SLOVENSKI STANDARD

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Dielektrične in uporovne lastnosti trdnih izolacijskih materialov - 3-2. del: Ugotavljanje uporovnih lastnosti (metode z enosmernim tokom) - Površinska upornost in površinska specifična upornost

Dielectric and resistive properties of solid insulating materials - Part 3-2: Determination of resistive properties (DC methods) - Surface resistance and surface resistivity

Propriétés diélectriques et résistives des matériaux isolants solides - Partie 3-2: Détermination des propriétés résistives (méthodes en courant continu) - Résistance superficielle et résistivité superficielle

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IEC TC 112 : EVALUATION AND QUALIFICATION OF ELECTRICAL INSULATING MATERIALS AND SYSTEMS	
SECRETARIAT: Germany	SECRETARY: Mr Bernd Komanschek
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 2,TC 10,TC 14,TC 15,SC 17A,TC 23,TC 36,TC 42,SC 45A,TC 55,TC 89,TC 96,TC 101,TC 109,SC 121A	PROPOSED HORIZONTAL STANDARD: ☒ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☒ SAFETY	
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TITLE:

Dielectric and resistive properties of solid insulating materials - Part 3-2: Determination of resistive properties (DC methods) - Surface resistance and surface resistivity

PROPOSED STABILITY DATE: 2026

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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DIELECTRIC AND RESISTIVE PROPERTIES OF SOLID INSULATING MATERIALS

Part 3-2: Determination of resistive properties (DC methods) – Surface resistance and surface resistivity

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IEC 62631-3-2 has been prepared by IEC technical committee 12: Evaluation and qualification of electrical insulating materials and systems. It is an International Standard.

This 2nd edition cancels and replaces the 1st edition published in 2015-12-04. This edition constitutes a technical revision.

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

a) Clarified descriptions of the electrode arrangements;
b) Added new descriptions of the conductive means;
c) Added new informative Annex B summarizing the results of the comparative verification study on surface resistivities using different electrode arrangements.

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

Draft	Report on voting
112/304/FDIS	112/351/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.

A list of all parts in the IEC 62631 series, published under the general title *Dielectric and Resistive properties of solid insulating materials*, can be found on the IEC website.

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

DIELECTRIC AND RESISTIVE PROPERTIES OF SOLID INSULATING MATERIALS

Part 3-2: Determination of resistive properties (DC methods) – Surface resistance and surface resistivity

1 Scope

This part of IEC 62631 describes methods of test for the determination of surface resistance and surface resistivity of electrical insulation materials by applying DC voltage.

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

IEC 62631-3-1, Dielectric and resistive properties of solid insulating materials – Part 3-1: Determination of resistive properties (DC Methods) – Volume resistance and volume resistivity – General method

IEC 62631-3-3, Dielectric and resistive properties of solid insulating materials – Part 3-3: Determination of resistive properties (DC Methods) – Insulation resistance

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1
electrode arrangement
electrical conductive bodies on the surface of a test specimen

Note 1 to entry: The arrangement of electrodes should include procedures to ascertain sufficient contact to the surface (e.g. by means of conducting paint) and/or the use of adequate mechanical system applying the necessary contact force to the test specimen's surface.

3.1.1
annular electrodes
central circular planar electrode with a surrounding ring electrode separated by a gap as shown in Figure 3

Note 1 to entry: Guard electrode systems as described in IEC 62321-3-1 are of similar shape. In the case of surface resistance, the ring electrode does not have the function of a guard; guard functionality, however, is provided by the opposite electrode.

3.1.2
line electrodes
electrode arrangement provided by two parallel lines, separated by a gap, applied to the test specimen's surface using a conductive material as shown in Figure 2

3.1.3
spring loaded electrodes
line electrode system using two parallel lines of conducting spring tongues with sharp edges, separated by a gap as shown in Figure 1

3.2
measured resistance
ratio of DC voltage applied to an electrode arrangement in contact with a test specimen to the current between them measured with sufficient precision

Note 1 to entry: A three terminal electrode arrangement may be used to exclude undesired volume currents from the determination of the measured resistance.

Note 2 to entry: A Wheatstone bridge may also be used to compare the measured resistance with a standard resistor. However, Wheatstone bridges are not commonly used anymore.

Note 3 to entry: According to IEC 60050-121: Electromagnetism, "conductivity" is defined as "scalar or tensor quantity, the product of which by the electric field strength in a medium is equal to the electric current density" and "resistivity" as "the inverse of the conductivity when this inverse exists". Measured in this way, the surface resistivity is an average of the resistivity over possible heterogeneities in the volume incorporated in the measurement; it includes the effect of possible polarization phenomena at the electrodes.

