

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Varnishes used for electrical insulation –
Part 2: Methods of test**

**Vernis utilisés pour l'isolation électrique –
Partie 2: Méthodes d'essai**

IEC 60464-2:2001

<https://standards.iteh.ai/catalog/standards/iec/341f8c1c-a015-48d8-9ad3-52880f8b012d/iec-60464-2-2001>





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VARNISHES USED FOR ELECTRICAL INSULATION –

Part 2: Methods of test

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IEC 60464-2 edition 2.1 contains the second edition (2001-07) [documents 15C/1224/FDIS and 15C/1253/RVD] and its amendment 1 (2006-01) [documents 15/253/FDIS and 15/280/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 60464-2 has been prepared by subcommittee 15C: Specifications, of IEC technical committee 15: Insulating materials.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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INTRODUCTION

This part of IEC 60464 is one of a series which deals with varnishes used for electrical insulation. The series consists of three parts:

Part 1: Definitions and general requirements (IEC 60464-1);

Part 2: Methods of test (IEC 60464-2);

Part 3: Specifications for individual materials (IEC 60464-3).

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VARNISHES USED FOR ELECTRICAL INSULATION –

Part 2: Methods of test

1 Scope

This part of IEC 60464 specifies methods of test to be used for testing varnishes used for electrical insulation. This includes methods of test to be applied before and others to be applied after drying and/or curing of the varnish.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60464. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60464 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(212):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 212: Insulating solids, liquids and gases*

IEC 60068-2-10:1988, *Environmental testing – Part 2: Tests – Test J and guidance: Mould growth*

IEC 60093:1980, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

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IEC 60216 (all parts), *Guide for the determination of thermal endurance properties of electrical insulating materials*

IEC 60243-1:1998, *Electrical strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60250:1969, *Recommended methods for the determination of the permittivity and dielectric dissipation factor of electrical insulating materials at power, audio and radio frequencies including metre wavelengths*

IEC 60296:1982, *Specification for unused mineral insulating oils for transformers and switchgear*

IEC 60464 (all parts), *Varnishes used for electrical insulation*

IEC 60641-3-1:1992, *Specification for pressboard and presspaper for electrical purposes – Part 3: Specifications for individual materials – Sheet 1: Requirements for pressboard, types B.0.1, B.2.1, B.2.3, B.3.1, B.3.3, B.4.1, B.4.3, B.5.1, B.6.1 and B.7.1*

IEC 60851-4:1996, *Methods of test for winding wires – Part 4: Chemical properties*

IEC 61033:1991, *Test methods for the determination of bond strength of impregnating agents to an enamelled wire substrate*

IEC 61099:1992, *Specifications for unused synthetic organic esters for electrical purposes*

ISO 291:1997, *Plastics – Standard atmospheres for conditioning and testing*

ISO 558:1980, *Conditioning and testing – Standard atmospheres – Definitions*

ISO 760:1978, *Determination of water – Karl Fischer Method (General method)*

ISO 1144:1973, *Textiles – Universal system for designating linear density (Tex System)*

ISO 1513:1992, *Paints and varnishes – Examination and preparation of samples for testing*

ISO 1514:1993, *Paints and varnishes – Standard panels for testing*

ISO 1519:1973, *Paints and varnishes – Bend test (cylindrical mandrel)*

ISO 1520:1999, *Paints and varnishes – Cupping test*

ISO 1523:1983, *Paints, varnishes, petroleum and related products – Determination of flash point – Closed cup equilibrium method*

ISO 2078:1993, *Textile glass – Yarns – Designation*

ISO 2113:1996, *Reinforcement fibres – Woven fabrics – Basis for a specification*

ISO 2431:1993, *Paints and varnishes – Determination of flow time by use of flow cups*

ISO 2555:1989, *Plastics – Resins in the liquid state or as emulsions or dispersions – Determination of apparent viscosity by the Brookfield Test method*

ISO 2578:1993, *Plastics – Determination of time-temperature limits after prolonged exposure to heat*

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ISO 2592:2000, *Determination of flash and fire points – Cleveland open cup method*

ISO 2808:1997, *Paints and varnishes – Determination of film thickness*

ISO 2811 (all parts), *Paints and varnishes – Determination of density*

ISO 2812-1:1993, *Paints and varnishes – Determination of resistance to liquids – Part 1: General methods*

ISO 3219:1993, *Plastics – Polymers/resins in the liquid state or as emulsions or dispersions – Determination of viscosity using a rotational viscometer with defined shear rate*

ISO 3251:1993, *Paints and varnishes – Determination of non-volatile matter of paints, varnishes and binders for paints and varnishes*

ISO 3679:1983, *Paints, varnishes, petroleum and related products – Determination of flashpoint – Rapid equilibrium method*

ISO 11890-1:2000, *Paints and varnishes – Determination of volatile organic component (VOC) content – Part 1: Difference method*

ISO 11890-2:2000, *Paints and varnishes – Determination of volatile organic component (VOC) content – Part 2: Gas chromatographic method*

3 Definitions

For the purposes of this part of IEC 60464, the following definitions as well as the definitions of IEC 60050(212) and IEC 60464-1 apply.

