

Live working — Gloves and mitts with mechanical protection

ICS 13.260; 29.260.99

National foreword

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The UK participation in its preparation was entrusted to Technical Committee PEL/78, Tools for live working, which has the responsibility to:

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**Travaux sous tension –
Gants et moufles avec protection mécanique**

**Live working –
Gloves and mitts with mechanical protection**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LIVE WORKING – GLOVES AND MITTS WITH MECHANICAL PROTECTION

FOREWORD

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International Standard IEC 61942 has been prepared by IEC technical committee 78: Live working.

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

FDIS	Report on voting
78/220+220A/FDIS	78/227/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.

Annexes A, B and C form an integral part of this standard.

Annexes D, E, F, G and H are for information only.

INTRODUCTION

This International Standard was established on the basis of IEC 60903 on insulating gloves. The same quality level of insulation was required as basic principle. The purpose was to combine in one unique glove the insulating properties of elastomer gloves and the mechanical properties of leather gloves which are commonly used to protect the insulating gloves.

For the time being, only three classes of gloves are covered due to the lack of data and practice for high voltages. Some difficulties were observed when combining electrical and mechanical properties. It seems to be difficult to obtain flexible gloves providing adequate mechanical protection.

LIVE WORKING – GLOVES AND MITTS WITH MECHANICAL PROTECTION

1 Scope

This International Standard is applicable to insulating gloves and mitts made of plastic or elastomer with appropriate mechanical protection for use without over-gloves. Unless otherwise stated, the use of the term glove only includes gloves and mitts.

The gloves are intended to be used for working live or close to live parts at nominal voltages up to 7 500 V a.c. or 11 250 V d.c.

For other voltages information is not yet available.

1.1 Classes of gloves

Three classes of gloves, differing in electrical characteristics, are provided and are designated class 00, class 0, class 1 (see annex D).

For other classes such as class 2, class 3 and class 4 additional data will be necessary.

1.2 Categories of gloves

Five categories of gloves, differing in properties related to acid, oil, ozone and a combination of all are provided and designated categories A, H, Z and P respectively, and also extreme low temperature designated as category C.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(121):1978, *International Electrotechnical Vocabulary (IEV) – Chapter 121: Electromagnetism*

IEC 60050(151):1978, *International Electrotechnical Vocabulary (IEV) – Chapter 151: Electrical and magnetic devices*

IEC 60050(601):1985, *International Electrotechnical Vocabulary (IEV) – Chapter 601: Generation, transmission and distribution of electricity – General*

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60060-2:1994, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60212:1971, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

IEC 60903:1988, *Specifications for gloves and mitts of insulating material for live working*

IEC 61318:1994, *Live working – Guidelines for quality assurance plans*

ISO 37: 1994, *Rubber-vulcanized or thermoplastic – Determination of tensile stress-strain properties*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 472: 1988, *Plastics – Vocabulary*

ISO 2592: 1973, *Petroleum products – Determination of flash and fire points – Cleveland open cup method*

ISO 2977: 1989, *Petroleum products and hydrocarbon solvents – Determination of aniline point and mixed aniline point*

ISO 3104: 1994, *Petroleum products – Transparent and opaque liquids – Determination of kinematic viscosity and calculation of dynamic viscosity*

ISO 9000-1: 1994, *Quality management and quality assurance standards – Part 1: Guidelines for selection and use*

3 Definitions

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

3.1 Terms defined in accordance with IEC 60050(121), IEC 60050(151), IEC 60050(601) and ISO 472

3.1.1 **electrical puncture:** A disruptive breakdown through a solid insulant. [IEV 121-03-13 modified]

3.1.2 **flashover:** An arc by-passing an insulating body and occurring between electrodes and over or around, but not through, the equipment being tested. [IEV 121-03-14 modified]

3.1.3 **type test:** A test on one or more devices made to a certain design to show that the design meets certain specifications. [IEV 151-04-15]

3.1.4 **routine test:** A test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria. [IEV 151-04-16]

3.1.5 **sampling test:** A test on a number of devices taken at random from a batch. [IEV 151-04-17]

3.1.6 **acceptance test:** A contractual test to prove to the customer that the device meets certain conditions of its specification. [IEV 151-04-20]

3.1.7 nominal voltage: A suitable approximate value of voltage used to identify a system. [IEV 601-01-21]

3.1.8 plastic: A material which contains as an essential ingredient a high polymer and which at some stage in its processing into finished products can be shaped by flow. [ISO 472-1-2-22]

3.2 Definitions of special terms used in this standard

3.2.1 palm: Part of glove covering the face of the central inside hand.

3.2.2 wrist: The narrowest part of the glove above the cuff.

3.2.3 contour glove: A glove shaped at the upper part of the cuff in such a way as to facilitate the bending of the arm.

3.2.4 fork: Part of glove at the junction of two fingers, or finger and thumb.

3.2.5 curved glove: A glove on which the fingers are slightly bent in a position corresponding to the position the hand forms while holding an object.