3.3
surface resistance
R_S
measured resistance between any electrode arrangement defined by this standard

Note 1 to entry: Dependent on the electrode arrangement used it is designated as R_{SA}, R_{SB}, R_{SC}, R_{SD} or R_{SE} with surface resistance, R_S expressed by the unit Ω.

Note 2 to entry: An indeterminable part of the resistance inside the material is also included in surface resistance during measurement of this resistance.

3.4
surface resistance between annular electrodes
R_{SC}
measured resistance between the inner circular area of an annular electrode system and the outer circular ring electrode

3.5
surface resistance between line electrodes
R_{SD}
measured resistance between line electrodes

3.6
surface resistance between line electrodes for small plates
R_{SF}
measured resistance between line electrodes for small plates

3.7
surface resistance between small line electrodes
R_{SB}
measured resistance between small line electrodes

3.8
surface resistance between spring load electrodes
R_{SA}
measured resistance between spring loaded electrodes

3.9
surface resistivity
σ/square
surface resistance reduced to a squared value.

Note 1 to entry: The numerical value of surface resistivity is independent of the size of the square.

Note 2 to entry: Surface resistance R_{SA}, R_{SB}, R_{SC}, R_{SD} and R_{SE} referred to a square, are expressed as σ_A, σ_B, σ_C, σ_D and σ_E respectively.

Note 3 to entry: Surface resistivity is often expressed by the non-standardized unit Ω per square, to show that the electrode dimension has been taken into account by calculating the specific value.

Note 4 to entry: The surface resistivity is often used to compare one kind of surface characteristic of a sample material with those of other materials. It can be compared for materials only if identical standardized dimensions of the electrodes are used. Recommended dimensions are given in 5.3.

4 Significance

Insulating materials are used in general to electrically isolate components of an electrical system from each other and from the earth. Solid insulating materials can also provide mechanical support. For the purpose it is generally desirable to have the insulation resistance as high as possible, consistent with acceptable mechanical, chemical and heat resistance properties.

Surface resistance is, as volume resistance, a part of the insulating resistance.

Insulating resistance shall be determined according to IEC 62631-3-3 and volume resistance according to IEC 62631-3-1.

Surface resistance supplies information on the electrical resistances of the surface of materials and products. The surface resistance also permits monitoring of changes in the resistance by external effects. Surface resistance, however, for its major part is not a materials property. Surface resistance depends mainly on processing parameters, environmental conditions, surface ageing phenomena and pollution, etc.

NOTE Depending on the specific application, different electrode arrangements can be preferable.

5 Method of test

5.1 General

This general method describes common values for general measurements. If a method for a specific type of material is described in this standard, the specific method shall be used.

Different types of electrodes can be used, depending on the specific measurement or product demands. For instance, on surfaces with a curved shape, a small line electrode can be advantageous. Spring loaded electrodes provide measurements with low effort on products and are optimal for materials which have to be conditioned before the test. If not already stipulated by a product standard, the choice of the electrode arrangement shall be made considering the typical application.

If test specimens are made from materials (e.g. soft rubber) changing their dimensions significantly when applying force by electrodes on them, these electrodes are not applicable and an alternative arrangement shall be used.

If no information about the application is available, small line electrodes (R_{SB}) are recommended.

5.2 Voltage

The measuring voltage shall preferably be

10 V, 100 V, 500 V, 1 000 V, 10 000 V.

If not otherwise specified by the relevant product standard, a voltage of 100 V shall be used.

Technical committee shall specify the preferred test voltage when referring to this standard.

NOTE 1 Partial discharge can lead to erroneous measurements when a specific inception voltage is exceeded. In air, below 340 V, no partial discharges will occur.

NOTE 2 The ripple of the voltage source is important. A typical value for 100 V is < 5 x 10^{-5} peak to peak.

5.3 Equipment

5.3.1 General

Care should be taken that the surface resistance is not negatively influenced by parasitic resistances parallel to the electrode arrangement, such as the resistance of test supports or cable isolation.

To prevent measuring errors for measured resistances higher than 10^{10} Ω, shielded cables and shielded measuring cabinets shall be used.

For the determination of surface resistance and surface resistivity different electrode arrangements can be used. The evaluation of surface resistivity is dependent on the selected electrode arrangement.

