IEC 62631-3-12

Edition 1.0 2024-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Dielectric and resistive properties of solid insulating materials – Part 3-12: Determination of resistive properties (DC methods) – Volume resistance and volume resistivity – Method for casting resins

Propriétés diélectriques et résistives des matériaux isolant solides – Partie 3-12: Détermination des propriétés résistives (méthodes en courant continu) – Résistance volumique et résistivité volumique – Méthode pour résines de coulée

IEC 62631-3-12:2024-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 17.220.99, 29.035.01

ISBN 978-2-8322-9299-0

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIELECTRIC AND RESISTIVE PROPERTIES OF SOLID INSULATING MATERIALS –

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

Draft	Report on voting
112/645/FDIS	112/652/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- withdrawn, or
- revised.

INTRODUCTION

Many segments of the electrotechnical industry use volume resistance and volume resistivity data of solid insulating materials. This part of the IEC 62631-3 series is focused on the method for casting resins. Clear guidelines will provide the user of this document a uniform approach to sample preparation and test procedures.

DIELECTRIC AND RESISTIVE PROPERTIES OF SOLID INSULATING MATERIALS –

Part 3-12: Determination of resistive properties (DC methods) – Volume resistance and volume resistivity – Method for casting resins

1 Scope

This part of IEC 62631 specifies a method of test for the determination of volume resistance and volume resistivity of electrical insulation materials by applying a DC voltage. It covers casting resins described in IEC 60455-3-1, IEC 60455-3-2, IEC 60455-3-3, IEC 60455-3-4, IEC 60455-3-8 and similar products.

For other specific types of materials, other standards or the general method described in IEC 62631-3-1 can be more suitable.

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 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*

ISO 2808, *Paints and varnishes – Determination of film thickness*

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
volume resistance
part of the insulation resistance which is due to conduction through the volume

Note 1 to entry: Volume resistance is expressed in Ω.

3.2
volume resistivity
ratio of the potential gradient (parallel to the current in a material) to the current density

Note 1 to entry: Volume resistivity is expressed in ohm metre (Ω m).

Note 2 to entry: For insulating materials the volume resistivity is usually determined by means of measuring electrodes arranged on a sheet of the material.

Note 3 to entry: According to IEC 60050-121, "conductivity" (IEV 121-12-03) 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 volume 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.

4 Significance

The materials applicable to the test method described in this document are used to cast electrical or electronic equipment to fix the construction, protect it from humidity, dirt and other environmental influence. Main field applications are electric motors, transformers, electronic devices and similar appliances.

Additional electrical insulation is desirable but not essential. In many cases mechanical support, thermal and chemical resistance are more important. In particular, the changes in resistivity with temperature or humidity, or both, are of great importance and need to be known when designing the equipment for operation conditions.

When a direct voltage is applied between electrodes in contact with a specimen, the current through it decreases asymptotically towards a steady-state value. The decrease of current with time can be due to dielectric polarization and the sweep of mobile ions to the electrodes. For materials having a volume resistivity less than about 10^{10} Ω m the steady state is generally reached within 1 min and the resistance is determined after this time of electrification. For materials with higher volume resistivity the current can continue decreasing for several minutes, hours, days or even weeks. However, the result is taken after one minute.

NOTE For very high electric field strengths different behaviours can occur.

5 Method of test

5.1 General

The method described in this document is used for casting resins. For other specific types of materials other standards or the general method described in IEC 62631-3-1 can be more suitable.

For a casting resin the absolute value of volume resistance or resistivity is of minor interest. More important is the change of this value as a function of temperature or after immersion into water.

5.2 Power supply and voltage

A source of very steady direct voltage is required. This may 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.

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

A voltage of 500 V shall be used, if not otherwise stipulated. Other test voltages may be 10 V, 100 V or 1 000 V.

To avoid migration effects during measurement, the field strength shall be less than 3 000 V/mm.

5.3 Equipment

5.3.1 Accuracy

The measuring device shall be capable of determining the unknown resistance with an overall accuracy of at least:

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

5.3.2 Guarding

For routine measurements, especially in production control to determine the specified minimum values, guarding is not necessary. This allows smaller and simplified specimens.

If the exact absolute value is of interest, or the value is above 10^{12} Ω, or in case of doubt, guarding is recommended. Further information related to guarding can be found in IEC 62631-3-1.

5.3.3 Electrodes

For simple measurements a permanent electrode (e.g. conductive silver paint) may be used.

In case of measurements before and after a treatment (e.g. immersion into water) a removable electrode shall be used. Further information related to electrodes can be found in IEC 62631-3-1.

5.3.4 Calibration

The equipment shall be calibrated in the magnitude of the volume resistance measured.

NOTE Calibration resistors in the range up to 100 TΩ are commercially available.

5.4 Test specimen

A casted plate of resin with a length and a width of at least 60 mm shall be used, unless otherwise specified.

The casting resin shall be mixed in accordance with the manufacturer's instructions, degassed and poured into a mould. A closed mould is preferred, however if an open mould is necessary, precautions shall be taken to obtain flat, smooth and plan parallel surfaces.

The thickness of the resin after curing shall be determined by one of the procedures specified in ISO 2808. Do not intentionally use specimens with widely different thickness. The thickness shall be not less than 0,5 mm.

5.5 Procedure for volume resistivity as function of temperature

5.5.1 General

The following procedure describes an established method used for quality control and is meant as an example. Any other method in line with the general requirements may be used. However, measuring parameters (time, temperatures, environmental influences, etc.) can vary widely and are dependent on the purpose of the measurement and the intended use of the material.