

INTERNATIONAL STANDARD

REDLINE VERSION

Live working - Electrical insulating matting

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

Live working - Electrical insulating matting

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61111:2009. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 61111 has been prepared by IEC technical committee 78: Live Working. It is an International Standard.

This third edition cancels and replaces the second edition published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) review of the scope;
- b) introduction of AC/DC use and AC use only;
- c) verification of dated referenced standards;
- d) improvement of the marking;
- e) rewriting of the test for slip resistance;
- f) updating the use of IEC 61318;
- g) creation of an alternative test;
- h) revision and updating of Annexes A, B, C, D, F, G.

The text of this International Standard is based on the following documents:

Draft	Report on voting
78/1559/FDIS	78/1584/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

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

The product covered by this document ~~may~~ can 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 document 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.

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1 Scope

This document is applicable to electrical insulating matting made of ~~elastomer~~ flexible insulating material for use as a ~~floor~~ covering ~~for~~ of the surface on which the worker is positioned and for worker's electrical protection ~~of workers~~ on electrical installations up to 36 000 V AC for AC use or 36 000 V AC and 54 000 V DC for AC/DC use.

~~NOTE 1—For a.c. electrical classification, as well as d.c. use, see 4.2.~~

~~NOTE 2—This document gives a.c. test provisions. There is limited history for use in d.c. applications.~~

~~NOTE 3—See Annex A for suggested maximum voltage use.~~

NOTE 1 The electric potential of the surface on which the worker is positioned is usually that of earth.

NOTE 2 See 4.2 for maximum use voltage.

NOTE 3 DC only rated matting is not specified in this document.

NOTE 4 This document does not cover the use of insulating blankets (see IEC 61112)

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

IEC 60068-1, *Environmental testing - Part 1: General and guidance*

IEC 60212:~~1974~~, *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, *Live Working —~~Conformity~~ Methods for assessment of defects and verification of performance applicable to tools, devices and equipment*

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

ISO 2592, *Petroleum and related products - Determination of flash and fire points - Cleveland open cup method*

ISO 2977, *Petroleum products and hydrocarbon solvents - Determination of aniline point and mixed aniline point*

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

ISO 4649:2017, *Rubber, vulcanized or thermoplastic - Determination of abrasion resistance using a rotating cylindrical drum device*

~~ISO 5904:1981, Gymnastic equipment — Landing mats and surfaces for floor exercises — Determination of resistance to slipping~~

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

~~ASTM D 3767:2003 (reapproved 2008), Standard practice for rubber — Measurement of dimensions~~

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

disruptive discharge

passage of an electric arc following ~~dielectric~~ electric breakdown

Note 1 to entry: The term “sparkover” is used when a disruptive discharge occurs in a gaseous or liquid dielectric.

Note 2 to entry: The term “flashover” 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 3 to entry: The term “puncture” is used when a disruptive discharge occurs through a solid dielectric producing permanent damage.

~~[IEV 651-01-18 and definition 2.7.7 of IEC 60743, modified]~~

[SOURCE: IEC 60050-212:2010, 212-11-46, modified – Note to entry deleted and replaced by notes to entry 1,2 and 3]

3.2

elastomer

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

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

Note 2 to entry: Elastomer is a generic term that includes rubber, latex and elastomeric compounds that may be natural or synthetic or a mixture or a combination of both. It also includes thermoplastic elastomer (TPE) material.

~~[ISO 472 modified]~~

[SOURCE: IEC 60050-212:2010, 212-14-05, modified – Note 2 to entry has been added.]

3.3

electrical insulating matting

~~flexible sheeting made of elastomer, used to cover the surface on which the worker is standing (the potential of this surface is usually that of earth)~~

~~NOTE The sheeting is either of various definite shapes or in roll allowing the workers to custom-cut the material to fit the application.~~

~~[Definition 5.2.3 of IEC 60743 and IEV 651-04-07, modified]~~

flat protective cover made of flexible insulating material, used to provide electrical insulation between the feet of the worker and the surface on which the worker is standing

Note 1 to entry: The electric potential of the surface on which the worker is standing is usually that of earth.

[SOURCE: IEC 60050-651:2014, 651-22-13, modified – Note 2 to entry has been deleted]

3.4

international rubber hardness degree

IRHD

measure of hardness, the magnitude of which is derived from the depth of penetration of a specified indenter into a test piece under specified conditions

Note 1 to entry: The IRHD scale is such that 0 degrees represents a material showing no measurable resistance to indentation and 100 degrees represents a material showing no measurable indentation. The scale is described fully in ISO 48.

