

NATIONAL STANDARD OF CANADA NORME NATIONALE DU CANADA

CAN/ULC-60903-15 (IEC 60903:2014 MOD)

La norme internationale IEC 60903:2014, (troisième édition, 2014-07), a été adoptée avec les exigences propres au Canada (MOD), et porte la désignation **CAN/ULC-60903-15** la troisième édition. Elle a été approuvée comme Norme nationale du Canada par le Conseil canadien des normes.

ISSN 0317-526X

Juin 2015

International Standard IEC 60903:2014 (Third Edition, 2014-07), has been adopted with Canadian deviations (MOD) as the Third Edition of **CAN/ULC-60903-15**, which has been approved as a National Standard of Canada by the Standards Council of Canada.

ISSN 0317-526X

June 2015

Travaux sous tension – Gants isolants électriques

ICS 13.260, 29.240.20, 29.260.99

Live working – Electrical insulating gloves

ICS 13.260, 29.240.20, 29.260.99



Numéro de référence
Reference Number
IEC 60903 :2014

**Commission Electrotechnique Internationale
International Electrotechnical Commission**

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NORME NATIONALE DU CANADA

NATIONAL STANDARD OF CANADA

CAN/ULC-60903-15
(IEC 60903:2014, MOD)

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électriques**

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**Live working – Electrical insulating
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Préparée par / Prepared by
**International Electrotechnical Commission
Commission Électrotechnique Internationale**



Examinée par / Reviewed by



Approuvée par le / Approved by



Première Édition / First Edition.....Octobre / October 2004
Deuxième Édition / Second Edition..... Mai / May 2009
TROISIÈME ÉDITION / THIRD EDITION..... JUIN 2015/ JUNE 2015

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La composition du comité peut avoir changé depuis ce temps-là.

This list represents the membership at the time the Committee balloted on the final text of this edition. Since that time, changes in the membership may have occurred.

CAN/ULC-60903-15

(IEC 60903:2014, MOD)

Travaux sous tension – Gants isolants électriques

PRÉFACE NORMES ULC

Ce document constitue la troisième édition de la norme, CAN/ULC-60903-15 (IEC 60903 :2014, MOD), Travaux sous tension – Gants isolants électriques, laquelle constitue une adoption, avec les exigences propres au Canada, de la norme internationale de la Commission Électrotechnique Internationale, IEC 60903 (troisième édition, 2014-07).

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Cette troisième édition de la norme nationale du Canada remplace désormais la deuxième édition.

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La présente norme est destinée à être utilisée à des fins d'évaluation de la conformité.

Une grande partie du financement nécessaire au processus d'adoption de cette Norme nationale du Canada a été assurée par l'association canadienne de l'électricité (ACE) que nous tenons à remercier.

Juin 2015

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CAN/ULC-60903-15

(IEC 60903:2014, MOD)

Live working – Electrical insulating gloves

ULC STANDARDS PREFACE

This is the Third Edition of the Standard CAN/ULC-60903-15 (IEC 60903:2014, MOD), Live working – Electrical insulating gloves, with Canadian Deviations, of the international standard by International Electrotechnical Commission, IEC 60903:2014 (Third Edition, 2014-07).

In Canada there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

The requirements of the Third Edition of this National Standard now supersede the Second Edition.

Attention is drawn to the possibility that some of the elements of this Canadian standard may be the subject of patent rights. ULC Standards shall not be held responsible for identifying any or all such patent rights.

The initiation of the review of this Standard will commence within 5 years of the date of publication, unless the Standard is identified as fitting within a stabilized category, whereby the review will commence within the appropriate time frame set out by ULC Standards

This Standard is intended to be used for conformity assessment.

Major funding in support of the adoption process of this National Standard of Canada was provided by the Canadian Electricity Association (CEA), whose assistance is acknowledged with thanks.

June 2015

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Exigences propres au Canada

GÉNÉRALITÉS

[Remplacez tous les références «IEC 61318» dans le document avec « CAN/ULC-61318 »]

[Remplacez tous les références «IEC 61477» dans le document avec « CAN/ULC-61477 »]

2 RÉFÉRENCES NORMATIVES

[Reviser les références IEC 61318 et IEC 61477 comme suit:

« CAN/ULC-61318-08, Travaux sous tension – Évaluation de la conformité applicable à l'outillage, au matériel et aux dispositifs (CEI/IEC 61318:2007, IDT)»

« CAN/ULC-61477-11, Travaux sous tension – Exigences minimales pour l'utilisation des outils, dispositifs et équipements (CEI/IEC 61477:2009, MOD)»]

4.6 MARQUAGE

[Supprimer la première point avec tiret relatif au « - symbole IEC 60417-5216:2002-10...» et la REMARQUE connexe]

[Réviser le deuxième point avec tiret comme suit :]

« –numéro de la norme CAN/ULC applicable (CAN/ULC-60903). »]

[Réviser le deuxième paragraphe «Les gants composites doivent aussi être identifiés...» pour indiquer ce qui suit :

«Les gants composites doivent être identifiés avec symbole mécanique (marteau) (voir Figure 3). »]

ANNEXE A

[Ajouter un nouveau paragraphe à A.6 comme suit :

« Pour les gants de la catégorie 4 seulement, la valeur efficace de l'essai de surcharge du contre-essai électrique peut être révisée pour passer de la valeur indiquée au tableau 6 à une valeur efficace réduite déterminée à l'aide de la formule suivante :

Tension d'essai de surcharge minimale = tension nominale maximale + 2 000 V + (0,05 x tension d'essai de surcharge maximale)¹

p. ex. tension d'essai de surcharge minimale = 26 500 V + 2 000 V + (0,05 x 40 000 V) = 30 500 V rms

Si un gant de catégorie 4 est vérifié à une tension d'essai de surcharge inférieure à celle indiquée au tableau 6, il doit être marqué de façon durable (voir 5.3.2) à côté de la désignation de catégorie du fabricant ou de la tension d'utilisation maximale avec la nouvelle tension nominale maximale désignée de l'utilisateur (tension d'utilisation maximale).

¹ ASTM D120-14, Standard Specification for Rubber Insulating Gloves »

ANNEXE B

[Supprimer l'annexe B.]

Canadian Deviations

GENERAL

[Change all "IEC 61318" references in the document to read "CAN/ULC-61318"]

[Change all "IEC 61477" references in the document to read "CAN/ULC-61477"]

2 NORMATIVE REFERENCES

[Revise IEC 61318 and IEC 61477 to read:

"CAN/ULC-61318-08, Live Working – Conformity assessment applicable to tools, devices and equipment (CEI/IEC 61318:2007, IDT)"

"CAN/ULC-61477-11, Live Working – Minimum requirements for the utilizations of tools, devices and equipment (CEI/IEC 61477:2009, MOD)"]

4.6 MARKING

[Delete the first dash item regarding "- symbol IEC 60417-5216:2002-10..." and accompanying NOTE]

[Revise the second dash item to state:

"– number of the relevant CAN/ULC standard (CAN/ULC-60903)."]

