrist. The straight line distance between the two points shall be measured to the nearest millimeter, as shown in Figure 2.

Dimensions in millimetres




[a] Hand length

**Figure 2 — Method of measuring hand dimensions for selection of proper glove**

#### 4.4.3 Marking of glove size

Glove size shall be indicated on the label.

NOTE Manufacturers should also provide information to the end-user or purchaser on how they have defined their sizes in terms of hand length and circumference.

### 4.5 Leather chromium VI content

Leather used in the construction of gloves shall have a Cr(VI) content of less than 10 mg/kg when tested in accordance with clause 6.1 of EN 420:1994.

### 4.6 Other design requirements

Gloves shall be designed to restrict the entry of embers or foreign particles through the glove openings.

Gloves shall be compatible with the sleeves of the firefighters' protective clothing used.

Any labels or accessories shall not adversely affect the performance of the gloves or present a hazard to the wearer.

# 5 Sampling and pretreatment

## 5.1 Sampling levels

Sampling levels for testing and inspection shall be established by the responsible testing laboratory and the manufacturer in order to assure a reasonable and acceptable reliability at a reasonable and acceptable confidence level that products certified as being compliant with this International Standard are, in fact, compliant.

## 5.2 Inspection

Inspection for determining compliance with the design requirements specified in clause 4 shall be performed on whole gloves.

## 5.3 Testing

### 5.3.1 Specimens

Testing for determining material and component compliance with the requirements specified in clause 6 shall be performed on samples representative of materials and components used in the actual construction of the protective glove. If suitably sized representative materials and components for the respective test method cannot be obtained, then samples from the glove shall be used as specified in the performance requirement. The responsible testing laboratory organization shall be permitted to also use sample materials cut from representative protective gloves.

### 5.3.2 Exposure surface

In all surface tests, the outermost surface shall be exposed.

### 5.3.3 Interpretation criteria

In all tests involving measurements, the determination of compliance shall be based on the mean value.

## 5.4 Pretreatments

### 5.4.1 Washing pretreatment

When pretreatment is specified as part of the test procedure or performance requirement, then the test materials shall be cycled through five washings and five dryings. Washing shall be carried out by procedure 2A at 60 °C ± 3 °C using a front loading horizontal drum machine with a detergent which achieves a pH of 7,0 and drying shall be carried out by procedure E (tumble drying) of ISO 6330:2000 unless otherwise specified in the care labelling. A total of five washing and drying cycles shall be used. A laundry bag shall not be used.

After the five washing and drying cycles, sample gloves shall be donned by a test subject and shall be flexed by making a tight fist 10 times during a 30 s period.

### 5.4.2 Dry conditioning

Sample gloves and sample specimens shall be conditioned at a temperature of (20 ± 2) °C and at a relative humidity of (65 ± 5) % for at least 24 h in accordance with ISO 139.

Sample gloves and sample specimens shall be tested within 5 min of removal from conditioning.

NOTE This conditioning is used in some cases after washing pretreatment to ensure that the gloves are totally dry before testing.

#### 5.4.3 Wet conditioning

Sample gloves or sample specimens shall be conditioned by completely immersing the glove or the glove specimen in water at a temperature of (20 ± 2) °C for 2 min. If gloves are used the glove specimen shall be first filled with water prior to immersion.

Sample gloves or sample specimens shall be removed from the water, hung in a vertical position for 5 min with the fingers uppermost, laid horizontal with textile blotting paper both under and over the specimen, under a pressure of 3,5 kPa for a period of 20 min.

Sample gloves or sample specimens shall be tested within 5 min of conditioning.

## 6 Performance requirements

### 6.1 General requirements

All firefighter gloves shall meet flame resistance and ergonomic requirements and shall be either classified as Type 1, Type 2 or Type 3 gloves based on the lowest requirement of any other performance property that the gloves can meet. Firefighter gloves shall not be permitted to be classified separately for different performance properties.

