SLOVENSKI STANDARD
oSIST prEN IEC 60112:2024

01-julij-2024

Metoda za ugotavljanje preskusnih in primerjalnih indeksov ustvarjanja prevodnih poti trdnih izolacijskih materialov

Method for the determination of the proof and the comparative tracking indices of solid insulating materials

Verfahren zur Bestimmung der Prüfzahl und der Vergleichszahl der Kriechwegbildung von festen, isolierenden Werkstoffen

Méthode de détermination des indices de résistance et de tenue au cheminement des matériaux isolants solides

Ta slovenski standard je istoveten z: **prEN IEC 60112:2024**

ICS:

19.080	Električno in elektronsko preskušanje	Electrical and electronic testing
29.035.01	Izolacijski materiali na splošno	Insulating materials in general

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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 15	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:

Method for the determination of the proof and the comparative tracking indices of solid insulating materials

PROPOSED STABILITY DATE: 2027

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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METHOD FOR THE DETERMINATION OF THE PROOF AND THE COMPARATIVE TRACKING INDICES OF SOLID INSULATING MATERIALS

FOREWORD

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International Standard IEC 60112 has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems.

This sixth edition cancels and replaces the fifth edition published in 2020 and its Amendment 1:2009. This edition constitutes a technical revision.

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

- In Clause 7.3 resistivity has been replaced by conductivity

It has the status of a basic safety publication in accordance with IEC Guide 104.

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

FDIS	Report on voting
112/XX/FDIS	112/XX/RVD

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

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://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.

METHOD FOR THE DETERMINATION OF THE PROOF AND THE COMPARATIVE TRACKING INDICES OF SOLID INSULATING MATERIALS

1 Scope

This document specifies the method of test for the determination of the proof and comparative tracking indices of solid insulating materials on pieces taken from parts of equipment and on plaques of material using alternating voltage.

The document provides a procedure for the determination of erosion when required.

NOTE 1 The proof tracking index is used as an acceptance criterion as well as a means for the quality control of materials and fabricated parts. The comparative tracking index is mainly used for the basic characterization and comparison of the properties of materials.

This test method evaluates the composition of the material as well as the surface of the material being evaluated. Both the composition and surface condition directly influence the results of the evaluation and are considered when using the results in material selection process.

Test results are not directly suitable for the evaluation of safe creepage distances when designing electrical apparatus.

NOTE 2 The results of this method have been used for insulation coordination of equipment with rated voltage up to 1000 Vac or 1500 Vdc connected to low-voltage supply systems (higher voltages permitted in internal circuits). Use of these results need to also consider the overvoltage levels, creepage distances, and establish the pollution degree to which the product insulation system will be expected to be subjected. This is in compliance with IEC 60664-1, Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests.

NOTE 3 This test discriminates between materials with relatively poor resistance to tracking, and those with moderate or good resistance, for use in equipment which can be used under moist conditions. More severe tests of longer duration are available for the assessment of performance of materials for outdoor use, utilizing higher voltages and larger test specimens (see the inclined plane test of IEC 60587). Other test methods such as the inclined method can rank materials in a different order from the drop test given in this document.

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 Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

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

ISO 293, *Plastics – Compression moulding test specimens of thermoplastic materials*

ISO 294-1, *Plastics – Injection moulding of test specimens of thermoplastic materials – Part 1: General principles, and moulding of multi-purpose and bar test specimens*

ISO 294-3, *Plastics – Injection moulding of test specimens of thermoplastic materials – Part 3: Small plates*

ISO 295, *Plastics – Compression moulding of test specimens of thermosetting materials*

ISO 4287, *Geometrical Product Specification (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters*

ISO 3696, *Water for analytical laboratory use – Specification and test methods*

ISO 304, *Surface active agents – Determination of surface tension by drawing up liquid films*

ISO 7888, *Water quality; Determination of electrical conductivity*

3 Terms and definitions

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

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

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

3.1
tracking
progressive formation of conducting paths, which are produced on the surface and/or within a solid insulating material, due to the combined effects of electric stress and electrolytic contamination

3.2
tracking failure
failure of insulation due to tracking between conductive parts

Note 1 to entry: In the present test, tracking is indicated by operation of an over-current device due to the passage of a current across the test surface and/or within the specimen.

3.3
electrical erosion
wearing away of insulating material by the action of electrical discharges

3.4
air arc
arc between the electrodes above the surface of the specimen

3.5
comparative tracking index
CTI
numerical value of the maximum voltage (in V) at which five test specimens withstand the test period for 50 drops without tracking failure and without a persistent flame occurring and including also a statement relating to the behaviour of the material when tested using 100 drops (see 11.3)

Note 1 to entry: No tracking failure and no persistant flame is allowed at any lower test voltage.

Note 2 to entry: The criteria for CTI may also require a statement concerning the degree of erosion.

Note 3 to entry: Although a non-persistent flame is allowed in the test without constituting failure, materials which generate no flame at all are preferred unless other factors are considered to be more important. See also Annex A.

Note 4 to entry: Some materials can withstand high test voltages, but fail at lower test voltages. See also 11.2.