[Revise the second paragraph regarding "composite gloves shall also be identified..." to state: "composite gloves shall also be identified with a mechanical symbol (hammer) (see Figure 3)".]

ANNEX A

[Add new paragraph to A.6 to read:

"For class 4 gloves only, the electrical re-testing proof test rms value can be revised from that specified in Table 6 to a reduced rms value as determined by the following formula:

Minimum proof test voltage = Maximum nominal voltage + 2 000 V + (0.05 x Maximum Proof Test Voltage)¹

e.g., Minimum proof test voltage = 26 500 V + 2 000 V + (0.05 x 40 000 V) = 30 500 V rms

If a class 4 glove is tested at a proof test voltage less than that specified in Table 6, it shall be durably marked (see 5.3.2) adjacent to the manufacturer's class designation or maximum use voltage indication with the user's new designated maximum nominal voltage (maximum use voltage).

¹ ASTM D120-14, Standard Specification for Rubber Insulating Gloves"]

ANNEX B

[Delete Annex B]

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Live working – Electrical insulating gloves

Travaux sous tension – Gants isolants électriques



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IEC 60903

Edition 3.0 2014-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Live working – Electrical insulating gloves

Travaux sous tension – Gants isolants électriques

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

XA

ICS 13.260; 29.240.20; 29.260.99

ISBN 978-2-8322-1781-8

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**LIVE WORKING –
ELECTRICAL INSULATING GLOVES****FOREWORD**

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International Standard IEC 60903 has been prepared by IEC technical committee 78: Live working.

This third edition cancels and replaces the second edition of IEC 60903, published in 2002. It constitutes a technical revision.

The major changes are:

- clarification of the requirements and tests for *long gloves*;
- introduction of a new special property for gloves resistant to leakage current;
- removal of the requirement for an area to mark the date of inspection;
- for the thickness measurement, no other instrument than the micrometer with specified parameters is allowed;
- the d.c. electric tests are no longer included in the normative part of the document but a proof test is suggested at the production level where a d.c. use of gloves is expected, as presented in a new informative Annex E;

- preparation of the elements of evaluation of defects, and general application of IEC 61318:2007;
- the normative Annex C on sampling plans and procedure has been deleted (not applicable according to IEC 61318:2007);
- in the new normative Annex F, updating of the characteristics of the liquid specified for tests on gloves of category H, according to the latest edition of ISO 1817;
- the informative Annex H on acceptance tests has been deleted (consideration now included in IEC 61318:2007);
- introduction of a new normative Annex H on classification of defects;
- introduction of a new informative Annex I on the rationale for the classification of defects;
- review of the annex on in-service recommendations.

The text of this standard is based on the following documents:

FDIS	Report on voting
78/1043/FDIS	78/1056/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

Terms defined in Clause 3 are given in italic print throughout this standard.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

Document IEC 60903:2014

INTRODUCTION

In this document, the clauses on requirements and testing are reorganized in order to bring together the common requirements and tests, then to lay down separately those which are specific to insulating gloves for electrical protection normally worn under leather protector gloves as opposed to those specific to insulating gloves for combined electrical and mechanical protection. This arrangement meets the basic necessity that a same quality level of electrical insulation is achieved for all types of *electrical insulating gloves*.

This document has been prepared according to the requirements of IEC 61477 where applicable.

The product covered by this standard may have an impact on the environment during some or all stages of its life cycle. These impacts can range from slight to significant, be of short-term or long-term, and occur at the global, regional or local level.

Except for a disposal statement in the Instructions for use, this standard does not include requirements and test provisions for the manufacturers of the product, or recommendations to the users of the product for environmental improvement. However, all parties intervening in its design, manufacture, packaging, distribution, use, maintenance, repair, reuse, recovery and disposal are invited to take account of environmental considerations.

LIVE WORKING – ELECTRICAL INSULATING GLOVES

1 Scope

This International Standard is applicable to *electrical insulating gloves* and *mitts* that provide protection of the worker against electric shock.

Unless otherwise stated, the use of the term “glove” includes both gloves and *mitts*.

This standard also covers *electrical insulating gloves* with additional integrated mechanical protection referred to in this document as “*composite gloves*”.

The products designed and manufactured according to this standard contribute to the safety of the users provided they are used by skilled persons, in accordance with safe methods of work and the instructions for use.

NOTE Insulating gloves are normally to be used in conjunction with leather protector gloves to provide mechanical protection. *Composite insulating gloves* are normally used without over-gloves.

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.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60212, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

IEC 60417, *Graphical symbols for use on equipment*

IEC 61318:2007, *Live working – Conformity assessment applicable to tools, devices and equipment*

IEC 61477, *Live working – Minimum requirements for the utilization of tools, devices and equipment*

ISO 23529, *Rubber – General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61318 as well as the following apply.

3.1**bell cuff glove**

glove with an enlarged shape from the *wrist* to the *cuff* in such a way as to facilitate pull-on over a thick garment

3.2**composite glove**

electrical insulating glove made with additional integrated mechanical protection of the glove

[SOURCE: IEC 60050-651:2014, 651-23-03 and IEC 60743:2013, 8.2.1, modified – The definition clarifies that the mechanical protection is an additional one]

3.3**contour glove**

glove shaped at the upper part of the *gauntlet* in such a way as to facilitate the bending of the arm and intended for gloves that extend to or above the elbow

3.4**cuff**

open part of a glove

3.5**cuff roll**

roll or reinforced edge of a glove at the *cuff*

3.6**disruptive discharge**

passage of an arc following dielectric breakdown

Note 1 to entry: The term “flashover” (in French “contournement”) is used when a *disruptive discharge* occurs at least partly along the surface of a solid dielectric surrounded by a gaseous or liquid medium.

Note 2 to entry: The term “puncture” (in French “perforation”) is used when a *disruptive discharge* occurs through a solid dielectric producing permanent damage.

[SOURCE: IEC 60050-604:1987, 604-03-38 modified – the content of the original note has been reduced, modified to suit the application and presented in the form of two notes to entry]

3.7**elastomer**

macromolecular material which returns rapidly to its initial dimensions and shape after substantial deformation by a weak stress and release of the stress

Note 1 to entry: The definition applies under room temperature test conditions.

