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PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures —

Part 4: Gloves

Équipement de protection personnelle pour pompiers — Méthodes d'essai et exigences pour les équipements de protection personnelle utilisés par les pompiers qui sont à risque d'une exposition à des niveaux élevés de chaleur et/ou de flamme quand la lutte contre les incendies survient dans les structures —

Partie 4: Gants

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 94, *Personal protection — Protective clothing and equipment*, Subcommittee SC 14, *Fire-fighters' personal equipment*.

ISO 11999 consists of the following parts, under the general title *PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and to flame while fighting fires occurring in structures*:

— *Part 1: General*

— *Part 2: Compatibility*

— *Part 3: Clothing*

— *Part 4: Gloves*

The following parts are under preparation:

— *Part 5: Helmets*

— *Part 6: Footwear*

— *Part 7: Face and eye protection*

— *Part 8: Hearing*

— *Part 9: Firehoods*

— *Part 10: Respiratory protection*

NOTE The number of this draft has been changed from ISO/DIS 11613-4 to ISO 11999-4. The Committee agreed a new number for this project was appropriate given the scope of the publication of the ISO 11999 series was to cover ensemble standards. It was further agreed that ISO 11613:1999 would remain current

PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures —

Part 4: Gloves

1 Scope

This part of ISO 11999 specifies minimum design and performance requirements for gloves as part of personal protective equipment (PPE) to be used by firefighters, primarily, but not solely, to protect against exposure to flame and high thermal loads.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3146:2000, *Plastics — Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods*

ISO 3175-1, *Textiles — Dry cleaning and finishing — Part 1: Procedures for tetrachloroethylene*

ISO 6330, *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 11999-1:2013, *PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures — Part 1: General*

ISO 11999-2, *PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures — Part 2: Compatibility*

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

ISO 13994:2005, *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, *Protective clothing — Protection against heat and flame — Method of test for limited flame spread*

ISO 16604:2004, *Clothing for protection against contact with blood and body fluids — Determination of resistance of protective clothing materials to penetration by blood-borne pathogens — Test method using Phi-X 174 bacteriophage*

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

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

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

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

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

3 Terms and definitions

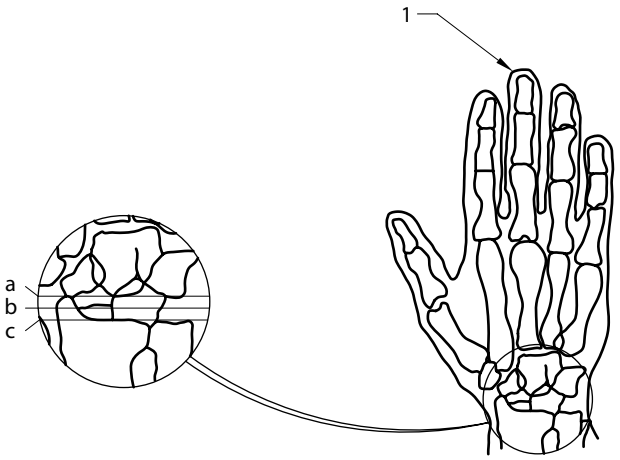
For the purposes of this document, the terms and definitions given in ISO 11999-1 apply.

4 Glove design requirements

Gloves shall consist of a component assembly meeting the design and performance requirements of this part of ISO 11999. The component assembly shall be permitted to be configured as a continuous or joined single layer or as continuous or joined multiple layers. The component assembly shall be permitted to be different for the palm, back, and fingers.

4.1 Glove body length

The glove shall extend circumferentially beyond the wrist crease for 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 the base of the hand

4.2 Wristlet or cuff

Gloves can 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 for at least 50 mm beyond the wrist crease, taking into consideration the requirement specified in 4.1. Where gloves are not provided with a cuff or a wristlet, the sample glove shall extend circumferentially for at least 50 mm beyond the wrist crease, which is a 25 mm addition to the requirement in 4.1.

4.3 Glove sizing

Glove sizing shall be as required in 4.3.1 and 4.3.2.

4.3.1 Minimum sizing

Gloves shall be provided in a minimum of six 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 4.3.2.

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 part of ISO 11999.

4.3.2 Hand dimensions

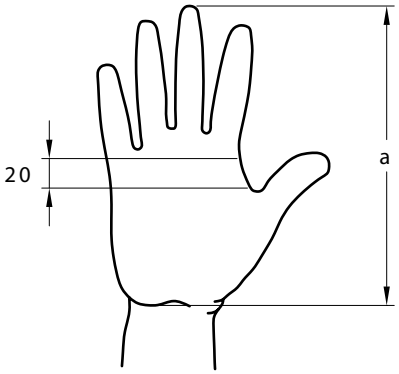
Hand dimensions for the selection of proper glove size shall consist of measuring two dimensions, namely hand circumference and hand length, as shown in Figure 2.