### 6.2 Thermal requirements

#### 6.2.1 Flame resistance

The glove component assembly, when tested in accordance with ISO 15025, using the procedures for face exposure, before and after the pretreatment specified in 5.4.1 followed by the pretreatment specified in 5.4.2, shall meet the following requirements:

a) no specimen shall exhibit flaming at top or either side edge;

b) no specimen shall exhibit hole formation in any layer;

c) no specimen shall produce flaming or molten debris;

d) the mean value of afterflame time shall be $\leqslant$ 2 s;

e) the mean value of the afterglow time shall be $\leqslant$ 2 s.

If suitably sized representative materials cannot be obtained then the whole glove shall be used for testing. The flame shall be contacted on the glove at the palm side, back side and fingers.

If the glove assembly incorporates wristlet material, this material shall be tested separately applying the flame to the outer surface of the wristlet material.

If the glove assembly incorporates seams, specimens of component assembly containing seams shall be tested separately by applying the flame to the seam portion of the component assembly with the seam oriented vertically.

Performance shall be determined using the poorest results from all areas of the glove that are tested.

#### 6.2.2 Heat transfer (flame exposure)

The glove component assembly, when tested in accordance with ISO 9151 shall be classified according to the levels of performance given in Table 1. Testing shall be performed on the glove component assembly after the following pretreatments:

a) after the pretreatment specified in 5.4.2.

b) after the pretreatment specified in 5.4.1 and then followed by the pretreatment specified in 5.4.2.

**Table 1 — Classification of heat transfer (flame exposure)**

| Type | Performance |
|---|---|
| 3 | $HTI_{24} \geqslant 17$ s and $(HTI_{24} - HTI_{12}) \geqslant 6$ s |
| 2 | $HTI_{24} \geqslant 13$ s and $(HTI_{24} - HTI_{12}) \geqslant 4$ s |
| 1 | $HTI_{24} \geqslant 9$ s and $(HTI_{24} - HTI_{12}) \geqslant 3$ s |

Where different, the palm and back sides of the glove shall be tested. The performance of the glove shall be determined using the lowest mean results for each side.

### 6.2.3 Heat transfer (radiant exposure)

The glove component assembly, when tested in accordance with Method B of ISO 6942:— shall be classified according to the levels of performance given in Table 2 and shall have a mean transmission factor $\leqslant 60$ %. Testing shall be performed on the glove component assembly after the following pretreatments:

a) after the pretreatment specified in 5.4.2.

b) after the pretreatment specified in 5.4.1 and then followed by the pretreatment specified in 5.4.2.

**Table 2 — Classification of heat transfer (radiant exposure)**

| Type | Heat flux density | Performance |
|---|---|---|
| 3 | 40 kW/m$^2$ | $t_2 \geqslant 33$ s and $(t_{24} - t_{12}) \geqslant 10$ s |
| 2 | 40 kW/m$^2$ | $t_2 \geqslant 22$ s and $(t_{24} - t_{12}) \geqslant 6$ s |
| 1 | 20 kW/m$^2$ | $t_2 \geqslant 11$ s and $(t_{24} - t_{12}) \geqslant 4$ s |

Where different, the palm and back sides of the glove shall be tested. The performance of the glove shall be determined using the lowest mean results for each side.

### 6.2.4 Heat transfer (conductive exposure)

The glove component assembly, when tested in accordance with ISO 12127 at a contact temperature of 250 °C shall be classified according to the levels of performance given in Table 3. Testing shall be performed on the glove component assembly after the following pretreatments:

a) after the pretreatment specified in 5.4.2.

b) after the pretreatment specified in 5.4.1 and then followed by the pretreatment specified in 5.4.2.

c) after the pretreatment specified in 5.4.1 and then followed by the pretreatment specified in 5.4.3.

**Table 3 — Classification of heat transfer (conductive exposure)**

| Type | Performance |
|---|---|
| 3 | $t_t \geqslant 14$ s |
| 2 | $t_t \geqslant 10$ s |
| 1 | $t_t \geqslant 6$ s |

Where different, the palm and back sides of the glove shall be tested. The performance of the glove shall be determined using the lowest mean results for each side.