[SOURCE: ISO 1382:2020, 3.264]

3.5

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]

3.6

proof test

<dielectric testing> test to demonstrate the safety of the equipment for work by evaluating the capability of the insulating material or product under prescribed test conditions to conform with applicable rating

Note 1 to entry: An AC proof test typically involves applying a voltage corresponding to a temporary overvoltage higher than the equipment's nominal operating voltage for a specified period.

Note 2 to entry: A DC proof test typically involves applying a voltage value gain from long time in-service testing experience corresponding to DC voltage level able to find harmful physical irregularities in insulating material with sufficient safety margin.

3.7

proof test voltage

specified voltage that is applied to a device or test piece for the time defined under specified conditions to assure that the electrical strength of the insulation is above ~~a specified value~~ the applicable rating

3.8

routine test

conformity test made on each individual item during or after manufacture

[SOURCE: IEC 60050-151:2001, 151-16-17]

3.9

withstand test

<dielectric testing> test on insulating material or product made by applying a high voltage across the insulation to determine the adequacy of the dielectric strength

Note 1 to entry: The dielectric strength includes the material integrity.

Note 2 to entry: An AC withstand test typically involves applying a high voltage stress corresponding to a switching overvoltage.

Note 3 to entry: The value of the DC withstand test is gain from the experience testing and the knowledge of the insulating material quality and integrity.

3.10**withstand test voltage**

voltage that a test piece is required to withstand without disruptive discharge or other electric failure when voltage is applied under specified conditions

4 Requirements**4.1 General**

Electrical insulating matting shall be designed and manufactured to 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.

4.2 Electrical classification

The electrical insulating matting covered by this document shall be designated as follows:

- by electrical class as given in Table 1

Table 1 – Classes and maximum use voltages for electrical insulating matting

Class	Maximum use voltages for AC/DC used matting	Maximum use voltage for AC only used matting
0	1 000 V AC / 1 500 V DC	1 000 V
1	7 500 V AC / 11 250 V DC	7 500 V
2	17 000 V AC / 25 500 V DC	17 000 V
3	26 500 V AC / 39 750 V DC	26 500 V
4	36 000 V AC / 54 000 V DC	36 000 V

- by adding the suffix “C” to the class designation, in case of category C matting (resistance to extremely low temperature).

Additional guidance for the selection of electrical class ~~(a.e. and d.e.)~~ is given in Annex A.

~~Guidance as to temperature range at which electrical insulating matting can be used is given in Annex B.~~

4.3 Physical requirements**4.3.1 Composition**

The electrical insulating matting shall be manufactured of flexible insulating material such as elastomer.

Both sides of the electrical insulating matting shall be slip resistant. The slip resistance ~~may~~ can be achieved with surface such as corrugated or diamond design.

Any insert shall not adversely affect the dielectric characteristics of the electrical insulating matting.

4.3.2 Shape

There is no requirement for the shape of the electrical insulating matting.

Electrical insulating matting ~~may~~ can be supplied in either ~~of various shapes~~ portable style or stationary style (in roll) to be cut for individual applications.

4.3.3 Dimensions and tolerances

4.3.3.1 Length and width

Electrical insulating matting of class 0, 1 and 2 shall not have length and width less than 600 mm.

Electrical insulating matting of class 3 and 4 shall not have length and width less than 914 mm.

Manufacturers shall provide the dimensions of the matting length and width. These dimensions for each matting shall be within a tolerance of up to ± 2 % of the stated dimensions.

~~Common lengths and widths for electrical insulating matting are indicated in Table 1.~~

~~Table 1 – Common lengths and widths for electrical insulating matting~~

Matting in various shapes		Matting in rolls
Length mm	Width mm	Width mm
1 000	600	610
1 000	1 000	760
1 000	2 000	915
		1 220

Portable matting shall have maximum dimensions of (width x length) less than or equal to 1 220 × 2 000 mm.

Stationary matting shall have longitudinal length above 2 000 mm.

4.3.3.2 Maximum thickness

The maximum thickness of matting shall be as given in Table 2 in order to obtain appropriate flexibility.