3.1

volume resistance

that part of the insulation resistance which is due to conduction through the volume and excludes surface current

3.2

volume resistivity

volume resistance reduced to a cubical unit volume

3.3

dielectric dissipation factor ($\tan \delta$)

numerical value of the ratio of the imaginary to the real part of the complex permittivity

3.4

relative permittivity (ϵ_r)

ratio of the absolute permittivity to the electric constant

NOTE In practical engineering, it is usual to employ the term "permittivity" when referring to relative permittivity.

4 General notes on methods of test

Unless otherwise specified in the relevant specification standard, or in the method of test, all tests shall be carried out at atmospheric conditions in a temperature of (25 ± 4) °C and a relative humidity range between 45 % to 70 %. Before measurements are made, the sample or test specimen shall be pre-conditioned under these atmospheric conditions for a time sufficient to allow the sample or the test specimen to reach stability. For taking samples in liquid or paste form, ISO 15528 shall be applied. For preparation of such samples for testing, ISO 1513 shall be applied.

NOTE For definitions of terms for standard atmospheres, see ISO 558. The test atmosphere as specified above does not comply with any of the two standard atmospheres as specified in ISO 291 but covers both ranges inclusive of their tolerances.

Normally, all mandatory requirements for a method of test are given in the description, and diagrams are intended only to illustrate one possible arrangement for conducting the test. In case of inconsistencies between this standard and the specification sheets of IEC 60464-3, the latter shall prevail.

When another standard is invoked for a test method, reference to that standard shall be included in the report.

5 Methods of test for undried and/or uncured varnishes

The materials before drying and/or curing are varnishes in their original liquid state.

5.1 Flashpoint

For flashpoint temperatures of 79 °C and above, the method given in ISO 2592 shall be used. For flashpoint temperatures below 79 °C, the method given in ISO 1523 shall be used with any of the closed-cup apparatus as described in annex A of that standard. ISO 1523 shall be read in conjunction with ISO 3679.

Two measurements shall be made on two separate samples and the two results of flashpoint shall be reported.

5.2 Density

The method given in ISO 2811 shall be used. Two measurements shall be made and the two results of density shall be reported.

5.3 Viscosity

The viscosity shall be determined with a suitable device at $(23 \pm 0,5)$ °C. If a rotating type of device is used, it shall be in accordance with ISO 2555 (Brookfield type) or with ISO 3219 (a type working at defined shear rate). If an efflux type of equipment is used, the method of test and the flow cup shall be in accordance with ISO 2431.

Two measurements shall be made and the two results of viscosity shall be reported.

5.4 Content of non-volatile matter

The method given in ISO 3251 shall be used. Two measurements shall be made and the two results of the content of non-volatile matter shall be reported.

5.5 Dilution ability

Dilution ability is expressed by the amount of solvent and/or diluent which can be added to the varnish until cloudiness or separation is observed.

5.5.1 Procedure

A varnish sample of (50 ± 1) ml shall be poured into a glass cylinder of about 250 ml volume. Solvent and/or diluent as agreed between supplier and purchaser shall be added in defined portions of for instance $(10 \pm 0,2)$ ml until cloudiness or separation is observed. After each addition, the content of the glass cylinder shall be properly stirred to obtain a homogeneous mixture and shall be allowed to settle for at least 5 min and not more than 10 min.

5.5.2 Result

One measurement shall be made and the type of solvent and/or diluent and the percentage in volume added without appearance of cloudiness or separation shall be reported.

5.6 Stability of varnish in an open vessel

Stability in an open vessel is expressed by the change in viscosity after storing the varnish at (50 ± 2) °C for (96 ± 1) h (four days).

5.6.1 Equipment

If not otherwise specified, the following equipment shall be used:

- a glass cylinder of 7 cm to 8 cm in diameter and of 9 cm to 10 cm in height;
- an oven without forced air circulation and with a rate of ventilation of 6 to 10 air changes per hour.