### 6.2.5 Heat resistance

Complete glove specimens, when tested in accordance with the method described in ISO 17493, using the procedures for protective gloves at the test temperature corresponding to the level of performance given in Table 4 and before and after the pretreatment specified in 5.4.1, shall not melt, separate or ignite, and shall not shrink more than as specified in length or width.

Specimens of the innermost lining of the glove body component assembly that is designed to come into contact with the wearer's skin, when tested in accordance with the method given in ISO 17493, using the procedure for flat textile or other sheet materials at the test temperature corresponding to the level of performance given in Table 4 and before and after the pretreatment specified in 5.4.1, shall not melt, separate or ignite.

**Table 4 — Classification of heat resistance**

| Type | Performance |
|---|---|
| 3 | Passing performance at 260 °C, shrinkage $\leqslant 8$ % |
| 2 | Passing performance at 180 °C, shrinkage $\leqslant 5$ % |
| 1 | Passing performance at 180 °C, shrinkage $\leqslant 5$ % |

## 6.3 Mechanical requirements

### 6.3.1 Abrasion resistance

Specimens of the outer material from the palm area of the glove body component assembly when tested in accordance with ISO 5470-1 with a 300 g/m$^2$ finish glass paper (grade 100/F2) at a pressure of 9 kPa after the pretreatment specified in 5.4.2, shall be classified according to the levels of performance given in Table 5.

**Table 5 — Classification of abrasion resistance**

| Type | Performance |
|---|---|
| 3 | No wear-through after 8 000 cycles |
| 2 | No wear-through after 2 000 cycles |
| 1 | No wear-through after 2 000 cycles |

Where different, the palm and back sides of the glove shall be tested. The performance of the glove shall be determined using the lowest mean results for each side.

### 6.3.2 Cut resistance

Specimens of the outer material from the palm and back areas of the glove body component assembly when tested in accordance with ISO 13997 after the pretreatments specified in 5.4.2 and 5.4.3, shall be classified according to the levels of performance given in Table 6.

**Table 6 — Classification of cut resistance**

| Type | Performance (20 mm blade stroke distance) |
|---|---|
| 3 | Cut force $\geqslant$ 4 N |
| 2 | Cut force $\geqslant$ 2 N |
| 1 | Cut force $\geqslant$ 2 N |

Where different, the palm and back sides of the glove shall be tested. The performance of the glove shall be determined using the lowest mean results for each side.

Where cuffs or wristlets are provided, specimens of the glove cuff or glove wristlet component assembly shall be separately tested and compared with the levels of performance given in Table 6. The glove shall be classified on the poorest performance measured for the glove body and the cuff/wristlet.

### 6.3.3 Tear resistance

Specimens of outer material from the palm area of the glove body component assembly when tested in accordance with clause 6.3 of EN 388:1994 after the pretreatment specified in 5.4.2, shall be classified according to the levels of performance given in Table 7.

**Table 7 — Classification of tear resistance**

| Type | Performance |
|---|---|
| 3 | Tear resistance $\geqslant$ 50 N |
| 2 | Tear resistance $\geqslant$ 25 N |
| 1 | Tear resistance $\geqslant$ 25 N |

Where different, the palm and back sides of the glove shall be tested. The performance of the glove shall be determined using the lowest mean of the results for each side.

### 6.3.4 Puncture resistance

Specimens of outer material from the palm area of the glove body component assembly when tested in accordance with ISO 13996 after the pretreatments specified in 5.4.2 and 5.4.3, shall be classified according to the levels of performance given in Table 8.

**Table 8 — Classification of puncture resistance**

| Type | Performance |
|---|---|
| 3 | Puncture resistance $\geqslant$ 120 N |
| 2 | Puncture resistance $\geqslant$ 60 N |
| 1 | Puncture resistance $\geqslant$ 60 N |

Where different, the palm and back sides of the glove shall be tested. The performance of the glove shall be determined using the lowest mean of the results for each side.

#### 6.3.5 Label legibility

Specimen glove labels when tested after pretreatment as specified in 5.4.1 shall be legible at a distance of at least 30 cm by a person with 20/20 vision, or vision corrected to 20/20.