3.6
persistent flame
a flame which burns for more than 2 s

Note 1 to entry: In the present test, persistent flame is indicated by a visual check.

proof tracking index
PTI
numerical value of the proof voltage (in V) at which five test specimens withstand the test period for 50 drops without tracking failure and without a persistent flame occurring

Note 1 to entry: Although a non-persistent flame is allowed in the test without constituting failure, materials which generate no flame at all are preferred unless other factors are considered to be more important. See also Annex A.

3.7
de-ionized water
water for analytical laboratory use according ISO 3696, grade 3, or same quality

4 Principle

The upper surface of the test specimen is supported in a horizontal plane and subjected to an electrical stress via two electrodes. The surface between the electrodes is subjected to a succession of drops of electrolyte either until the over-current device operates, or until a persistent flame occurs, or until the test period has elapsed.

The individual tests are of short duration (less than 1 h) with up to 50 or 100 drops of about 20 mg of electrolyte falling at 30 s intervals between platinum electrodes, 4 mm apart on the test specimen surface.

An a.c. voltage between 100 V and 600 V is applied to the electrodes during the test.

During the test, specimens may also erode or soften, thereby allowing the electrodes to penetrate them. The formation of a hole through the test specimen during a test is to be reported together with the hole depth (test specimen thickness). Retests may be made using thicker test specimens, up to a maximum of 10 mm.

NOTE The number of drops needed to cause failure by tracking usually increases with decreasing applied voltage and, below a critical value, tracking ceases to occur. For some materials, tracking also ceases to occur above an upper critical value.

5 Test specimen

Any approximately flat surface may be used, provided that the area is sufficient to ensure that during the test no liquid flows away from the test electrodes.

NOTE 1 Flat surfaces of not less than 20 mm × 20 mm are recommended to reduce the probability of electrolyte flows away from the test electrodes although smaller sizes can be used, subject to no electrolyte loss, e.g. ISO 3167, 15 mm × 15 mm multi-purpose test specimens.

NOTE 2 In general separate test specimens for each test are used. If several tests are to be made on the same test piece, testing points can be sufficiently far from each other so that splashes, fumes, or erosion, from the testing point will not contaminate or influence the other areas to be tested.

The thickness of the test specimen shall be 3 mm or more. Individual pieces of material may be stacked to obtain the required thickness of at least 3 mm.

NOTE 3 The values of the CTI obtained on specimens with a thickness below 3 mm cannot be comparable with those obtained on thicker specimens because of greater heat transmission to the glass support through thinner test specimens. For this reason, stacked specimens are possible.

Test specimens shall have uniformly smooth and untextured surfaces which are free from surface imperfections such as scratches, blemishes, impurities, etc, unless otherwise stated in the product standard. If this is impossible, the results shall be reported together with a statement describing the surface of the specimen because certain characteristics on the surface of the specimen could add to the dispersion of the results.

For tests on parts of products, where it is impossible to cut a suitable test specimen from a part of a product, specimens cut from moulded plaques of the same insulating material may be used. In these cases, care should be taken to ensure that both the part and the plaque are produced by the same fabrication process, resulting in the same surface texture, wherever possible. Where the details of the final fabrication process are unknown, methods given in ISO 293, ISO 294-1 and ISO 294-3 and ISO 295 may be appropriate.

NOTE 4 The use of different fabrication conditions/processes can lead to different levels of performance in the PTI and CTI test.

NOTE 5 Parts moulded using different flow directions can also exhibit different levels of performance in the PTI and CTI test.

In special cases, the test specimen may be ground to obtain a flat surface. In this case, the surface texture according ISO 4287 (e.g. R_z values) shall be reported (see 10.2 and 11.5).

NOTE 6 Any grinding can damage the specimen. In this case, material surface made by grinding has higher or lower tracking value than the original surface.

Where the direction of the electrodes relative to any feature of the material is significant, measurements shall be made in the direction of the feature and orthogonal to it. The direction giving the lower CTI shall be reported, unless otherwise specified.

NOTE 7 Use of an aggressive electrolyte, such as solution C, is common, when the material has a hydrophobic surface.

6 Test specimen conditioning

6.1 Environmental conditioning

Unless otherwise specified, the test specimens shall be conditioned for a minimum of 24 h at (23 ± 5) °C, with (50 ± 10) % RH. Once the test specimen has been removed from the conditioning chamber (see 7.7) the test shall be started within 30 minutes.

6.2 Test specimen surface state

Unless otherwise specified,

a) tests shall be made on clean surfaces;

b) any cleaning procedure used shall be reported. Wherever possible, the details shall be agreed between supplier and customer.

Dust, dirt, fingerprints, grease, oil, mould release or other contaminants can influence the results. Care shall be taken when cleaning the test specimen to avoid swelling, softening, abrasion or other damage to the material.

7 Test apparatus

7.1 Electrodes

Two electrodes of platinum with a minimum purity of 99 % shall be used (see Annex C). The two electrodes shall have a rectangular cross-section of (5 ± 0,1) mm × (2 ± 0,1) mm, with one end chisel-edged with an angle of (30 ± 2)° (see Figure 1). The sharp edge shall be removed to produce an approximately flat surface, 0,01 mm to 0,1 mm wide.