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 the thumb and the 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 millimetre, as shown in Figure 2.

Dimensions in millimetres



Key

a hand length

Figure 2 — Method of measuring hand dimensions for the selection of proper gloves

4.3.3 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.

4.3.4 Other design requirements

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

5 Glove sampling, testing, and pretreatment

Sampling shall be as required in 5.1 and 5.2, testing as required in 5.3, and pretreatment as required in 5.4.

5.1 Sampling levels for testing

Unless otherwise specified, the number and size of specimens for the different tests shall be in accordance with the respective standards.

5.2 Sampling level for determining design compliance

Inspection for determining compliance with the design requirements specified in 4.1 to 4.3 shall be performed on whole gloves with all labels and accessories.

5.3 Testing

Testing for determining material and component compliance with the requirements specified in Clauses 6 to 9 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.

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

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

5.4 Pretreatments

Pretreatments shall be as required in 5.4.1 to 5.4.3.

NOTE Pretreatments are done to provide uniformly treated materials for testing. Ageing, life expectancy, and washing instructions are not to be confused with the following pretreatments.

5.4.1 Pretreatment by laundering or dry cleaning

Pretreatment by laundering or dry cleaning is done to remove finishes and contaminants.

Where specified, 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 of ISO 6330. Washing shall be carried out using procedure 2N at 60 °C ± 3 °C and drying using procedure E (tumble drying) unless otherwise specified in the care labelling.

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.

5.4.2 Conditioning

Unless otherwise specified in the specific test methods, all specimens shall be conditioned at 20 °C ± 2 °C and relative humidity of 65 % ± 5 % for a minimum of 24 h prior to testing.

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

5.4.3 Wet pretreatment

Sample gloves or sample specimens shall be conditioned by completely immersing the glove or the glove 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 or sample specimens shall be removed from water, hung in a vertical position with the fingers up for 5 min, and laid horizontal with textile blotting paper both under and over the specimen, under a differential 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 Glove performance requirements

Gloves, when tested according to the requirements listed in performance level 1 of Table 1, shall achieve at least the minimum performance for all tests. Gloves shall be classified according to the performance they can achieve.

Table 1 — Classification of performance

Performance category	Performance level	1	2	3
a) Thermal	7.1 Flame resistance	Required	Required	
	7.2 Heat transfer (flame exposure)	HTI > 13 and $HTI_{24} - HTI_{12} \geq 4$	HTI > 17 and $HTI_{24} - HTI_{12} \geq 6$	
	7.3 Heat transfer (radiant exposure)	RHTI > 20 and $RHTI_{24} - RHTI_{12} \geq 4$	RHTI > 26 and $RHTI_{24} - RHTI_{12} \geq 8$	
	7.4 Heat transfer (combined flame and radiant exposure) — Alternative to 7.2 and 7.3	TTI > 1 050	TTI > 1 400	
	7.5 Heat transfer (conductive exposure), s	$t_t > 10$	$t_t > 14$	
	7.6 Heat resistance, °C	≤ 180	≤ 260	
	7.7 Thread heat resistance, °C	≤ 260	≤ 260	
b)Mechanical	8.1 Abrasion resistance, cycle	≥ 2 000	≥ 8 000	≥ 8 000
	8.2 Cut resistance, N	≥ 5	≥ 10	≥ 15
	8.3 Tear resistance, N	≥ 25	≥ 40	≥ 50
	8.4 Puncture resistance, N	≥ 60	≥ 90	≥ 120
c) Barrier	9.1 Water penetration resistance	No drops	No drops	
	9.2 Liquid penetration resistance	Not required	No penetration ≤ 1 h	
	9.3 Liquid penetration resistance (runoff method)	Not required	> 80 % runoff and no penetration	
	9.4 Whole glove integrity	Not required	No leakage	
	9.5 Viral penetration resistance	Not required	No penetration	
d) Ergonomic	10.1 Dexterity	> level 1	> level 2	
	10.2 Grip	> 80 % of bare hand control	> 80 % of bare hand control	
	10.3 Linear inversion	No inversion	No inversion	
	10.4 Dry hand donning and doffing time, *s*	< 10	< 10	
	Wet hand donning and doffing time, *s*	< 20	< 20	

The performance level for each performance category in Table 1 shall be determined by the lowest level achieved for the required testing in the respective performance category. For example, where a glove or multilayer assembly can achieve performance level 1 for some tests and performance level 2 for other tests within a performance category, it shall be classified as performance level 1.

