INTERNATIONAL STANDARD

ISO 18639-4

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PPE ensembles for firefighters undertaking specific rescue activities —

Part 4: Gloves

Équipements de protection personnelle pour pompiers entreprenant des activités de sauvetage particulières —

Partie 4: Gants

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents 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 equipment*, Subcommittee SC 14, *Firefighters' personal equipment*.

A list of all parts in the ISO 18639 series can be found on the ISO website.

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

ISO 18639 is a series of standards for personal protective equipment (PPE) for firefighters when engaged in specific rescue activities. It is not possible to provide a standard for PPE to cover all of the diverse range of rescue scenarios that firefighters are likely to encounter so it is important that risk assessments be undertaken to determine if the PPE covered by the ISO 18639 series is suitable for its intended use and the expected exposure to hazards. For complete protection against exposures, the risk assessment should allow protection of the whole body including the torso, arms and legs, head, face, hands and feet.

For certain rescue activities, safety ropes and harnesses can be required. For certain rescue situations, special PPE for use in and on water can be required. In some cases, appropriate respiratory protection can also be identified as being necessary.

The performance requirements specified in this document take account of accidental exposure to heat and flame, but do not cover PPE for firefighting. While this document takes account of accidental exposure to some common chemicals, it is not intended that PPE conforming to this document should be considered as providing chemical protection as a primary function. It does not cover PPE to protect against biological, electrical or radiation hazards. The risk assessment should determine whether PPE complying with this document or to the requirements of any other relevant standard is more suitable.

Firefighters should be trained in the use, care and maintenance of the PPE covered by this document, including an understanding of its limitations.

PPE ensembles for firefighters undertaking specific rescue activities —

Part 4: Gloves

1 Scope

This document provides the principles that govern the development of incident type and/or hazard specific test methods and minimum performance requirements for protective gloves for firefighters while engaged in specific rescue activities.

Gloves related to specific specialist rescue activities, such as road traffic crash (RTC) and urban search and rescue (USAR), are documented in individual subclauses of this document.

NOTE Further guidance can be found in ISO 18639-1.

The purpose of this document is to ensure that minimum performance requirements for incident type and/or hazard specific protective gloves are designated.

This document deals with "rescue from emergencies involving modes of transportation" in particular performance requirements for personal protective equipment (PPE) intended to be used by firefighters, primarily but not solely to protect against hazard exposure at non fire rescue activities involving road traffic crash (RTC) or motor vehicle accidents (MVA).

This document covers general glove design, the minimum performance level of the materials used and the methods of test for determining this performance level.

This document does not cover special gloves for use in other high risk situations such as firefighting.

This document does not cover protection for the head, torso, arms, legs and feet. These are covered in other parts of the ISO 18639 series. It does not cover protection of the hands against other hazards, e.g. chemical, biological, radiation and electrical hazards, except for limited, accidental exposure to fire ground chemicals and blood or body fluids.

Selection of the appropriate system of personal protective equipment (PPE), including gloves, is dependent on carrying out an effective risk assessment which identifies the hazard to be faced, evaluates the likelihood of those hazards and provides the means of reducing or eliminating these hazards.

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

ISO 3175-1, *Textiles — Professional care, drycleaning and wetcleaning of fabrics and garments — Part 1: Assessment of performance after cleaning and finishing*

ISO 6330:2012, *Textiles — Domestic washing and drying procedures for textile testing*

ISO 6942:2002, *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 12127-1, *Clothing for protection against heat and flame — Determination of contact heat transmission through protective clothing or constituent materials — Part 1: Contact heat produced by heating cylinder*

ISO 12947-4, *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method — Part 4: Assessment of appearance change*

ISO 13994:2005, *Clothing for protection against liquid chemicals — Determination of the resistance of protective clothing materials to penetration by liquids under pressure*

ISO 13995, *Protective clothing — Mechanical properties — Test method for the determination of the resistance to puncture and dynamic tearing of materials*

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 15025:2016, *Protective clothing — Protection against flame — Method of test for limited flame spread*

ISO 17075 (all parts), *Leather — Chemical determination of chromium(VI) content in leather*

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

ISO 18639-1, *PPE ensembles for firefighters undertaking specific rescue activities — Part 1: General*

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

EN 420:2003+A1:2009, *General requirements for gloves*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 19591 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/

4 Design and general requirements

4.1 General

The protective glove shall be designed and manufactured so that in the foreseeable conditions of use for which it is intended, the user can perform the hazard related activity normally while achieving appropriate protection at the highest possible level.