NOTE The intention of this test is to ensure that the label remain readable after use.

### 6.4 Barrier requirements

#### 6.4.1 Water penetration resistance

Specimens of glove moisture barrier and its seams, when tested in accordance with ISO 811 at 7 kPa for a period of 5 min after the pretreatments specified in 5.4.1 and 5.4.2, shall be classified according to the levels of performance given in Table 9.

**Table 9 — Classification of water penetration resistance**

| Type | Performance |
|---|---|
| 3 | No appearance of water drops |
| 2 | No appearance of water drops |
| 1 | Not required |

#### 6.4.2 Liquid penetration resistance

Specimens of glove moisture barrier and its seams when tested in accordance with ISO 13994:1998 using Procedure C1 after the pretreatment specified in 5.4.1, shall be classified according to the levels of performance given in Table 10 for the following liquids:

a) 40 % sodium hydroxide at 20 $^{o}$C

b) 36 % hydrochloric acid at 20°C

c) 37 % sulfuric acid at 20 °C

d) 50 % toluene and 50% iso-octane (*V*/*V*)

**Table 10 — Classification of liquid penetration resistance**

| Type | Performance |
|---|---|
| 3 | No penetration of any liquid for at least 1 h |
| 2 | Not required |
| 1 | Not required |

#### 6.4.3 Whole glove integrity

Specimen gloves when tested in accordance with annex A after the pretreatment specified in 5.4.1, shall be classified according to the levels of performance given in Table 11.

**Table 11 — Classification of whole glove integrity**

| Type | Performance |
|---|---|
| 3 | No leakage |
| 2 | Not required |
| 1 | Not required |

## 6.5 Ergonomic requirements

### 6.5.1 Dexterity

Specimen gloves, when tested for dexterity in accordance with Clause 6.3 of EN 420:1994 after the pretreatment specified in 5.4.1, shall have a performance level of 1 or better.

### 6.5.2 Grip

Specimen gloves when tested in accordance with annex B after the pretreatments specified in 5.4.1 and 5.4.3, shall not have a weight pulling capacity less than 80 % of the bare hand control values.

### 6.5.3 Donning

Specimen gloves when tested in accordiance with annex C after the pretreatment specified in 5.4.1, shall not have a donning time exceeding the baseline donning time plus 20 s.

# 7 Marking

Firefighter protective gloves, for which compliance with this International Standard is claimed, shall have a label permanently and conspicuously attached marked with the number of this International Standard, i.e., ISO 15383.

General marking requirements shall be as specified in ISO 13688 with the exception that sizing shall be marked as specified in 4.4.3. The pictogram used shall be as given in Figure 3.

**Figure 3 — Pictogram ISO 7000-2418**

# 8 Manufacturer's information

The manufacturer's information shall be given as specified in ISO 13688.

# Annex A
(normative)

# Whole glove integrity test

## A.1 Principle

Test subjects wearing gloves over a water-markable inner glove, partially immerse their hands in a container of water and flex their hands 12 times. The inner glove is then examined for water marks.

## A.2 Equipment

A water markable glove shall cover all areas of the tester's hand. The water-markable glove shall be constructed of a fabric which is easily water marked to determine leakage. An example of a water-markable glove material is 100 % cotton with a weight of $(50 \pm 10)$ g/m$^2$ and a thickness of $(0{,}5 \pm 0{,}1)$ mm.

Water used for integrity testing shall be treated with a non-foaming surfactant in order to lower its surface tension to less than $(34 \pm 5)$ dyn/cm.

## A.3 Specimens

A minimum of three pairs of gloves each for sizes small and large shall be used for testing by at least two different test subjects.

## A.4 Procedure

**A.4.1** Test subjects shall be selected such that their hand dimensions are as close as possible to the middle of the range for hand length and to the hand circumference for small and large gloves.

**A.4.2** The test subject shall don the glove specimen over a water-markable glove.

**A.4.3** The test subject shall immerse the glove specimen in $(20 \pm 3)$ $^{o}$C water to within 25 mm of the top of the body of the glove specimen for 5 min. The test subject shall flex the glove specimen in a fist clenching motion every 10 s.