The classification of firefighter gloves shall be determined based on their ability to satisfy the performance requirements in the thermal performance category as specified in Table 1. Gloves achieving performance level A1 for the thermal category shall be type 1 gloves. Gloves achieving performance level A2 for the thermal category shall be type 2 gloves.

The mechanical, barrier, and ergonomic performance levels of firefighter gloves shall be reported based on their ability to satisfy the performance requirements in the mechanical, barrier, and ergonomic

performance category, respectively, as specified in Table 1. The thermal, mechanical, barrier, and ergonomic performance levels shall be reported as required in ISO 11999-1:2013, Clause 6.

7 Glove thermal performance requirements

The thermal requirements for firefighter gloves shall be as required in 7.1 to 7.7.

7.1 Flame resistance

The glove component assembly, when tested in accordance with ISO 15025 using the procedures for surface ignition, both after conditioning according to 5.4.2 and after pretreatment according to 5.4.1 followed by 5.4.2, shall meet the following requirements.

a) No specimen shall exhibit hole formation in any layer.

b) No specimen shall produce flaming or molten debris.

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

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

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 fingertips. 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.

For testing finger tips, use the test method in ISO 15025, procedure A, surface ignition, with the following modifications.

a) The gloves shall be mounted in a vertical position so that the longest finger of the glove hangs down lowest. See Figure 3.

b) The burner is positioned below the glove so that it is in the plane normal to the palm of the hand and including the longest finger of the glove, plane A. Plane A is perpendicular to the plane of the palm of the glove, plane B.

c) The burner is mounted at an angle of 30° ± 3° to plane B, with the tip of the flame contacting the lowest point of the glove or finger.

d) The vertical distance between the top of the burner and the lowest point of the glove or finger shall be 20 mm ± 2 mm.

Performance shall be determined using the worst performance from all areas of the glove that are tested.

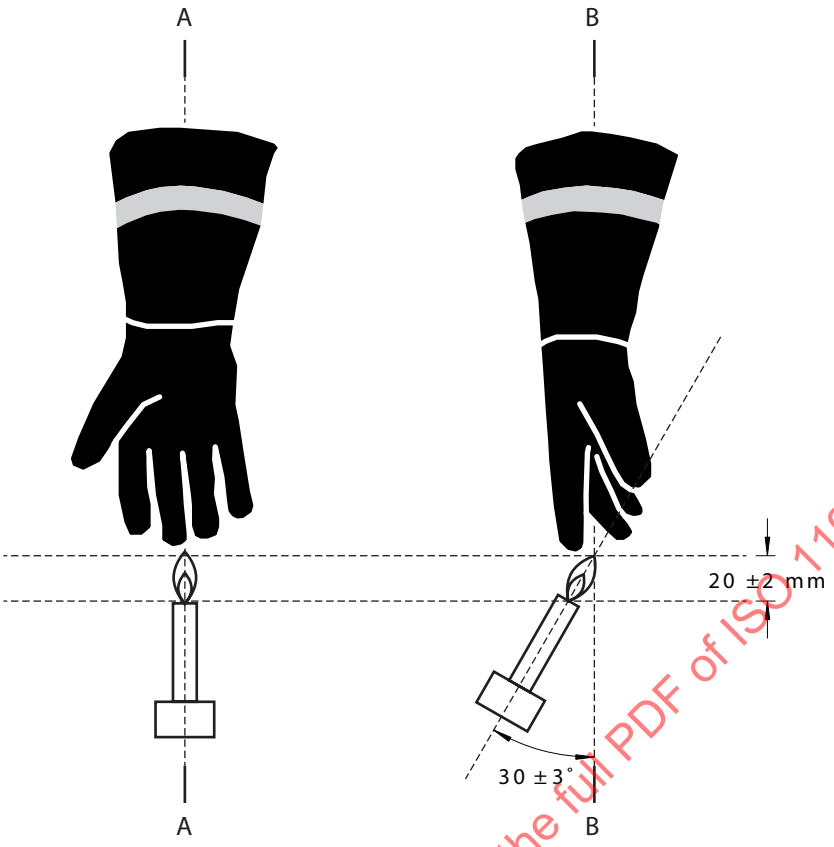


Figure 3 — Position of the glove relative to the burner for testing fingers

7.2 Heat transfer (flame exposure)

The glove component assembly, or material assembly of the same construction but of sufficient size for testing, when tested in accordance with ISO 9151, shall be classified according to the levels of performance given in Table 2. Testing shall be performed on the glove component assembly after the following pretreatments:

a) after conditioning specified in 5.4.2;

b) after the pretreatment specified in 5.4.1, followed by conditioning specified in 5.4.2.