[SOURCE: ISO 472:2013, 2.327]

3.8**electrical insulating glove**

glove made of *elastomer*, used for the protection of the worker against electric shock

[SOURCE: IEC 60050-651:2014, 651-23-02 and IEC 60743:2013, 8.1.3, modified – The definition is in line with the composition requirements of the standard for the type of insulating material. The note 1 to entry has been deleted]

3.9**fork**

part of glove at the junction of two fingers, or finger and thumb

3.10

formally trained and qualified person

competent person possessing the appropriate practical and theoretical knowledge and having adequate skill and experience to enable the person to perform the required periodic testing, interpret the resultant information and from that information determine that the *electrical insulating glove* is safe to use, and report the importance of any defect found or suspected in relation to the safety and continued use of the *electrical insulating glove*

3.11

gauntlet

part of a glove from the *wrist* to the open part of the glove

3.12

lined glove

glove with an inside lining of textile attached to the *elastomer*

3.13

long glove

electrical insulating glove used to extend the protection to the upper arm

Note 1 to entry: The length of the glove does not include protection up to the armpit.

[SOURCE: IEC 60743:2013, 8.1.5, modified – The whole document is about insulating glove protecting against electric shock so that does not need to be repeated in the term and its definition. The note 1 to entry has been added to clarify the type of protection offered]

3.14

mitt

glove with multiple fingers enclosed in one covering

3.15

nominal voltage of a system

suitable approximate value of voltage used to designate or identify a system

[SOURCE: IEC 60050-601:1985, 601-01-21]

3.16

palm

part of glove covering the face of the central inside hand

3.17

proof test voltage

specified voltage that is applied to a glove for the time defined under specified conditions to assure that the electrical strength of the insulation is above a specified value

3.18

withstand test voltage

voltage that the glove withstands without *disruptive discharge* when voltage is applied under specified conditions

3.19

wrist

narrowest part of the glove between the *cuff* and the hand

4 Requirements

4.1 General

The following requirements have been prepared in order that the products covered by this standard are designed and manufactured to contribute to the safety of the users, provided they are used by persons skilled for live working, in accordance with safe method of work and the instructions for use.

4.2 Classification

The gloves covered by this standard shall be designated as follows:

- by class, as class 00, class 0, class 1, class 2, class 3 and class 4;
- by special properties, by the addition of a suffix to the class of the glove as shown in Table 1.

Guidance as to temperature range at which gloves can be used is given in Annex A.

Table 1 – Special properties

Category	Resistant to
A	Acid
H	Oil
Z	Ozone
R	Acid, oil, ozone
C	Extremely low temperature
F	Leakage current
NOTE 1 Category R combines the characteristics of categories A, H and Z.	
NOTE 2 Category F is for long gloves only.	
NOTE 3 Any combination of categories may be used.	

4.3 Physical requirements

4.3.1 Composition

All gloves may be lined or unlined. They may have an exterior covering and may be specially compounded to reduce the effects of chemical attack. If gloves have an exterior covering, it shall be of a contrasting colour to assist in visual inspection.

Gloves are made of *elastomer*.

Gloves may be manufactured with or without *cuff roll*.

4.3.2 Dimensions

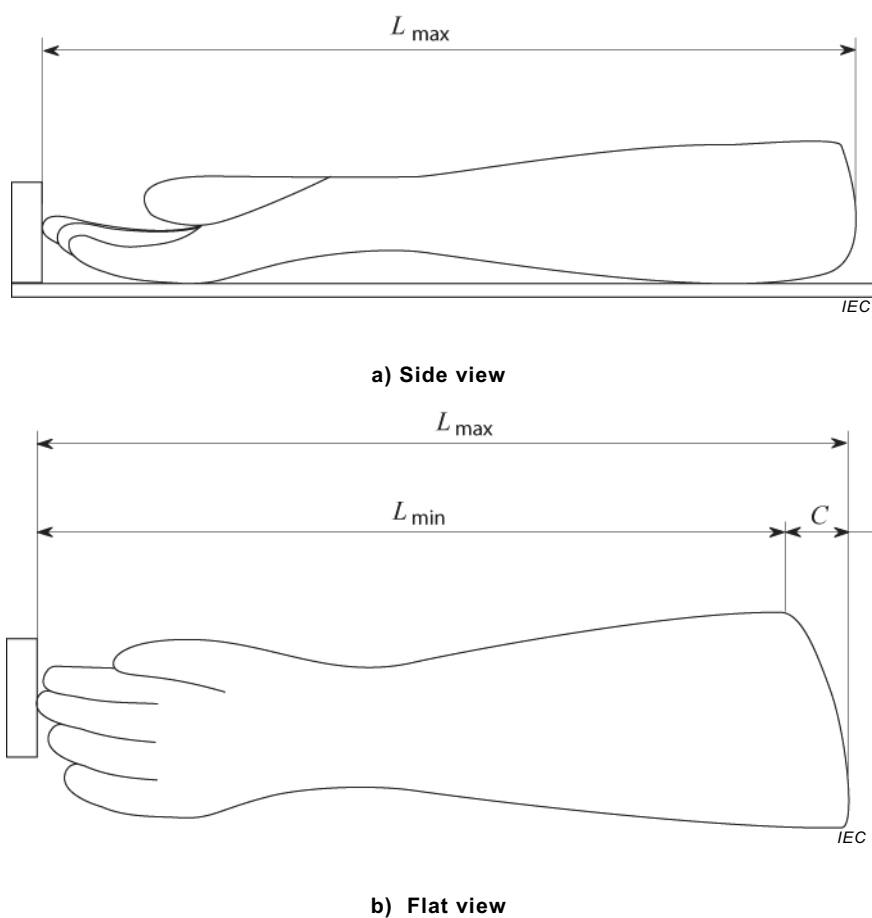
Gloves shall be of the length specified in Table 2.

Table 2 – Standard lengths of gloves

Class	Standard length mm ^b				
00	280	360	–	–	800 ^a
0	280	360	410	460	800 ^a
1	–	360	410	460	800 ^a
2	–	360	410	460	800 ^a
3	–	360	410	460	800 ^a
4	–	–	410	460	800 ^a
^a Long gloves. ^b The tolerance in length shall be ± 15 mm for any class, except for long gloves where tolerance shall be ± 20 mm.					

For contour-cuff gloves, the difference between the maximum and minimum lengths (see Figure 1) shall be $50 \text{ mm} \pm 6 \text{ mm}$ except for *long gloves* where this difference shall be $100 \text{ mm} \pm 12 \text{ mm}$.

NOTE 1 There are different shapes of gloves on the market including *bell cuff gloves*, *contour gloves* and *gauntlets*.



Key

- $L_{\max}$ maximum length
- $L_{\min}$ minimum length
- C contour shall be $50 \text{ mm} \pm 6 \text{ mm}$

Figure 1 – Contour of glove

Palm circumferences shall be defined as follows:

178 mm (size 7), 191 mm (size 7.5), 203 mm (size 8), 216 mm (size 8.5), 229 mm (size 9), 241 mm (size 9.5), 254 mm (size 10), 267 mm (size 10.5), 279 mm (size 11), 292 mm (size 11.5) and 305 mm (size 12).

The tolerance in size shall be ± 13 mm.

NOTE 2 Additional sizes may be available following agreement between manufacturer and client.

4.3.3 Thickness

The minimum thickness shall be determined only by the ability to pass the dielectric tests defined in 5.6.