**A.4.4** The test subject shall remove the glove specimen.

**A.4.5** The inner glove shall be inspected for water marks.

## A.5 Report

The appearance of water marks on the inner glove after testing shall be reported for all specimens. The appearance of water marks on the inner glove after testing any glove shall be considered leakage and shall constitute failing performance.

# Annex B
(normative)

# Grip test

## B.1 Principle

The bare-handed lifting capacity of a test subject using a halyard and a set of weights is compared with the same test subject wearing wet gloves on a dry and wet halyard.

## B.2 Equipment

Grip testing shall be conducted with a 9,5 mm diameter, 3-strand prestretched polyester rope attached to a calibrated force measuring device.

## B.3 Specimens

A minimum of three pairs of gloves each for sizes small and large shall be used for testing by at least two different test subjects. Each pair of gloves, as a complete set of gloves, shall be tested in the new, as-distributed condition. The laboratory shall ensure that glove specimens do not receive special softening treatments prior to tests. Glove specimens shall be conditioned as specified in 5.4.2 and 5.4.3.

## B.4 Procedure

**B.4.1** Test subjects shall be selected such that their hand dimensions are as close as possible to the middle of the range for hand length and to the hand circumference for small and large gloves.

**B.4.2** Each test subject shall make three successive attempts to lift as much weight as possible using the halyard and both hands and keeping both feet firmly planted on the ground while pulling downward on the halyard. The average weight hoisted over the three trials shall be the bare-handed weight lift capability.

**B.4.3** Dry-conditioned specimen gloves shall be tested on a dry rope and then on a wet rope.

**B.4.4** Wet-conditioned specimen gloves shall be tested on a dry rope and then on a wet rope.

**B.4.5** Each test subject shall be evaluated with a minimum of three pairs of gloves. Test subjects shall attempt one trial with each pair of gloves for a minimum of six grip tests for each set of conditions, with at least three grip tests with small sized gloves and three grip tests with large sized gloves.

**B.4.6** The weight pulling capacity of a test subject with gloves shall be compared with the bare-handed weight lift capability. The percentage of weight pulling capacity with gloves to bare-handed weight lift capability shall be calculated as follows:

$$\text{Percent of barehand control} = \frac{\text{Weight pulling capacity with gloves}}{\text{Bare-handed weight lift capability}} \times 100$$

## B.5 Report

The percent of barehand control for each glove pair specimen, condition and test subject tested shall be reported. One or more glove pair specimens failing this test shall constitute failing performance.

# Annex C
(normative)

# Donning test

## C.1 Principle

Donning times are measured for gloves which have been repeatedly laundered to determine failure of liner attachments within glove.

## C.2 Specimens

A minimum of three pairs of gloves each for sizes small and large shall be used for testing by at least two different test subjects. Specimens shall be conditioned as specified in 5.4.1.

## C.3 Procedure

**C.3.1** Test subjects shall be selected such that their hand dimensions are as close as possible to the middle of the range for hand length and to the hand circumference for small and large gloves.

**C.3.2** The time to don one glove of the glove pair specimen shall be determined by measuring the time it takes for the test subject to don the single glove on three consecutive trials without altering the sample glove linings between donnings.

**C.3.3** Each donning trial shall start with the glove lying in front of the test subject and end the trial when the test subject's fingers are seated in the sample glove.

**C.3.4** The average of the first three donning times shall be used as the baseline donning time. The baseline donning time shall not exceed 10 s.

**C.3.5** Glove pair specimens shall be conditioned as specified in 5.4.1.

**C.3.6** The average of the times for the first three donnings after removal from the final drying cycle shall be used as the final donning time.

## C.4 Report

The final donning time and the baseline donning time shall be reported to the nearest 0,1 s. for each trial. The average final and baseline donning times shall be calculated and reported. The pass/fail performance shall be determined using the average final and base line donning times.