If required, the glove shall be designed to minimize the time needed for putting on and taking off.

When the glove construction includes seams, the material and strength of the seams shall be such that the overall performance of the glove is not significantly decreased. Where relevant, test methods and requirements can be found in the specific standards listed in the Bibliography.

Gloves shall consist of a component assembly meeting the performance requirements of this document. 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 sizing

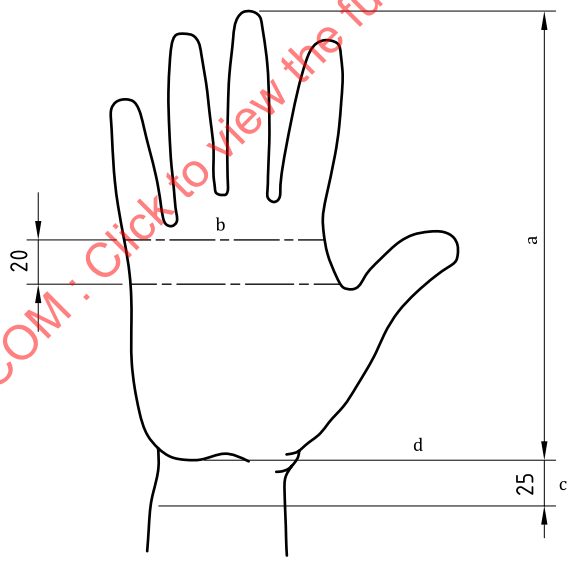
4.2.1 Hand dimensions

Hand dimensions for selection of proper glove size shall consist of measuring two dimensions, hand circumference and hand length, as shown in Figure 1.

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 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 millimetre, as shown in Figure 1.

Hand circumference shall be measured by placing a flexible 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 over the back of the hand (metacarpals). The circumference shall be measured to the nearest millimetre, 20 mm from the crotch between thumb and index finger as shown in Figure 1.

Dimensions in millimetres



Key

a Hand length.

b Position where circumference is measured.

c Minimum glove body length from wrist crease.

d Wrist cease.

Figure 1 — Method of measuring hand dimensions for selection of proper glove

4.2.2 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 specified in 4.2.1.

NOTE This requirement is intended to allow manufacturers to report information to the user that assists in their selection of the appropriate size. Standard sizes are not defined in this document.

4.2.3 Labelling

Glove size shall be indicated on the label. Manufacturers should provide information to the end user or purchaser on how they have defined their sizes in terms of hand length and circumference as specified in 4.2.1.

4.3 Glove body length

The glove body shall extend circumferentially beyond the wrist crease ≥ 25 mm. See "c" in Figure 1.

4.4 Wristlet or cuff

The sample glove body and the cuff or wristlet shall extend circumferentially at least 50 mm beyond the wrist crease shown in Figure 1.

4.5 Other design requirements

Gloves shall be designed to restrict the entry of 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 Pre-treatment, conditioning and sampling

5.1 Inspection

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

5.2 Testing

5.2.1 Specimens

Testing for determining material and component conformity with the requirements specified in Clause 6 shall be performed on samples representative of all the 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 appropriate testing laboratory shall be permitted to also use sample materials cut from representative protective gloves.

All specimens shall be taken from the palm of the different gloves for classification purposes. If relevant, additional areas of the protective glove shall be tested, e.g. for specific protection or for areas which provide lower protection.

5.2.2 Exposure surface

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

5.2.3 Interpretation criteria

All the individual results of the specimens of a test shall meet the performance requirements. The average result shall be given. If a material exhibits differing behaviour for a property in the length and cross directions of the material, the resultant property value shall be the value obtained in the lesser performing direction. In the event that only one specimen fails, another set of specimens shall be tested and all the individual results of this second set of specimens shall meet the requirements. Otherwise, the sample is considered to have failed meting the requirement.

5.3 Pre-treatments

5.3.1 Laundering

Unless otherwise specified in the care labelling, test samples shall be subjected to five washing/drying cycles in a front-loading horizontal drum machine using 1 g/l no. 2 (IEC) detergent in soft water in accordance with the procedures specified in ISO 6330:2012. Washing shall be carried out using the procedure 6N at 60 °C + 3 °C and drying using procedure E (tumble drying). Materials that are labelled as dry cleanable only shall be dry cleaned five times in accordance with ISO 3175-1.

A laundry bag shall not be used.

After five cycles of washing/drying or dry cleaning, 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.

5.3.2 Conditioning

After washing, sample gloves and/or specimens shall be conditioned at a temperature of 20 °C ± 2 °C and at a relative humidity of 65 % ± 5 % for at least 24 h in accordance with ISO 139.

