

TECHNICAL SPECIFICATION

**Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components –
Part 1: General requirements**



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**Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components –
Part 1: General requirements**

INTERNATIONAL
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COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICAL INSULATION SYSTEMS (EIS) –
THERMAL EVALUATION OF COMBINED LIQUID
AND SOLID COMPONENTS –****Part 1: General requirements****FOREWORD**

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC/TS 62332-1, which is a technical specification, has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems.

This second edition cancels and replaces the first edition, published in 2005, and constitutes editorial and technical revisions.

The following significant technical changes with respect to the previous edition have been made:

Modifications have been made to the technical specification based on an extensive test series conducted using this methodology based on the first edition. This included updating expected times and temperatures to use in order to get useful results, as well as making the range of equipment covered more broad. The method can now cover electrotechnical devices using different sealing systems, as well as devices using enamel covered wires

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
112/160/DTS	112/168/RVC

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

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

The committee has decided that the contents of this publication 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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

This technical specification describes a method for the thermal evaluation of electrical insulation systems (EIS) for electrotechnical products with combined liquid and solid components. Part 1 covers general test requirements. Subsequent parts should cover specific product test requirements.

Prior to this technical specification, the procedure for determining the thermal endurance of insulation systems for liquid-immersed products involved one of two processes: firstly, sealed-tube ageing and, secondly, ageing of full-scale models.

The ageing of full-scale models is impractical, especially for larger products, such as power transformers. Similarly, the use of sealed-tube ageing is not practical when testing components having drastically different thermal capabilities. For example, testing of a system with a solid material with an RTI of 200 °C with a liquid having a 130 °C thermal capability cannot be performed efficiently. Accelerated ageing temperatures, which fairly age the liquid, will result in extremely long ageing times for the solid. Accelerated ageing temperatures, which fairly age the solid, will result in extreme, or even hazardous, ageing of the liquid.

This technical specification describes an accelerated thermal ageing procedure and model that allows for the solid materials to be aged at temperatures separate from the liquid ageing temperatures, all in the same apparatus. The model acts more in the true-life ageing mode of insulation systems, where solid insulation near the active parts is exposed to much higher temperatures than the major volume of liquid in the equipment. The model contains all the primary EIS elements, and in relative component ratios which compare with actual electrotechnical products.

The model has a dual temperature capability that allows independent control of the temperatures of the solid and liquid components by the use of separate circuits. A detailed bibliography is provided.

This technical specification has been prepared in conjunction with TC 14, Power transformers. Any comments or suggestions from other technical committees to make this technical specification more general are welcome.

ELECTRICAL INSULATION SYSTEMS (EIS) – THERMAL EVALUATION OF COMBINED LIQUID AND SOLID COMPONENTS –

Part 1: General requirements

1 Scope

This part of IEC/TS 62332 is applicable to EIS containing solid and liquid components where the thermal stress is the dominant ageing factor, without restriction to voltage class.

This part specifies a dual-temperature test procedure for the thermal evaluation and qualification of electrical insulation systems (EIS).

2 Normative references

The following referenced documents are indispensable for the application 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 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60156, *Insulating liquids – Determination of the breakdown voltage at power frequency – Test method*

IEC 60216-2:2005, *Electrical insulating materials – Thermal endurance properties – Part 2: Determination of thermal endurance properties of electrical insulating materials – Choice of test criteria* IEC 60216-3, *Electrical insulating materials – Thermal endurance properties – Part 3: Instructions for calculating thermal endurance characteristics*

IEC 60216-5, *Electrical insulating materials – Thermal endurance properties – Part 5: Determination of relative thermal endurance index (RTE) of an insulating material*

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

IEC 60247, *Insulating liquids – Measurement of relative permittivity, dielectric dissipation factor ($\tan \delta$) and d.c. resistivity*

IEC 60250, *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, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

IEC 60422, *Mineral insulating oils in electrical equipment – Supervision and maintenance guidance*

IEC 60450, *Measurement of the average viscometric degree of polymerization of new and aged cellulosic electrically insulating materials*

IEC 60505:2004, *Evaluation and qualification of electrical insulation systems*¹

IEC 60554-2, *Cellulosic papers for electrical purposes – Part 2: Methods of test*

IEC 60567, *Oil-filled electrical equipment – Sampling of gases and of oil for analysis of free and dissolved gases – Guidance*

IEC 60599, *Mineral oil-impregnated electrical equipment in service – Guide to the interpretation of dissolved and free gases analysis*

IEC 60763-2, *Specification for laminated pressboard – Part 2: Methods of test*

IEC 60814, *Insulating liquids – Oil-impregnated paper and pressboard – Determination of water by automatic coulometric Karl Fischer titration*

IEC 61198, *Mineral insulating oils– Methods for the determination of 2-furfural and related compounds*

IEC 61620, *Insulating liquids – Determination of dielectric dissipation factor by measurement of the conductance and capacitance – Test method*

IEC 61857-1:2008, *Electrical insulation systems– Procedures for thermal evaluation – Part 1: General requirements – Low voltage*

IEC 62021-1, *Insulating liquids – Determination of acidity – Part 1: Automatic potentiometric titration*

ISO 287, *Paper and board – Determination of moisture content of a lot – Oven-drying method*

ISO 1924 (all parts), *Paper and board – Determination of tensile properties*

ISO 2049, *Petroleum products – Determination of colour (ASTM scale)*

ASTM D971-99a, *Standard test method for interfacial tension of oil against water by the ring method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply, some of which are taken from IEC 60505.

3.1

electrical insulation system

EIS

insulating structure containing one or more electrical insulating materials (EIM) together with associated conducting parts employed in an electrotechnical device

[IEC 60505:2004, definition 3.1.1]

NOTE EIMs with different temperature indices (ATE RTE according to IEC 60216-5) may be combined to form an EIS, which has a thermal class that may be higher or lower than that of any of the individual components according to IEC 60505.

¹ A fourth edition of IEC 60505 is currently in preparation.