# Annex D
(informative)

# Guidelines and considerations for performing a risk assessment

## D.1 General

The role of firefighters' personal protective equipment (PPE) is not only to protect the firefighter but also to enable the firefighter to achieve these objectives. However, in emergency situations where the firefighter is unable to achieve these objectives, the PPE must also provide sufficient protection to enable the firefighter to escape without receiving unacceptable injury. The type of PPE and the protection it offers must be selected on the basis of a risk assessment specific to PPE use for identifying hazards, evaluating those hazards and selecting specific performance requirements which eliminate or reduce these hazards.

## D.2 Determination of type of glove

To assist in the determination of the type of glove that matches the risk assessment, the following guide is provided.

**Type 1** suitable for general purpose rescue or firefighting operations with relatively low levels of hazard, where extended wearing times might be needed, such as in wildland firefighting or firefighting suppression action involving a fire in vegetative fuels such as forests, crops, plantations, grass or farmland.

**Type 2** suitable for fire rescue, fire suppression and property conservation in buildings, vehicles, vessels or like properties that are involved in a fire or emergency situation where relatively moderate hazards may be encountered and when no exposure to hazardous liquids (e.g. chemicals at the fire scene or blood or body fluids) is expected.

**Type 3** suitable for fire rescue, fire suppression and property conservation in buildings, vehicles, vessels or like properties that are involved in a fire or emergency situation where relatively severe (high) hazards in terms of heat and physical exposure may occur, and where some contact may be expected with fireground chemicals or other hazardous liquids.

## D.3 General approach for conducting a risk assessment

The three major steps of the risk assessment process are:

a) **Risk identification.** For every aspect of the operation of the fire department or brigade, list potential problems and hazards. The following are examples of sources of information that may be useful in the process:

   1) a list of the risks to which members are or may be exposed;

   2) records of previous accidents, illnesses and injuries, both locally and nationally;

   3) facility and apparatus surveys, inspections, etc.

b) **Risk evaluation.** Evaluate each item listed in the risk identification process using the following questions:

   1) What is the level or potential severity of the occurrence?

   2) What is the potential frequency or likelihood of the occurrence?

3) What are the potential consequences of the occurrence?

This will help to set priorities in the developing of specifications for PPE performance. Some sources of information which may be useful are:

i) safety audits and inspection reports;

ii) prior accident, illness and injury statistics;

iii) application of national data to local circumstances;

iv) professional judgment in evaluation risks unique to the jurisdiction.

c) **Risk control.** Once the risks are identified and evaluated, a control for each should be implemented and documented. In the case of PPE, this should include determining the appropriateness of specific tests and requirements for eliminating or reducing risk. Normally, the two primary methods of controlling risk, in order of preference, are as follows:

1) wherever possible, totally eliminate/avoid the risk or activity that presents the risk;

2) where it is not possible to or practical to avoid or eliminate the risk, steps should be taken to control it (such as developing appropriate PPE specifications).

Specification of appropriate PPE must be part of any overall safety programme which includes Standard Operating Procedures, training and inspection. As with any programme, it is important to evaluate whether the plan is working. Periodic evaluations should be made, and if the programme elements are not working satisfactorily, then modifications to the programme should be made. If the methods are changed, a new risk assessment should be performed.

## D.4 Recommended factors for identifying and evaluating firefighter risks

In using this International Standard for purchasing appropriate firefighting gloves, some of the factors which should be considered in a risk assessment, include

a) **Level of firefighter training and experience.** Well-trained and experienced firefighters are more likely to recognize fireground hazards and appropriately respond in ways to minimize their potential for injury. The quality, amount and frequency of training will also impact the firefighter's potential for injury. Firefighters should be specifically trained in the use of the selected PPE.

b) **Level of fitness and health of the firefighter.** Firefighters who are in good health and physical condition are more likely to respond safely and be less subject to stress-related injuries on the fireground than firefighters in poor health and physical condition.