The maximum thickness on the flat surface of a glove (no ribbed area if present) shall be as given in Table 3 in order to obtain the appropriate flexibility.

Table 3 – Maximum thickness of the gloves

Class	Thickness mm	
	Gloves	Composite gloves
00	0,50	1,8
0	1,00	2,3
1	1,50	2,8
2	2,30	3,3
3	2,90	3,6
4	3,60	4,2

Long gloves may require additional thickness which shall not exceed 0,6 mm.

Gloves of categories A, H, Z and R may require additional thickness which shall not exceed 0,6 mm.

4.3.4 Workmanship and finish

Gloves shall be free on both inner and outer surfaces from harmful physical irregularities that can be detected by thorough test and inspection.

Harmful physical irregularities shall be defined as any feature that disrupts the uniform, smooth surface contour, such as pinholes, cracks, blisters, cuts, conductive embedded foreign matter, creases, pinch marks, voids (entrapped air), prominent ripples and prominent mould marks.

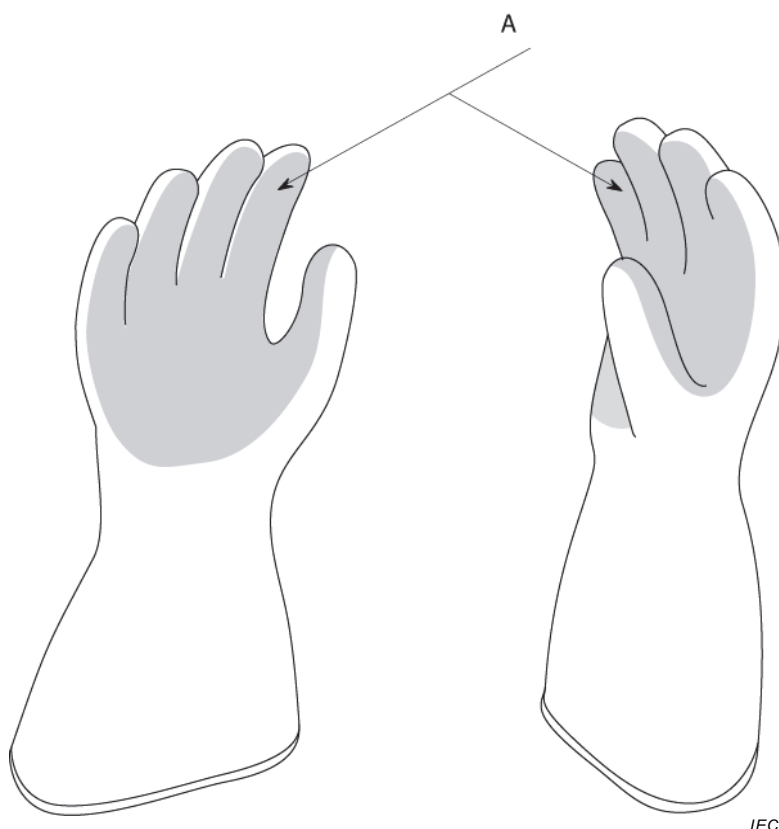
Non-harmful physical irregularities shall be defined as surface irregularities present on the inner and outer surfaces of the glove due to imperfections on molds and inherent difficulties in the manufacturing process. These irregularities may appear as mould marks that look like cuts even though they are actually a raised ridge of material, indentations, protuberances, embedded foreign matter, or colour splashes that are acceptable provided that:

- the indentations, protuberance or mould marks tend to blend into a smooth slope upon stretching of the material;
- foreign material remains in place when the glove is folded and stretched with the material surrounding it;

- c) colour splashes are no larger than 1 mm in any direction on the inner surface of the working area.

The working area is defined as all finger and thumb *forks*, the *palm* and the *palm* side of the fingers and thumb (see Figure 2).

Palm and finger surfaces designed to improve the grip shall not be considered as irregularities.



Key

A working area (shaded)

Figure 2 – Illustration of the working area

4.4 Mechanical, climatic and environmental requirements

Gloves shall withstand the mechanical, climatic and environmental stresses specified in this standard.

Gloves with one or more special categories (see Table 1) shall support any related stresses.

4.5 Electrical requirements

Gloves shall be capable of withstanding the corresponding electrical stresses according to its electrical class.

4.6 Marking

Each glove which is claimed to comply with the requirements of this standard shall bear a label and/or marking giving the following information:

- symbol IEC 60417-5216:2002-10 – Suitable for live working; double triangle (see Annex B);

NOTE The exact ratio of the height of the figure to the base of the triangle is 1,43. For the purpose of convenience, this ratio can be between the values of 1,4 and 1,5.

- number of the relevant IEC standard immediately adjacent to the symbol (IEC 60903);
- name, trademark or identification of the manufacturer;
- category, if applicable;
- size;
- class;
- month and year of manufacture.

Composite gloves shall also be identified with a mechanical symbol (hammer), adjacent to the double triangle (see Figure 3). The length of the hammer (x) shall be equal to the length of one side of the triangles.

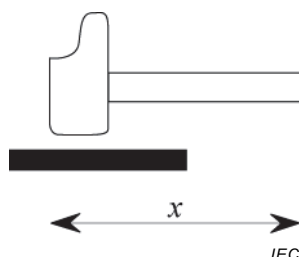


Figure 3 – Composite glove symbol – Hammer

Marking and/or label shall be adjacent to the *cuff* but not closer than 2,5 mm except for *long gloves* for which it shall be not less than 300 mm from the *cuff* in order to allow users to cut the glove at the required length.

Marking shall be on the external surface of the glove and shall be clearly visible and legible to a person with normal or corrected vision without additional magnification.

The marking or label shall not impair the quality of the glove. It shall be durable and shall remain visible after being subjected to a durability test (see 5.3.2).

Any additional marking or label shall be subject to agreement between the manufacturer and the customer.

When a colour code for symbols is used, it shall correspond to the following:

- class 00 – beige;
- class 0 – red;
- class 1 – white;
- class 2 – yellow;
- class 3 – green;
- class 4 – orange.

4.7 Packaging

Each pair of gloves shall be packaged in an individual container or package of sufficient strength to so far as is reasonably practicable, properly protect the gloves from damage when transported, handled and stored in accordance with the manufacturers instructions. The

outside of the container or package shall be marked with the name of the manufacturer or supplier, the classification, category, size, length and *cuff* design.

The type of packaging suitable for transport shall be defined by the manufacturer.

4.8 Instructions for use

The manufacturer shall provide written instructions for use with each packaging of gloves covered by this standard.

The instructions for use shall include information on storage, handling, disposal, periodic inspection, periodic testing and reference to the standard with its date of publication. Additional information may be provided.

These instructions shall be prepared in accordance with the general provisions of IEC 61477.