Table 2 – Maximum thickness for electrical insulating matting

Class	mm
0	6,0
1	6,0
2	8,0
3	11,0
4	14,0

When corrugations or diamonds are present, measurements shall be made over the corrugations or diamonds. The corrugations shall not be more than 3 mm deep. The corrugations of the matting on one side of the matting do not line up with corrugations on the other surface of the matting. The diamonds shall not be higher than 2 mm.

4.3.3.3 Minimum thickness

The minimum thickness shall be determined only by the ability to pass the tests defined in Clause 5.

4.3.4 Temperature

Standard electrical insulating matting shall be designed to be used in applications having ambient temperatures between -25°C and $+55^{\circ}\text{C}$ and category C matting in ambient temperatures between -40°C and $+55^{\circ}\text{C}$.

4.3.5 Workmanship and finish

Electrical insulating matting shall be free on both surfaces from harmful physical irregularities that can be detected by thorough test ~~and~~/or inspection.

Harmful physical irregularities are those 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 molded marks shall not be acceptable.

Non-harmful physical irregularities are those defined as surface irregularities present on either surface of the matting due to imperfections on forms or molds or other imperfections inherent to the manufacturing process ~~shall be acceptable. These irregularities appear as mould marks that look like cuts, even though they are actually a raised ridge of elastomer, indentations, or protuberances.~~ These irregularities may be considered acceptable provided that:

- a) the thickness at any irregularity conforms to the thickness requirements. Surface design to improve slip resistance shall not be considered as an irregularity;
- b) the indentations, protuberances or mold marks blend into a smooth slope upon stretching of the material mechanical, climatic and environmental requirements.

Any additions to the matting for marking or traceability e.g. identification tags or microchips can be considered as non-harmful irregularities as long as the matting fulfils the dielectric and mechanical requirements contained in subclauses 4.1 through 4.3.4, 4.4 and 4.5.

4.4 Mechanical, climatic and environmental requirements

Electrical insulating matting shall support the mechanical, climatic and environmental stresses occurring during normal working conditions.

All electrical insulating matting shall be ~~resistant to acid, oil, and low temperature and Category C shall be resistant to extremely low temperature:~~

- resistant to puncture and verified by test of 5.5.2 and 5.7;
- flame retardant and verified by test of 5.8.1;
- resistant to acid and verified by test of 5.9;
- resistant to oil and verified by test of 5.10;
- resistant to low temperature and verified by test of 5.8.2 (except for category C).

Category C electrical insulating matting shall be resistant to extremely low temperature and verified by test of 5.8.3.

4.5 Dielectric requirements

Electrical insulating matting shall be capable of withstanding the corresponding electrical stresses according to its electrical class.

4.6 Marking

Electrical insulating matting complying with the requirements of this document shall be marked on the product with the following items of marking:

- name, trademark or identification of the manufacturer;

- 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, with year of publication (4 digits);
- month and year of manufacture;
- category C if applicable;
- electrical class designation;
- AC/DC, or AC according to the expected use;
- in the case of matting in rolls, these items of marking shall appear at least every 0,6 meter.

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

The marking shall be clearly identifiable by persons with normal or corrected sight without further magnification; be clearly visible, durable and shall not impair the quality of the electrical insulating matting.

When a colour code for labels or space is used, the ~~colour of the symbol (double triangle)~~ marking shall correspond to the following code:

Class 0: red,

Class 1: white,

Class 2: yellow,

Class 3: green,

Class 4: orange.

4.7 Packaging

Electrical insulating matting shall be ~~packaged in containers or packages of sufficient strength to properly protect the electrical insulating matting from damage during delivery and normal storage and transportation before first use~~ supplied in suitable packaging for shipping and initial storage to provide protection until it is opened for use.

~~NOTE It is the responsibility of the user to provide protective packaging (ex: a specific bag) if cut portions are to be reused.~~

The outside of the container or package shall be marked with at least the following information:

- product name and reference or catalog number for example;
- number of the relevant IEC standard immediately adjacent to the symbol with year of publication (4 digits), ~~(IEC 61111:2009);~~
- ~~— name, trademark, or identification of the manufacturer.~~
- electrical class designation;
- AC/DC or AC according to the expected use;
- dimensions (length and width) of the product.

4.8 Instructions for use

The manufacturer shall provide written instructions for use with each ~~packaging~~ consignment of electrical insulating matting covered by this document.

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