Testing of sample gloves and/or specimens shall commence within 5 min after removal from conditioning.

5.3.3 Wetting

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

Sample gloves and/or 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 ± 0,5 kPa for a period of 20 min.

Testing of sample gloves and/or specimens shall commence within 5 min of wetting.

6 Performance requirements

6.1 General

Gloves shall be classified as RTC or USAR by meeting the performance requirements in Table 1.

6.2 Summary of requirements and classification

Table 1 — Summary of requirements for different applications

Requirements	Road traffic crash (RTC)	Urban search and rescue (USAR)
Flame resistance, see 6.4 ISO 15025:2016, Procedure A	See 6.4	
Heat transfer (flame exposure), see 6.5 ISO 9151	$HTI_{24} \geq 9$ s and $(HTI_{24} - HTI_{12}) \geq 3$ s	
Heat transfer (radiant exposure), see 6.6 ISO 6942:2002, Method B	$RHTI_{24} \geq 7$s	
Heat transfer (conductive exposure), see 6.7 ISO 12127-1	$t_t \geq 6$ s	
Heat resistance, see 6.8 ISO 17493	The specimen shall not melt, separate or ignite, and shall not shrink more than 5 % in length or width	
Liquid penetration resistance (optional), see 6.9 ISO 13994:2005 , Procedure C1	No penetration of any liquid for at least 1 h for the following liquids: 40 % sodium hydroxide at 20 °C; 36 % hydrochloric acid at 20 °C; 30 % sulfuric acid at 20 °C; 50 % toluene and 50 % iso-octane (V/V) at 20 °C.	
Abrasion resistance, see 7.1 ISO 12947-4	No wear-through after 2 000 cycles	No wear-through after 2 000 cycles
Cut resistance, see 7.2 ISO 13997	Cut force ≥ 30 N	Cut force ≥ 15 N
Tear resistance, see 7.3 ISO 13995	≥ 25 N	≥ 25 N
Puncture resistance, see 7.4 ISO 13996	≥ 60 N	≥ 60 N
Dexterity, see 7.6.1 EN 420:2003+A1:2009	Level 3 or better	
Grip, see 7.6.2 Annex A	Weight pulling capacity greater than 80 % of the bare hand control values	
Donning, see 7.6.3 Annex B	Final donning time after laundering ≤ the baseline donning time plus 20 s	

6.3 Road traffic crash (RTC)

RTC gloves shall meet the requirements in 6.4 to 6.8 and the mechanical and other requirements specified in Clause 7.

6.4 Flame resistance

The glove component assembly, shall be tested in accordance with ISO 15025:2016, procedure A (surface ignition) after the following pretreatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

The specimen shall meet the following performance requirements (Index 3 of ISO 14116):

— No specimen shall exhibit 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 produce flaming or molten debris.

— The mean value of afterflame time shall be ≤ 2 s.

— Any afterglow shall not spread from the carbonized area to the undamaged area after the cessation of flaming.

— The mean value of the afterglow time shall be ≤ 2 s.

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 lowest mean results from all areas of the glove that are tested. Mean results and all individual test results including failures shall be reported.

6.5 Heat transfer (flame exposure)

The glove component assembly, shall be tested in accordance with ISO 9151 and shall meet the following performance requirements:

$HTI_{24} \geq 9$ s and $(HTI_{24} - HTI_{12}) \geq 3$ s

Testing shall be performed on the glove component assembly after the following pretreatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

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 either side of the glove. Mean results and all individual test results including failures shall be reported.

6.6 Heat transfer (radiant exposure)

The glove component assembly, shall be tested in accordance with ISO 6942:2002, Method B using a heat flux density of 20 kW/m^2 and shall meet the following performance requirements:

Performance of $RHTI_{24} \geq 7$s

Mean transmission factor ≤ 60 %

Testing shall be performed on the glove component assembly after the following pretreatments:

a) after the conditioning specified in 5.3.2;

b) after the laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

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. Mean results and all individual test results including failures shall be reported.

6.7 Heat transfer (conductive exposure)

The glove component assembly shall be tested in accordance with ISO 12127-1 at a contact temperature of 260 °C + 5 °C/−0 °C and shall have a performance of threshold time $t_t \geq 6$ s. Testing shall be performed on the glove component assembly after the following pretreatments:

a) after the conditioning specified in 5.3.2;

b) after the laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2;

c) after the laundering specified in 5.3.1 and then followed by the wetting specified in 5.3.3.