5 Tests

5.1 General

The present standard provides testing provisions to demonstrate compliance of the product to the requirements of Clause 4. These testing provisions are primarily intended to be used as type test for validation of the design input. Where relevant, alternative means (calculation, examination, tests, etc.), are specified within the test subclauses for the purpose of gloves having completed the production phase.

The allocation of the gloves into various testing groups, the quantity required and the order in which the type tests are carried out are given in Annex C.

Gloves shall pass all type tests.

Gloves which have been subjected to type tests shall not be reused.

Unless otherwise specified, gloves for type test shall be preconditioned for a period of $2\text{ h} \pm 0,5\text{ h}$ at a temperature of $23\text{ °C} \pm 2\text{ °C}$ and $50\% \pm 5\%$ relative humidity.

Where relevant, testing equipments shall comply with IEC 60060-1. Measuring systems shall comply with IEC 60060-2 unless otherwise specified.

NOTE It is essential that the tests are done by a competent test facility.

5.2 Visual and dimensional inspection

5.2.1 General

Visual inspection shall be carried out by a person with normal or corrected vision without additional magnification, under normal lighting conditions.

5.2.2 Classification

It shall be checked by visual inspection that the requirements of 4.2 are fulfilled.

5.2.3 Dimensions

The length of the glove shall be measured from the tip of the second finger to the outer edge of the *cuff*. The measurement is made with the glove in a relaxed position and the edge of the *cuff* perpendicular to the line of measurement.

The difference in length for contour-*cuff* gloves shall be measured with the glove in the relaxed position, along a line parallel to the length dimension, as shown in Figure 1.

The circumference of the hand shall be measured with a measuring tape, 20 mm from the crotch between the thumb and index finger.

5.2.4 Thickness

On a single glove, thickness measurements shall be made as follows:

- at four or more points on the *palm* of the glove;
- at four or more points on the back of the glove but not on the *cuff*;
- at one or more points on the thumb and on the index finger in the “finger print” area.

Such points shall be distributed over the surface and not concentrated. They shall not be distributed on parts of the surface especially designed to improve the grip.

Measurements shall be made with a micrometer. The micrometer shall be graduated to within 0,02 mm and have an anvil of about 6 mm in diameter and a flat presser foot $3,17 \text{ mm} \pm 0,25 \text{ mm}$ in diameter. The presser foot shall exert a total force of $0,83 \text{ N} \pm 0,03 \text{ N}$. Sufficient support shall be given to the glove so that it presents an unstressed, flat surface between the anvil faces of the micrometer.

5.2.5 Workmanship and finish

The workmanship and finish shall be verified by visual inspection and, when found necessary, by dimensional inspection. The test shall be considered as passed if the requirements of 4.3.4 are satisfied.

5.3 Marking

5.3.1 Visual and dimensional inspection

Compliance with the requirements of 4.6 shall be verified by visual and dimensional inspection.

5.3.2 Durability of marking

The durability of marking shall be checked by rubbing the marking for 15 s with a piece of lint-free cloth soaked in soapy water and then rubbing it for a further 15 s with a piece of lint-free cloth soaked in isopropanol ($\text{CH}_3\text{-CH(OH)-CH}_3$).

It is the employer's duty to ensure that any relevant legislation and any specific safety instructions regarding the use of isopropanol are fully observed.

The test shall be considered as passed if the items of marking remain legible and the letters do not smear.

Marking produced by an engraving or moulding process shall be deemed to comply without a test for durability.

5.4 Packaging and instructions for use

The packaging and complete supply of the information required in 4.7 and 4.8 shall be verified by visual inspection.

5.5 Mechanical tests

5.5.1 General

All mechanical tests shall be performed on test pieces which have been conditioned in accordance with ISO 23529.

In the case of *lined gloves*, special unlined gloves shall be used in order to carry out the tensile strength test and the tension set test.

5.5.2 Tensile strength and elongation at break

5.5.2.1 Type test

Four test pieces having the dumb-bell outline shown in Figure 4 shall be cut from each glove under test; one from the *palm*, one from the back and two from the *wrist* area.

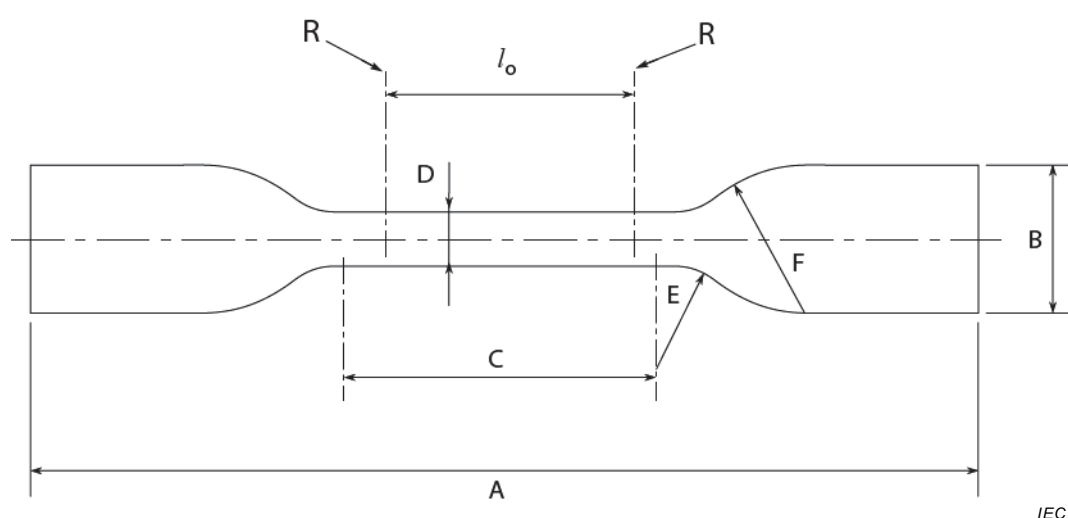
Reference lines, 20 mm apart (l_0), shall be marked on these test pieces, symmetrically placed on the narrow part of the dumb-bell (see Figure 4).

The test pieces shall be tested in a tensile testing machine which shall be power driven at a sufficient speed to maintain the rate of traverse of the driven grip substantially constant up to the maximum force capacity of the machine. The rate of traverse shall be 500 mm/min $\pm$ 50 mm/min. The machine should be equipped to give a continuous indication of the force applied to the test piece and a graduated scale to measure the elongation. After the test piece has been broken, the machine should give a permanent indication of the maximum force and, where possible, the maximum elongation

The tensile strength shall be calculated by dividing the force at break by the initial area of the cross section under test.

The test shall be considered as passed if:

- the average tensile strength is not less than 16 MPa, and
- the average elongation at break is not less than 600 %.



Key	Dimensions mm
A	75
B	$12,5 \pm 1,0$
C	25 ± 1
D	$4 \pm 0,1$
E	$8 \pm 0,5$
F	$12,5 \pm 1$
l_o	20
R	Reference line

Figure 4 – Dumb-bell test piece for mechanical tests (plan view)

5.5.2.2 Alternative tests in case of gloves having completed the production phase

At the production stage, it is not possible to perform the test of 5.5.2.1 which is destructive.