5.3.2 Accuracy

Any suitable equipment can be used. The measuring device shall be capable of determining the unknown resistance with an overall accuracy of at least

- ± 10 % for resistances less than 10^{10} Ω;
- ± 20 % for resistances between 10^{10} Ω and 10^{14} Ω; and
- ± 50 % for resistance higher than 10^{14} Ω.

5.3.3 Voltage source

A source of steady direct voltage is required. This can be provided either by batteries or by rectified and stabilized power supply. The degree of stability required is such that the change in current due to any change in voltage is negligible compared with the current to be measured.

5.3.4 Electrode arrangements

Electrode arrangements consist of the combination of electrodes and conductive means. The conductive means shall be applied to the test specimen before performing the measurements. Electrodes are then placed in contact with the conductive means applied on the test specimen in order to perform measurements.

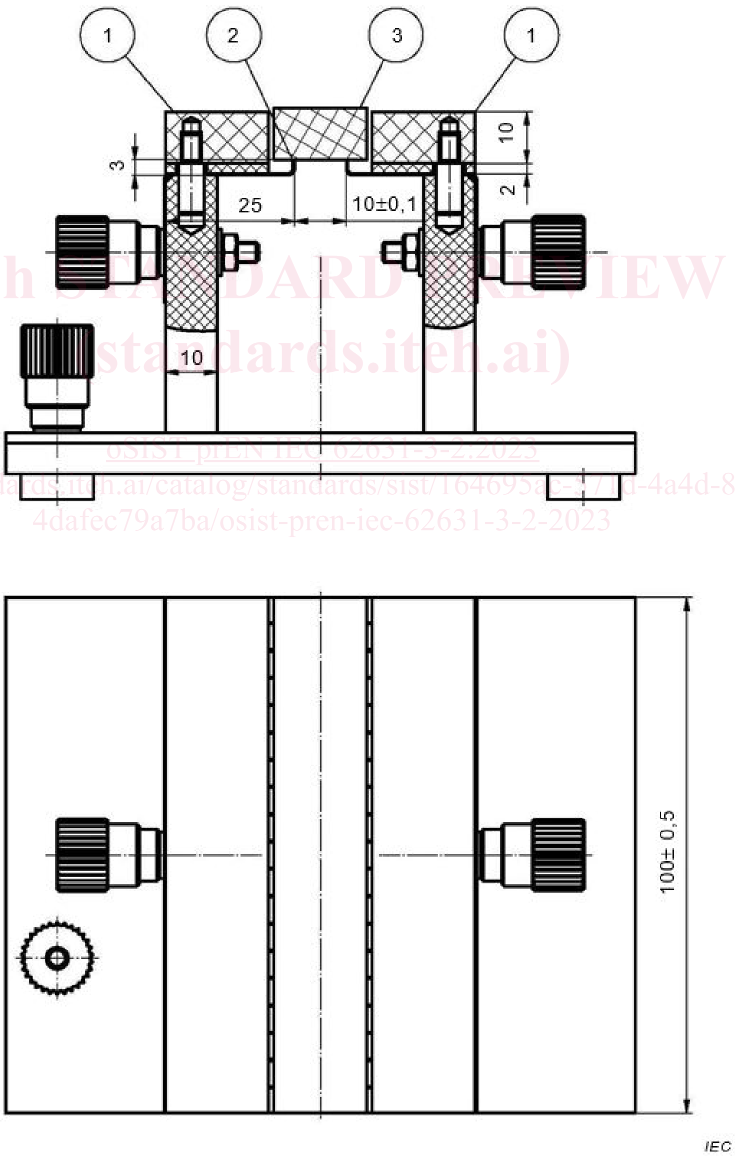
NOTE Informative Annex B contains results of the comparative verification study on surface resistivities using different electrode arrangements.

5.3.4.1 Electrode arrangement A – Spring loaded electrodes

The electrode arrangement A shall consist of two flexible metal knife-edges with a length of 100 mm and a gap distance of 10 mm apart as shown in Figure 1.

No guard electrode is used. The metal knife-edges shall consist of individual spring tongues arranged next to each other about 0,3 mm apart and each with a length not exceeding 5 mm and 0,3 mm thick. The contact force shall be high enough so that all tongues or segments, rest against the surface of the test specimen, but without damaging the surface.

A piece of metal exerting the contact force should be applied with high-grade insulation where in contact with the specimen.



Key

1) guide bar (detachable)

2) metal knife-edges

3) specimen