c) **Function of the firefighter at the incident scene.** Firefighters who make aggressive interior attacks at structural fires may be at more risk from burns than firefighters who assume defensive positions outside of burning structures. Some organizations may segregate firefighter responsibilities at the fire scene and subsequently require different levels of protection. Other organizations may require each firefighter to be equipped to perform any function at the fire scene, recognizing the possibility that any individual may be required to respond under emergency conditions. In all cases, the specific activities of firefighters in responding to fires or other emergencies must be accounted for in determining risk of injury. Examples may include equipping firefighters with PPE which is designed for aggressive interior attack as compared to functions where firefighters activities are primarily defensive.

d) **Environmental conditions at the incident scene.** Hot and humid conditions as well as cold conditions can affect firefighter protection at the response scene. In addition, the physical environment in which the response is conducted and its impact on firefighters performing assigned duties must be accounted for; e.g., firefighters using hoses may become wet. Water inside clothing systems has both positive and negative impacts on its performance.

e) **Specific hazards to be faced at the incident scene.** Thermal as well as physical and other hazards should be considered in evaluating response risks. The type, level and duration of heat exposure as well as the physical environment in which it is contained will have a significant effect on the potential risks faced by firefighters. Other hazards such as potential for flame contact, low visibility, fire ground chemicals and rough physical surfaces create additional risks for injury at the fire scene.

f) **Known limitations of the protective gloves and other PPE.** While protective gloves are designed to prevent or minimize injury, the specific limitations of protective gloves in providing protection under all situations must be recognized. Glove performance may be limited based on certain design features or material performance characteristics. In addition, these characteristics may be diminished as the gloves are worn. Protective gloves must be properly maintained to ensure continued performance. Methods for integrating other PPE such as garments, helmets, boots and self-contained breathing apparatus must be done in a manner that provides complete protection to the wearer.

g) **Appropriate fit of protective gloves.** Gloves must fit correctly in order to provide adequate protection for the firefighter. Gloves that are too loose will affect dexterity and tactility. Gloves that are too tight will lessen the insulation of the glove and not allow for shrinkage from continued use. Firefighters should ensure that their gloves are adequate by examining how the gloves fit on their hands and their ability to perform tasks using their gloved hands. Firefighters should initially fit themselves with the appropriate size glove by checking their hand dimensions against manufacturer's recommendations, but may have to try on different sizes to find the "best" fitting glove.

h) **Type and application of command system at the incident scene.** The amount of discipline and coordination of firefighters at the accident/response scene can impact the risk for injury. Firefighters who have well-defined responsibilities and are closely supervised are less likely to be injured as compared to firefighters which act more independently and in a less coordinated fashion.

Consideration should also be given to the build up of heat stress by prolonged use of the PPE in firefighting and associated activities. Heat stress and other stress-related injuries are one of the more frequent causes of firefighter fatalities and injuries. Heat stress is affected by a number of factors that include all of the factors described above.

# Annex E
(informative)

## Comparison of firefighter glove performance requirements for different types of gloves

| Performance requirement | Test method | Type 1 | Type 2 | Type 3 |
|---|---|---|---|---|
| Flame resistance<br>(6.2.1) | In accordance with ISO 15025, performed on surface of component assembly, glove seams and wristlet before and after 5 laundering cycles | Same for all three levels:<br>no hole formation, no flaming/molten debris, after-flame time $\leqslant$ 2 s, afterglow $\leqslant$ 2 s | | |
| Heat transfer (flame exposure)<br>(6.2.2) | In accordance with ISO 9151, using flame exposure only, performed on component assembly before and after 5 laundering cycles | $HTI_{24} \geqslant 9$ s<br>$(HTI_{24} - HTI_{12}) \geqslant 3$ s | $HTI_{24} \geqslant 13$ s<br>$(HTI_{24} - HTI_{12}) \geqslant 4$ s | $HTI_{24} \geqslant 17$ s<br>$(HTI_{24} - HTI_{12}) \geqslant 6$ s |
| Heat transfer (radiant exposure)<br>(6.2.3) | In accordance with Method B of ISO 6942:—, performed on component assembly after 5 laundering cycles | $t_2 \geqslant 11$ s<br>$(t_{24} - t_{12}) \geqslant 4$ s<br>at 20 kW/m$^2$ | $t_2 \geqslant 22$ s<br>$(t_{24} - t_{12}) \geqslant 6$ s<br>at 40 kW/m$^2$ | $t_2 \geqslant 33$ s<br>$(t_{24} - t_{12}) \geqslant 10$ s<br>at 40 kW/m$^2$ |
| Heat transfer (conductive exposure)<br>(6.2.4) | In accordance with ISO 12127, at a contact temperature of 260 °C on component assembly before and after 5 laundering cycles | $t_t \geqslant 6$ s | $t_t \geqslant 10$ s | $t_t \geqslant 14$ s |
| Heat resistance<br>(6.2.5) | In accordance with ISO 17493 for 5 min, performed on complete gloves and innermost lining of component assembly after 5 laundering cycles | At 180 °C, no melting, dripping, or ignition; shrinkage $\leqslant$ 5 % | At 180 °C, no melting, dripping, or ignition; shrinkage $\leqslant$ 5 % | At 260 °C, no melting, dripping, or ignition; shrinkage $\leqslant$ 8 % |
| Abrasion resistance<br>(6.3.1) | In accordance with ISO 5470-1, with 300 g/m$^2$ finish glass paper performed on outer material from glove palm area | No wear-through after 2 000 cycles | No wear-through after 2 000 cycles | No wear-through after 8 000 cycles |