Nevertheless, the manufacturer shall prove that he has followed the same documented manufacturing procedure as per the type-tested glove.

The manufacturer shall document components that could affect tensile strength and elongation at break performance.

Moreover, a sampling test in accordance with 5.5.2.1 shall be performed with the sampling plan specified in Table 4. When lot size is less than sampling size, the lot manufactured shall be great enough to provide the required sample, e.g. a lot of 2 will require a minimum lot size of 3.

Table 4 – Sampling plan

Lot Unit = 1 glove	Sample size	Number of defects for acceptance	Number of defects for rejection
2 to 90	3	0	1
91 to 3 200	13	1	2
3 201 to 35 000	20	2	3

5.5.3 Resistance to mechanical puncture

5.5.3.1 Type test

Two circular test pieces 50 mm in diameter shall be cut from the glove and each shall be clamped between two flat test plates of 50 mm diameter. The top plate shall have a circular opening of 6 mm in diameter and the bottom plate a 25 mm diameter circular opening. The edges of both openings shall be rounded to a radius of 0,8 mm (see Figure 5).

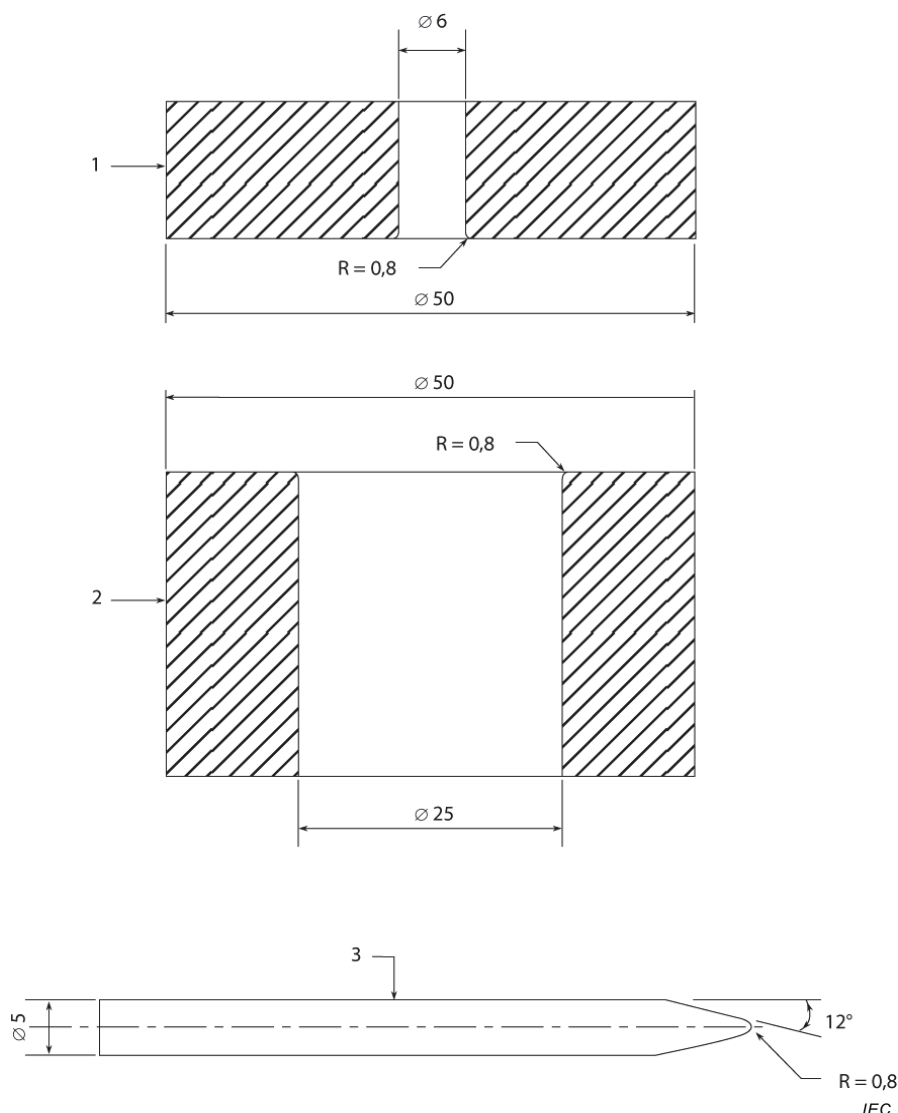
A needle shall be made from a 5 mm diameter metallic rod and one end shall be machined to produce a taper having an angle of 12° and with the tip rounded to a radius of 0,8 mm (see Figure 5). The needle shall be clean at time of use.

The needle shall be positioned perpendicularly above the test piece (clamped between the plates) and shall be driven into and through the test piece. The rate of traverse shall be 500 mm/min $\pm$ 10 mm/min. The force required to puncture the test piece shall be measured.

The test shall be considered as passed if each measured value is greater than 18 N/mm.

In case of *composite gloves*, the test shall be considered as passed if the resistance to mechanical puncture has a force value greater than 60 N.

Dimensions in millimetres except for angles



Key

- 1 top plate
- 2 bottom plate
- 3 needle

Figure 5 – Test plates and needle for resistance to mechanical puncture

5.5.3.2 Alternative tests in case of gloves having completed the production phase

At the production stage, it is not possible to perform the test of 5.5.3.1 which is destructive.

Nevertheless, the manufacturer shall prove that he has followed the same documented manufacturing procedure as per the type-tested glove.

The manufacturer shall document components that could affect puncture resistance performance.

Moreover, a sampling test in accordance with 5.5.3.1 shall be performed with the sampling plan specified in Table 4.

5.5.4 Tension set

5.5.4.1 Type test

Three test pieces, having the outline shown in Figure 4, shall be cut from each glove under test, one from the *palm*, one from the back and one from the *wrist*. Reference lines, 20 mm apart, shall be marked on these test pieces, symmetrically placed on the narrow part of the dumb-bell (see Figure 4). The measurement between the unstrained reference lines shall be checked to the nearest 0,1 mm.

The test pieces shall be fitted in a straining device consisting of a metal rod or other suitable guide fitted with a pair of holders, one fixed and one movable, to hold the ends of the test piece.

The test piece shall be extended at a speed of between 2 mm/s and 10 mm/s to a 400 % ± 10 % elongation and held for 10 min. After this time, the strain shall be released at a speed of between 2 mm/s and 10 mm/s, and then the test piece shall be removed from the holder and laid free on a flat surface. After a 10 min recovery time, the reference length shall be measured again.

The tension set is calculated as a percentage of the initial strain as follows:

$$Tension\ set = 100 \frac{l_1 - l_o}{l_s - l_o}$$

where

l_o is the original unstrained reference length;

l_s is the strained reference length;

l_1 is the reference length after recovery.