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 either side of the glove.

6.8 Heat resistance

6.8.1 Complete glove specimens, shall be tested in accordance with ISO 17493, using the procedures for protective gloves at the test temperature of 180 °C.

Testing shall be performed on the glove component assembly after the following pretreatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

The specimen shall not melt, separate or ignite, and shall not shrink more than 5 % in length or width.

6.8.2 Specimens of the innermost lining of the glove body component assembly that is designed to come into contact with the wearer's skin, shall be tested in accordance with the method given in ISO 17493, using the procedure for flat textile or other sheet materials at the temperature of 180 °C and shall be carried out after the following pretreatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

The specimen shall not melt, separate or ignite.

6.9 Liquid penetration resistance (optional)

Specimens of glove moisture barrier and its seams shall be tested in accordance with ISO 13994:2005, Procedure C1 after the following pretreatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

The specimen shall show no penetration of any liquid for at least 1 h for the following liquids at 20 °C ± 2 °C:

— 40 % NaOH;

— 36 % HCl;

— 37 % H_2SO_4;

— 100 % *o*-xylene.

6.10 Whole glove integrity test

Specimen gloves shall be tested in accordance with Annex C after laundering specified in 5.3.1 and shall have no leakage.

6.11 Urban search and rescue (USAR)

USAR gloves shall meet mechanical and other requirements as set out in Clause 7.

7 Mechanical and other requirements

7.1 Abrasion resistance

Specimens of the outer material from the palm shall be tested in accordance with ISO 12947-4 at a pressure of 9 kPa after the following pretreatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

The specimen shall meet the performance requirements given in Table 5. An abradant that meets the following requirements shall be used:

— Grit: 180.

— Grain type: aluminium oxide.

— Coating density: semi-open.

— Backing: the backing shall consist of suitable-quality paper having a minimum base mass of 110 g/m^2 ± 5,5 g/m^2.

— Adhesive: the adhesive shall be suitable for its purpose.

— Abrasive: the abrasive grain employed shall be suitable for its purpose. Only grain per FEPA P standard shall be used.

The abrasive paper shall have the following characteristics:

— the breaking strength shall be less than:

  — 500 N/50 mm in the longitudinal direction;

  — 250 N/50 mm in the transverse direction;

— the mass of abrasive paper shall be 300 g/m^2 ± 45 g/m^2.

Four test specimens shall be taken from four individual gloves of the same glove series. In case of an irregular design of the palm, the test specimen shall be taken in the area where the least protection is expected (removing the reinforcements that do not cover the whole palm).

Where the test specimen is made of several bonded or unbonded layers, the complete specimen shall be tested with all layers secured together on the edges by stitches or other means. The test can also be carried out on the outer layer. Care shall be taken not to have a seam in the test area.

Table 5 — Classification of abrasion resistance

Performance
No wear-through after 2 000 cycles

7.2 Cut resistance

Specimens of the outer material from the palm and back areas of the glove body component assembly shall be tested in accordance with ISO 13997 after the following pre-treatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2;

c) after laundering specified in 5.3.1 and wetting specified in 5.3.3.

The specimen shall meet the performance level given in Table 6.

In the case of a specimen made of several bonded layers, the complete specimen shall be tested with all layers together. In the case of a specimen made of several unbonded layers, the complete specimen shall be tested with all layers secured together on the edges by stitches or other means. In case of an irregular design of the palm, the test specimen shall be taken from the palm area where the least protection is expected.

Two test specimens shall be taken from two separate gloves.

Table 6 — Cut resistance

Performance (20 mm blade stroke distance)
RTC: Cut force ≥ 30 N
USAR: Cut force ≥ 15 N

Where cuffs or wristlets are provided, specimens of the glove cuff or glove wristlet component assembly shall be separately tested and shall meet performance requirements given in Table 6.

7.3 Tear resistance

Specimens of outer material from the palm area and back of the hand of the glove body component assembly shall be tested in accordance with ISO 13995 after the following pretreatments:

a) after conditioning specified in 5.4.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

The specimen shall meet the performance requirements given in Table 7.

Table 7 — Tear resistance

Performance
Tear resistance ≥ 25 N

7.4 Puncture resistance

Specimens of sufficient size for testing of the glove body component assembly taken from the palm area of the glove body component assembly shall be tested in accordance with ISO 13996 after the following pretreatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

The specimen shall meet the performance requirements given in Table 8.