| Performance requirement | Test method | Type 1 | Type 2 | Type 3 |
|---|---|---|---|---|
| Cut resistance (6.3.2) | In accordance with ISO 13997, at a blade stroke distance of 20 mm performed on outer material from glove palm and back areas | Cut force ⩾ 2 N | Cut force ⩾ 2 N | Cut force ⩾ 4 N |
| Tear resistance (6.3.3) | In accordance with clause 6.3 of EN 388:1994 ("tongue" or "trouser" tear method), performed on outer material | Tear strength ⩾ 25 N | Tear strength ⩾ 25 N | Tear strength ⩾ 50 N |
| Puncture resistance (6.3.4) | In accordance with ISO 13996, performed on outer material from glove palm area | Puncture force ⩾ 60 N | Puncture force ⩾ 60 N | Puncture force ⩾ 120 N |
| Label legibility (6.3.5) | In accordance with the conditioning in 5.4.1 | Same for all three levels: legible at a distance of 30 cm by a person with corrected vision of 20/20 | | |
| Water penetration resistance ( 6.4.1) | In accordance with ISO 811, at 7 kPa for 5 min after 5 cycles of laundering | Not required | No appearance of water droplets | No appearance of water droplets |
| Liquid chemical penetration resistance (6.4.2) | In accordance with ISO 13994, on glove component assembly after 5 cycles of laundering | Not required | Not required | No penetration of test liquids in 1 h |
| Whole glove integrity (6.4.3) | In accordance with annex A, performed on complete gloves before and after 5 cycles of laundering | Not required | Not required | No leakage |
| Dexterity (6.5.1) | In accordance with Clause 6.3 of EN 420:1994, performed on complete gloves after 5 cycles of laundering with and without wet conditioning | Same for all three levels: dexterity performance level ⩾ 1 | | |
| Grip (6.5.2) | In accordance with annex B, performed on complete gloves after 5 cycles of laundering with and without wet conditioning | Same for all three levels: weight pulling capacity ⩾ 80 % of bare hand control values | | |
| Donning (6.5.3) | In accordance with annex C performed on complete gloves after laundering | Same for all three levels: donning time ⩽ baseline donning time + 20 s | | |

# Bibliography

[1] ISO 7000:1989, *Graphical symbols for use on equipment — Index and synopsis.*

[2] ISO 15384:—[2)], *Protective clothing for firefighters — Laboratory test methods and performance requirements for wildland firefighting clothing*.

[3] EN 469:1995, *Protective clothing for firefighters — Requirements and test methods for protective clothing for firefighting.*

[4] EN 659:1996, *Protective gloves for firefighters.*

[5] NFPA 1971:2000, *Standard on protective ensemble for structural fire fighting.*

2) To be published.

**ICS 13.340.10; 13.340.40**

Price based on 22 pages