The test shall be considered as passed if the tension set does not exceed 15 %.

5.5.4.2 Alternative tests in case of gloves having completed the production phase

At the production stage, it is not possible to perform the test of 5.5.4.1 which is destructive.

Nevertheless, the manufacturer shall prove that he has followed the same documented manufacturing procedure as per the type-tested glove.

The manufacturer shall document components that could affect tension set performance.

Moreover, a sampling test in accordance with 5.5.4.1 shall be performed with the sampling plan specified in Table 4.

5.6 Dielectric tests

5.6.1 Type test

5.6.1.1 General

Dielectric testing shall be carried out using an a.c. power source in accordance with the requirements given in IEC 60060-1 and at a temperature of 23 °C ± 5 °C and 45 % to 75 % relative humidity (see IEC 60212, "standard ambient").

For type tests, the gloves shall be given an a.c. proof and withstand test after conditioning for moisture absorption by total immersion in water for a period of $16 \text{ h} \pm 0,5 \text{ h}$. The immersion shall be carried out without trapping air. Following the conditioning, the gloves shall be dried for $0,2 \text{ h} \pm 0,1 \text{ h}$ at $70 \text{ °C} \pm 2 \text{ °C}$. The apparatus shall consist of an air oven in which there is a circulation of air providing between 3 to 10 changes per hour. The incoming air shall be at $70 \text{ °C} \pm 2 \text{ °C}$.

The a.c. dielectric tests shall be conducted within 1 h after completion of conditioning.

The peak (crest) or rms value of the a.c. shall be measured with an error of not more than 3 %.

5.6.1.2 Test equipment

The test equipment used in both the proof and withstand tests shall be capable of supplying an essentially stepless and continuously variable voltage to the glove under test. Motor-driven regulating equipment is convenient and tends to provide uniform rate of rise to the test voltage. The test apparatus shall be protected by an automatic circuit-breaking device designed to open promptly on the current produced by failure of the glove under test. This circuit-breaking device shall be designed to protect the test equipment under any conditions of short circuit.

To eliminate damaging ozone and possible flashover along the *cuff*, there shall be a sufficient flow of air into and around the glove and an exhaust system to adequately remove ozone from the test machine. Consistent ozone checking during the test procedure should be carried out to ascertain the adequacy of the exhaust system.

5.6.1.3 Failure indicators

Glove failure indicators or accessory circuits shall be designed to give positive indication of failure.

5.6.1.4 Voltage dielectric test procedure

5.6.1.4.1 General

After conditioning, the gloves, right side out, shall be filled with tap water having a specific resistivity less than or equal to $100 \text{ } \Omega \cdot \text{m}$, and immersed in a tank of water. The water level during the test shall be the same inside and outside the glove.

The water inside the glove that forms one electrode shall be connected to one terminal of the voltage source by means of a chain or sliding rod that dips into the water. The water in the tank outside the glove that forms the other electrode shall be connected directly to the other terminal of the voltage source. The water shall be free of air bubbles and air pockets and the exposed portion of the glove above the water line shall be dry.

The clearance between the open part of the glove and the water line is given in Table 5. Where high humidity (above 55 %) or low barometric pressure (below 99,3 kPa) is encountered, the specified clearances may be (or could be) increased by a maximum of 25 mm.

NOTE 1 High humidity or low barometric pressure may influence the dielectric strength in the air.

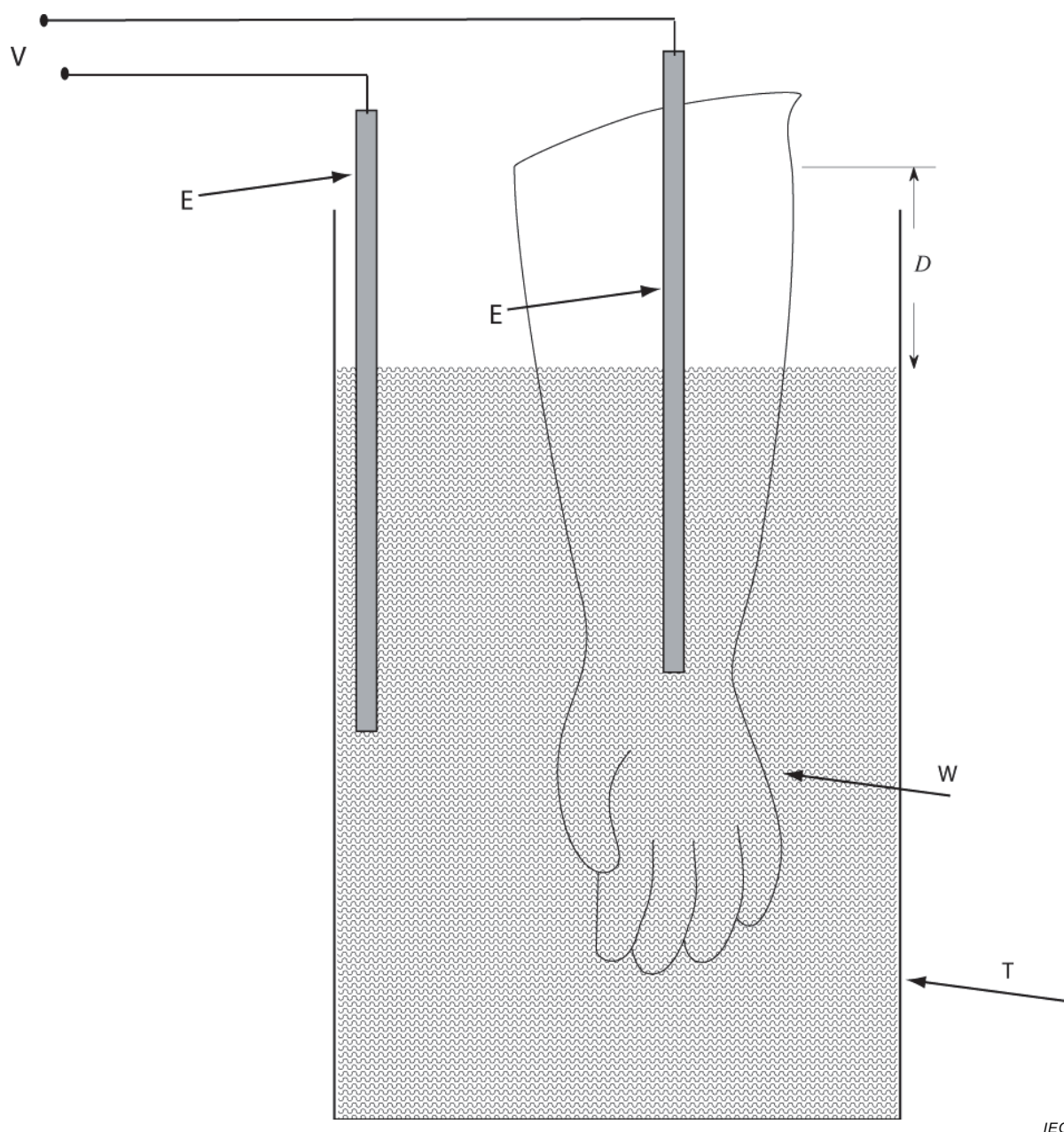
Table 5 – Clearance from open part of the glove to water line

Class	Clearance for tests <i>D</i> mm			
	Gloves		Long gloves	
	Proof test	Withstand test	Proof test	Withstand test
00	40	40	160	430
0	40	40	160	430
1	40	65	260	455
2	65	75	260	465
3	90	100	260	490
4	130	165	260	555
NOTE 1 See Figure 6 for open part of the glove to water line distance.				
NOTE 2 Tolerance for the clearance between the open part of the glove and water line is ± 13 mm.				