Table 8 — Classification of puncture resistance

Performance
Puncture resistance ≥ 60 N

7.5 Label legibility

Specimen glove labels shall be read after the following pretreatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

The specimen shall be legible at a distance of at least 300 mm 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.

7.6 Ergonomic requirements

7.6.1 Dexterity

Specimen gloves shall be tested for dexterity in accordance with EN 420:2003+A1:2009, 6.3 after the following pretreatments:

a) after conditioning specified in 5.3.2;

b) after laundering specified in 5.3.1 and then followed by the conditioning specified in 5.3.2.

The specimen shall have a performance level of 3 or better.

7.6.2 Grip

Specimen gloves shall be tested in accordance with Annex A after the following pre-treatments:

a) after conditioning specified in 5.3.2;

b) after wetting specified in 5.3.3.

The specimen shall have a weight pulling capacity ≥ 80 % of the bare hand control values.

7.6.3 Donning

Specimen gloves when tested in accordance with Annex B after the laundering specified in 5.3.1, shall have a final donning time less than the baseline donning time plus 20 s.

8 Leather chromium(VI) content

Leather used in the construction of gloves shall have a Cr(VI) content of less than 3 mg/kg when tested in accordance with ISO 17075 (all parts).

9 Marking

Gloves for specific rescue activities, for which conformity with this document is claimed, shall have a label permanently and conspicuously attached marked with the reference number of this document, i.e. ISO 18639-4.

General marking requirements shall be as specified in ISO 18639-1 with the exception that sizing shall be marked as specified in 4.2.1.

For the recommended graphical symbols, see Annex D.

10 Manufacturer/supplier information

The manufacturer/supplier information shall include:

a) details of any special tests carried out in a different environment;

b) if relevant, a warning for gloves with two or more layers where the overall classification does not necessarily reflect the performance of the outermost layer.

Annex A
(normative)

Grip test

A.1 Principle

The bare-handed pulling force of a test subject using a halyard attached to a force measuring device is compared with that of the same test subject wearing wet gloves on a dry and wet halyard.

A.2 Equipment

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

A.3 Specimens

A.3.1 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.3.2 Two sets of gloves shall be submitted for testing in a new as-distributed condition without laundering. Gloves shall not receive special softening treatment. The first set shall be conditioned in accordance with 5.3.2. The second set shall be wetted in accordance with 5.3.3.

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 hand circumference for small and large gloves.

A.4.2 Each test subject shall make three successive attempts to pull on the halyard as hard as possible using both hands and with both feet firmly planted on the ground while pulling downward on the halyard. The average force over the three trials shall be the bare-handed pulling force.

Test subject shall not wrap the rope around the hand.

A.4.3 Conditioned specimen gloves as specified in 5.3.2 shall be tested on a dry rope and then on a wet rope.

A.4.4 Wetted specimen gloves as specified in 5.3.3 shall be tested on a dry rope and then a wet rope.

A.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 as specified in A.4.3 and A.4.4, with at least three grip tests with small sized gloves and three grip tests with large sized gloves.

A.4.6 The pulling force of a test subject with gloves shall be compared with the bare-handed pulling force. The percent of bare-hand control is the mean of the values of the pulling force with gloves to bare-handed pulling force, and shall be calculated as follows:

$$\text{Percent of barehand control} = \frac{\text{Pulling force wearing gloves}}{\text{Bare hand pulling force}}$$

A.5 Test report

The percent of bare-hand 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 B
(normative)

Donning test

B.1 Principle

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

B.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 laundered as specified in 5.3.1.

B.3 Procedure

B.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 hand circumference for small and large gloves.

B.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.

B.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.

B.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.

B.3.5 The mean of the times for the first three donnings after removal from the final drying cycle shall be used as the final donning time.

B.4 Test report

The final donning time and the baseline donning time shall be reported to the nearest 0,1 s for each trial. The final and baseline donning times shall be calculated and reported. The pass/fail performance shall be determined using the average final and baseline donning times. One or more glove pair specimens failing this test shall constitute failing performance.

Annex C
(normative)

Whole glove integrity test

C.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. The inner glove is then examined for water marks.

C.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 mass of (50 ± 10) g/m^2 and a thickness of (0,5 ± 0,1) mm.

Water used for integrity testing shall be treated with a non-foaming surfactant at a concentration of 1 g/l in order to lower its surface tension.

C.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.

C.4 Procedure

C.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.

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

C.4.3 The test subject shall immerse the glove specimen in water with temperature (20 ± 3) °C 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.

C.4.4 The test subject shall remove the glove specimen.

C.4.5 The inner glove shall be inspected for water marks.

C.5 Test 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.