3.2.6 lined glove: A glove with an inside lining of textile attached to the plastic or to the elastomer.

3.2.7 composite glove: A glove composed of several attached or superimposed layers of different colours.

3.2.8 mitt: A glove which has less than four fingers enclosed.

3.2.9 cuff: Part of a glove from the wrist to the open part of the glove.

3.2.10 cuff roll: The roll or reinforced edge of a glove at the cuff.

3.2.11 elastomer: A generic term that includes rubbers, latex and elastomeric compounds that may be natural or synthetic or a mixture or a combination of both.

3.2.12 proof test voltage: The specified voltage that is applied to a device for the time defined under specified conditions to assure that the electrical strength of the insulation is above a specified value.

3.2.13 withstand test voltage: The voltage that the device shall withstand without flashover, disruptive discharge, puncture or other electric failure when voltage is applied under specified conditions.

4 Composition

The gloves shall be manufactured of plastic or elastomer. They may be lined or unlined, uncovered or have an exterior covering for protection against mechanical wear, chemical attack, and the effects of ozone.

The gloves shall be provided with a cuff.

5 Classification

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

- by class as class 00, class 0, class 1;
- by special properties by the addition of a suffix as shown in table 1.

Guidance as to use in relation to nominal voltage of a system is given in annex D.

Guidance as to temperature range at which gloves can be used is given in annex E.

Table 1 – Special properties

Category	Resistant to
A	Acid
H	Oil
Z	Ozone
P	Acid, oil, ozone
C	Extreme low temperature
NOTES 1 Category P combines the characteristics of categories A, H, and Z. 2 Any combination of categories may be used.	

6 Physical requirements

6.1 Shape

6.1.1 The shape of a glove is indicated in figure 1. The letter "h" in figure 1 represents the curve of the finger in curved gloves. The shape of a mitt is indicated in figure 2.

6.1.2 Gloves may be manufactured with or without cuff roll.

6.2 Dimensions

6.2.1 Length

- Class 00: standard lengths are 280 mm and 360 mm.
- Class 0: standard lengths are 280 mm, 360 mm, 410 mm and 460 mm.
- Class 1: standard lengths are 360 mm, 410 mm and 460 mm.

The permissible variation in length shall be ± 15 mm for any class.

NOTE – If other classes are required, lengths should be those of IEC 60903.

6.2.2 For contour cuff gloves the difference between the maximum and minimum lengths shall be $50 \text{ mm} \pm 6 \text{ mm}$ (see figure 3).

6.2.3 It is not practicable to specify other dimensions but typical glove dimensions are suggested in annex F.

6.3 Thickness

6.3.1 The maximum thickness on the flat surface (not ribbed area if present) of a glove shall be as given in table 2 in order to obtain appropriate flexibility.

Table 2 – Maximum thickness

Class	Thickness mm
00	1,80
0	2,30
1	¹⁾
¹⁾ Under consideration	
NOTE – No value available for classes 2, 3, and 4.	

6.3.2 The minimum thickness shall be determined only by the ability to pass the tests defined in clauses 7 and 8.

6.4 Workmanship and finish

6.4.1 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 forms or moulds or other imperfections inherent to the manufacturing process. These irregularities appear as mould marks that look like cuts even though they are actually a raised ridge of plastic or elastomer, indentations, or protuberances that are acceptable.

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

6.5 Marking

6.5.1 Each glove which is claimed to comply with the requirements of this standard shall be marked with the following (see figure 5):

- symbol (double triangle);
- mechanical protection mark (star);
- name, trademark, or identification of the manufacturer;
- category if applicable;
- size;
- class;
- month and year of manufacture.

In addition each glove shall provide:

- a) a rectangular band permitting the marking of the date when put into service and the dates of periodic inspection and test. Its dimensions and position are given in figure 5;
- b) or an additional coloured band in which holes can be punched, the glove cuff shall not be punched. This band shall be affixed to the edge of the cuff and the date when put into service and the dates of periodic inspection and test shall be given by punched holes which shall be located at not more than 20 mm from the periphery of the cuff;
- c) or any other suitable means to identify the date when put into service and the dates of periodic inspection and test.

6.5.2 The marking shall be durable and shall not impair the quality of the glove.

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

6.5.4 When a colour code is used, the symbol shall correspond to this code. The code is as follows:

- class 00: beige;
- class 0: red;
- class 1: white.

6.6 *Packaging*

Type test and sampling test

Each pair of gloves shall be packaged in an individual container or package of sufficient strength to protect properly the gloves from damage. The outside of the container or package shall be marked with the name of the manufacturer or supplier, classification, category, size, length and cuff design.

At the request of the customer, or according to national specifications, information contained in annex H and any additional or amended instructions shall be included in the package.

7 **Tests on gloves**

7.1 *General*

Each of the following subclauses defines whether type, routine or sampling tests are required.