The proof test current is measured directly by inserting a milliammeter in series with each individual glove in turn. The reading should be taken towards the end of the *proof test voltage* period.

NOTE 2 It is customary to make this type of high-voltage test with one end of the circuit earthed. When proof tests are made on one glove at a time, the water in the tank is usually connected to the earthed end of the high-voltage circuit. The milliammeter is connected in the earthed end of the circuit and shunted by a short-circuiting, automatic self-closing switch which keeps the circuit closed except at the instant of reading and thus maintains an uninterrupted ground.

NOTE 3 When proof tests are made on more than one glove at one time, it is practical to have the water in the tank at high potential and the water electrodes inside the gloves be the earthed electrodes. The ammeter for reading proof test current is then connected to the earthed electrode through a suitable switching arrangement to permit reading of the proof test current in each glove separately.



IEC

Key

- V connection to the voltage source
- T tank
- W water inside and outside the glove
- E electrodes (chain or sliding rod) to connect water to the two poles of the voltage source
- D clearance from open part of the glove to water line

Figure 6 – Test set up for the dielectric test on glove**5.6.1.4.2 Proof test**

Each glove shall be submitted to a proof voltage test as specified in Table 6. The a.c. voltage shall be initially applied at a low value and gradually increased at a constant rate-of-rise of approximately 1 000 V/s until the specified test voltage level is reached or failure occurs. The current is measured during test period, either continuously or at end of period. The test voltage shall be reduced at the same rate. The test period shall be equal to 3 min, considered to start at the instant the specified proof voltage is reached. Unless an electrical failure

occurred during the period test, the applied voltage should be reduced at least to half value before opening the test circuit.

Table 6 – Proof test and withstand test

Class of gloves ^{c d}	Proof test voltage kV rms	Maximum proof test current ^b mA rms					Withstand test voltage kV rms
		Glove length mm					
		280	360	410	460	800	
00	2,5	12	14	N/a ^a	N/a ^a	18	5
0	5	12	14	16	18	20	10
1	10	N/a	16	18	20	22	20
2	20	N/a	18	20	22	24	30
3	30	N/a	20	22	24	26	40
4	40	N/a	N/a	24	26	30	50

^a N/a = Not applicable.

^b Gloves which during tests show proof test current values equal to or less than the values indicated in Table 6 will, during normal use, have actual leakage current values much lower than the threshold of ventricular fibrillation. This is because the contact area with water during these tests is much greater than the contact area of the hand on the inside of the glove and the contact area of the glove with live electrical parts of equipment handled during normal use. Moreover, the proof test voltage is higher than the recommended maximum use voltage.

^c Refer to Annex D for the selection of the class of the gloves in a.c.

^d Refer to Annex E for the selection of the class of the gloves in d.c. and for recommendations for testing.

The proof test shall be considered as passed if

- the *proof test voltage* is reached and maintained during the test period,
- the proof test current does not exceed the specified values during the test period. Current measurement may be done continuously or at the end of the test period.

5.6.1.4.3 Withstand test

The a.c. voltage shall be applied as specified in 5.6.1.4.2 until the specified *withstand test voltage* is reached, and then reduced.

The withstand test shall be considered as passed if no puncture occurs during the test.

5.6.2 Alternative tests in case of gloves having completed the production phase

At the production level, it is not possible to perform the tests of 5.6.1 which make the glove not usable (due to humidity conditioning combined with test duration).

Nevertheless, the manufacturer shall prove that he has followed the same documented manufacturing procedure as per the type-tested glove.

The manufacturer shall document components that could affect dielectric performance.

Moreover, the following tests shall be performed:

- 1) a sampling test in accordance with 5.6.1.4.2 with the sampling plan specified in Table 4,
- 2) a routine test where the remaining gloves of the batch are tested according to 5.6.1.4.2 but they are not submitted to a conditioning for moisture absorption and the time duration is limited to 1 min continuous test. The proof test current given by Table 6 shall be

reduced by 2 mA. For routine test, the clearance from open part of the glove to water line shall be according to Table 7.

Table 7 – Clearance from open part of the gloves / long gloves to water line for alternative routine proof test

Class	Clearance for tests <i>D</i> mm
00	40
0	40
1	40
2	65
3	90
4	130
NOTE 1 See Figure 6 for open part of the glove to water line distance.	
NOTE 2 Tolerance for the clearance between the open part of the glove and water line is ± 13 mm.	

5.7 Ageing test

Seven dumb-bell test pieces shall be cut as shown in Figure 4.

The test pieces, along with two gloves, shall be placed in an air oven for 168 h at $70\text{ °C} \pm 2\text{ °C}$ and with less than 20 % relative humidity (see IEC 60212, “dry hot” atmosphere).

The apparatus shall consist of an air oven as defined in 5.6.1.1.

There shall be no copper or copper alloy parts inside the ageing chamber. Provision shall be made for suspending the test pieces so that there is a minimum separation of 10 mm between the test pieces and of 50 mm between the test pieces and the inner surfaces of the oven.

At the end of the heating period, the test pieces shall be removed from the oven and allowed to cool for not less than 24 h and then tested.

For dumb-bell test pieces, the lowest value of tensile strength at break shall be a value of not less than 80 % of the unaged value. The tension set shall not exceed 15 %.

Each glove shall also pass the dielectric proof test, but without being subjected to the moisture conditioning.

5.8 Thermal tests

5.8.1 Low temperature test

The glove shall be placed in a chamber for 1 h at a temperature of $-25\text{ °C} \pm 3\text{ °C}$. Two polyethylene plates $200\text{ mm} \times 200\text{ mm} \times 5\text{ mm}$ depth shall be conditioned at the same temperature and for the same time.

Within 1 min after being removed from the chamber, the glove shall be folded at the *wrist* (see Figure 7), placed between the two polyethylene plates and subjected to a force of 100 N for 30 s as shown in Figure 8.

No tear, break or crack shall be visible on the glove, after being subjected to a low temperature test.