Table 2 — Classification of heat transfer (flame exposure)

Performance level A		1	2
Heat transfer index	HTI_{24}	≥ 13	≥ 17
	$HTI_{24} - HTI_{12}$	≥ 4	≥ 6

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

7.3 Heat transfer (radiant exposure)

The glove component assembly, or material assembly of the same construction but of sufficient size for testing, when tested in accordance with method B of ISO 6942:2002, 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 conditioning specified in 5.4.2;

b) after the pretreatment specified in 5.4.1, followed by conditioning specified in 5.4.2.

Table 3 — Classification of heat transfer (radiant exposure)

Performance level A		1	2
Heat transfer index (heat flux density: 40 kW/m²)	$RHTI_{24}$	≥ 20	≥ 26
	$RHTI_{24} - RHTI_{12}$	≥ 4	≥ 8

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

7.4 Heat transfer (combined flame and radiant exposure)

As an alternative to meeting the requirements of 7.2 and 7.3, the glove component assembly or the material assembly of the same construction but of sufficient size for testing, when tested in accordance with ISO 17492 using the TTI analysis procedure, before and after the pretreatment as specified in 5.4.1 followed by conditioning specified in 5.4.2, shall achieve the performance levels as specified in Table 4.

Table 4 — Heat transfer (combined flame and radiant exposure)

Performance level A	1	2
Thermal threshold index (TTI)	≥ 1 050	≥ 1 400

7.5 Heat transfer (conductive exposure)

The glove component assembly, or material assembly of the same construction but of sufficient size for testing, when tested in accordance with ISO 12127-1 at a contact temperature of 260 °C +5/−0 °C shall be classified according to the levels of performance of the threshold time, t_t, of contact heat transmission given in Table 5. Testing shall be performed on the glove component assembly after the following pretreatments:

a) after conditioning specified in 5.4.2;

b) after the pretreatment specified in 5.4.1, followed by conditioning specified in 5.4.2;

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

Table 5 — Classification of heat transfer (conductive exposure)

Performance level A	1	2
Threshold time (t_t) s	≥ 10	≥ 14

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

7.6 Heat resistance

Complete glove specimens, when tested in accordance with the method given in ISO 17493, using the procedures for protective gloves, at the test temperature corresponding to the level of performance given in Table 6 and before and after the pretreatment specified in 5.4.1, shall not melt, separate, or ignite, and shall not shrink in length or width more than as specified in Table 6. For performance level A2, the glove body shall be filled to capacity with nominal 4-mm-sized perforated soda lime or borosilicate glass beads prior to exposing them to heat in the oven.

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 6 and before and after the pretreatment specified in 5.4.1, shall not melt, separate, or ignite.

Table 6 — Classification of heat resistance

Performance level A	1	2
Heat resistance	Pass at 180 °C +5/−0 °C, shrinkage ≤ 5 %	Pass at 260 °C +5/−0 °C, shrinkage ≤ 5%

7.7 Thread heat resistance

All thread utilized in the construction of the protective glove, when tested in accordance with ISO 3146:2000 method B at a temperature of 260 °C +5/−0 °C, shall not ignite, melt, or char.

8 Glove mechanical performance requirements

8.1 Abrasion resistance

Specimens of sufficient size for testing of the outer material of the glove body component assembly, when tested in accordance with ISO 12947-2 with a 300 g/m^2 finished 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 7.

Table 7 — Classification of abrasion resistance

Performance level b	1	2, 3
Wear through cycles	> 2 000	> 8 000

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

8.2 Cut resistance

Specimens of the glove body component assembly, or material assembly of the same construction but of sufficient size for testing, from the palm, back sides, and fingertips, when tested in accordance with ISO 13997, shall be classified according to the levels of performance given in Table 8. Testing shall be performed on the glove body assembly after the following pretreatments:

a) after pretreatment specified in 5.4.2;

b) after pretreatment specified in 5.4.3.

Table 8 — Classification of cut resistance

Performance level b	1	2	3
Cut force (20 mm blade stroke distance) N	≥ 5	≥ 10	≥ 15

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

For all performance levels, where cuffs or wristlets are provided, specimens of the glove cuff or glove wristlet component assembly shall be separately tested and achieve a cut force of ≥ 7 N.

8.3 Tear resistance

Specimens of sufficient size for testing of the outer material of the glove body component assembly, when tested in accordance with 6.3 of EN 388 after the pretreatment specified in 5.4.2, shall be classified according to the levels of performance given in Table 9.