In order to carry out the type tests, it is necessary to have:

- twenty gloves to cover all tests common to all categories of gloves;
- five gloves of category A;
- five gloves of category H;
- three gloves of category Z;
- thirteen gloves of category P.

The allotment of these gloves in various testing lots and the order in which these tests are carried out are given in annex A. The gloves used in the visual tests shall be utilized in one of the other tests.

Gloves shall be preconditioned for a period of 2 h $\pm$ 30 min at a temperature of 23 °C $\pm$ 2 °C and 50 % $\pm$ 5 % relative humidity (see IEC 60212, standard atmosphere B).

7.2 *Visual inspection and measurements*

7.2.1 *Shape*

Type test and sampling test (see 6.1 and figures 1 and 2)

The shape shall be verified by visual inspection.

7.2.2 *Dimensions*

Type test and sampling test (see 6.2 and figure 1 and figure 2 and annex F).

The length 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 3.

7.2.3 *Thickness*

Type test and sampling test (see 6.3)

Thickness measurements shall be made on complete gloves 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.

Measurements shall be made with a micrometer or any alternative instrument giving substantially the same results. The micrometer shall be graduated to within 0,02 mm, have an anvil 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 the glove so that it will present an unstressed, flat surface between the anvil faces of the micrometer.

In case of dispute, the micrometer method described above shall be used.

NOTE – A method for measuring ribbed gloves is under consideration.

7.2.4 *Workmanship and finish*

Type test and sampling test (see 6.4)

The workmanship and finish shall be verified by visual inspection.

7.2.5 Marking

Type test and routine test (see 6.5)

The marking shall be verified by visual inspection. No durability test is required for routine test.

7.2.6 Packaging

Type test and sampling test (see 6.6)

The packaging shall be verified by visual inspection.

7.3 Mechanical tests

7.3.1 General

7.3.1.1 All mechanical tests shall be performed on samples which have been conditioned by storing each glove separately in a horizontal position for 24 h at a room temperature of $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, $50\text{ \%} \pm 5\text{ \%}$ relative humidity (see IEC 60212, standard atmosphere B).

7.3.2 Abrasive resistance

Type test and sampling test

The abrasive tester (see figure 6) consists of a test piece holder which rotates around a central axis at a speed of $60\text{ r/min} \pm 5\text{ r/min}$. The test piece is secured onto the disk by means of a fixing ring.

Two abrasive rings made of tungsten carbide are placed onto two wheels of 13 mm wide and 52 mm in diameter. Their inner sides are $52\text{ mm} \pm 1\text{ mm}$ apart from each other. A brush eliminates the particles coming from the test piece being tested by vacuum suction.

The surface of the test piece is cleaned with dry compressed air at $200\text{ kPa} \pm 35\text{ kPa}$. The two abrasive wheels are fixed at the free end of oscillating arms and are in contact with the upper surface of the test piece.

The rotation of the wheels in opposite directions is obtained by rotating the test piece to change the friction axis.

The test piece shall consist of a plate of 114 mm in diameter and have a hole of 6 mm in diameter in the centre. The test piece shall be cut near the palm of the glove.

Five gloves shall be subjected to the test. The abrasive rings are of S 35 type.

The vertical force of each wheel which is applied onto the test piece is 2,45 N.

The result is given in mg/revolution in accordance with the following formula:

$$\frac{m_0 - m_1}{n}$$

where

m_0 is the initial weight of the test piece in milligrams (mg);

m_1 is the weight of the test piece after test in milligrams (mg);

n is the number of revolutions

The test is considered as passed if the average value of the five tests is less than 0,05 mg/r.

7.3.3 *Resistance to mechanical puncture*

Type test and sampling test

Five 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 7).

A needle shall be made from 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 7). 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 100 mm/min $\pm$ 10 mm/min. The force required to puncture the test piece shall be measured.

The test is considered as passed if the puncture resistance is greater than 60 N.

7.3.4 *Tear resistance*

Type test and sampling test

Only tensile testers equipped with low inertia force measurement systems shall be used.

The tear resistance is defined as the force necessary to tear a test piece which was previously cut in a defined manner.

Two test pieces shall be tested in the direction of the glove from cuff to finger tips, and two test pieces shall be tested across the palm width (see figure 8).

The test piece dimensions are defined in figure 9. Dimensions are 100 mm $\times$ 50 mm. A 50 mm incision is made in the longitudinal direction of the test piece, 25 mm from the edge. The last millimetre incision shall be made with a sharp unused blade straight and perpendicular to the test piece surface.

The pre-cut strips (see figure 9) are clamped in a tensile tester, at a distance of 20 mm from the end, with the jaws separated by 50 mm to ensure that the pulling direction remains in the plane parallel to the longitudinal direction of the test piece.

The testing force shall be recorded on a X-Y recorder at a tensile test speed of 100 mm/min $\pm$ 10 mm/min.

The test piece shall be torn totally apart. Note that in some cases the tearing may not be in the longitudinal direction of the test piece.

The test shall be performed on one test piece cut from each of four different gloves of the same glove series.