Table 9 — Classification of tear resistance

Performance level b	1	2	3
Tear resistance N	≥ 25	≥ 40	≥ 50

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

8.4 Puncture resistance

Specimens of sufficient size for testing 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 10.

Table 10 — Classification of puncture resistance

Performance level b	1	2	3
Puncture resistance N	≥ 60	≥ 90	≥ 120

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

9 Glove moisture barrier performance

9.1 Water penetration resistance

Specimens of the glove moisture barrier component and its seams, shall be tested in accordance with ISO 811 at 20 kPa for a period of 5 min after the pretreatments specified in 5.4.1 and conditioning in 5.4.2, and shall allow no appearance of water drops for performance level c_1 and c_2.

9.2 Liquid penetration resistance

Specimens of the glove moisture barrier component and its seams, when tested in accordance with ISO 13994:2005 using procedure C after the pretreatments specified in 5.4.1 and conditioning specified in 5.4.2, shall be classified according to the levels of performance given in Table 11 for the following liquids:

a) 40 % sodium hydroxide (NaOH) at 20 °C ± 2 °C;

b) 36 % hydrochloric acid (HCl) at 20 °C ± 2 °C;

c) 37 % sulfuric acid (H_2SO_4) at 20 °C ± 2 °C;

d) 100 % o-xylene at 20 °C ± 2 °C.

Table 11 — Classification of liquid penetration resistance

Performance level c	1	2
Time of penetration of any liquid min	Not required	> 60

9.3 Liquid penetration resistance (runoff method)

Specimens of the glove moisture barrier component and its seams, when tested in accordance with ISO 6530 using

a) 40 % sodium hydroxide (NaOH) at 20 °C ± 2 °C,

b) 36 % hydrochloric acid (HCl) at 20 °C ± 2 °C,

c) 37 % sulfuric acid (H_2SO_4) at 20 °C ± 2 °C, or

d) 100 % o-xylene at 20 °C ± 2 °C,

shall be classified according to the levels of performance given in Table 12.

All tests shall be carried out with a pouring time of 10 s ± 1 s and at a temperature of 20 °C ± 2 °C.

Table 12 — Classification of liquid penetration resistance

Performance level c	1	2
Runoff	Not required	> 80 % (no penetration to innermost surface)

9.4 Whole glove integrity

Specimen gloves, when tested in accordance with 11.1, after the pretreatments specified in 5.4.1, shall be classified according to the levels of performance given in Table 13.

Table 13 — Classification of whole glove integrity

Performance level c	1	2
Leakage	Not required	No leakage

9.5 Viral penetration resistance

Specimens of glove moisture barrier component seams, when tested in accordance with ISO 16604:2004, after the pretreatments specified in 5.4.1, by being subject to a pressure and time sequence of 0 kPa for 5 min, followed by 14 kPa for 1 min and 0 kPa for ≥54 min. The specimens shall achieve the performance levels specified in Table 14. A retaining screen shall not be used to support the specimen.

Table 14 — Classification of viral penetration resistance

Performance level c	1	2
Time of penetration of Phi-X 174 min	Not required	≥ 60

10 Glove ergonomic performance requirements

10.1 Dexterity

Specimen gloves, when tested for dexterity in accordance with 6.2 of EN 420:2003 A1:2009 after the pretreatment specified in 5.4.1, shall achieve the performance required by Table 15.

Table 15 — Classification of dexterity

Performance level d	1	2
Dexterity level	≥ 1	≥ 2

10.2 Grip

Specimen gloves, when tested according to 11.2, shall have a weight-pulling capacity according to the performance required by Table 16.

Table 16 — Classification of grip

Performance level d	1	2
Weight-pulling capacity relative to bare hand %	≥ 80	≥ 80

10.3 Liner inversion

No part of the liner shall invert when the hand is withdrawn from the glove.

10.4 Ease of donning and doffing

Gloves of both performance levels shall be tested according to 11.4. shall have an average dry hand donning and doffing time for both dry and wet gloves not to exceed 10 s and an average wet hand donning and doffing time for both dry and wet gloves not to exceed 20 s, and shall allow the test to be completed, having no detachment of the inner liner, or moisture barrier, and allowing full insertion of all digits.

11 Glove test methods

11.1 Whole glove integrity test

11.1.1 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.

11.1.2 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 g/m^2 ± 10 g/m^2 and a thickness of 0,5 mm ± 0,1 mm.

Water used for integrity testing shall be treated with a non-foaming surfactant to lower its surface tension to less than 34 dyn/cm ± 5 dyn/cm.