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BSI Standards Publication

Electrical insulation systems — Procedures for thermal evaluation

Part 2: Selection of the appropriate test method for evaluation and classification of electrical insulation systems

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A list of organizations represented on this committee can be obtained on request to its secretary.

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TECHNICAL REPORT

Electrical insulation systems – Procedures for thermal evaluation – Part 2: Selection of the appropriate test method for evaluation and classification of electrical insulation systems

INTERNATIONAL
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COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSULATION SYSTEMS – PROCEDURES FOR THERMAL EVALUATION –

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FOREWORD

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IEC TR 61857-2, which is a technical report, has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems.

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

Enquiry draft	Report on voting
112/312/DTR	112/318/RVC

Full information on the voting for the approval of this technical report 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.

A list of all parts in the IEC 61857 series, published under the general title *Electrical insulation systems – Procedures for thermal evaluation*, can be found on the IEC website.

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

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- withdrawn,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

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

ELECTRICAL INSULATION SYSTEMS – PROCEDURES FOR THERMAL EVALUATION –

Part 2: Selection of the appropriate test method for evaluation and classification of electrical insulation systems

1 Scope

This part of IEC 61857 gives guidelines to identify the appropriate test method to be used for the evaluation of a proposed Electrical Insulation System (EIS). Some of the standards are for evaluation and classification of the EIS, while other standards identify the appropriate method to evaluate single or multi-factor stresses of a proposed or of an established EIS.

This Technical Report is applicable to existing or proposed EIS used in electrotechnical products across a wide range of operating voltages of IEC Standards. The report takes care to select the appropriate standard based on construction and intended operating conditions.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60034-18-21, *Rotating electrical machines – Part 18-21: Functional evaluation of insulation systems – Test procedures for wire-wound windings – Thermal evaluation and classification*

IEC 60034-18-31, *Rotating electrical machines – Part 18-31: Functional evaluation of insulation systems – Test procedures for form-wound windings – Thermal evaluation and classification of insulation systems used in rotating machines*

IEC 60505, *Evaluation and qualification of electrical insulation systems*

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

IEC 61857-21, *Electrical insulation systems – Procedures for thermal evaluation – Part 21: Specific requirements for general-purpose models – Wire-wound applications*

IEC 61857-22, *Electrical insulation systems – Procedures for thermal evaluation – Part 22: Specific requirements for encapsulated-coil model – Wire-wound electrical insulation system (EIS)*

IEC 61858-1, *Electrical insulation systems – Thermal evaluation of modifications to an established electrical insulation system (EIS) – Part 1: Wire-wound winding EIS*

IEC 61858-2, *Electrical insulation systems – Thermal evaluation of modifications to an established electrical insulation system (EIS) – Part 2: Form-wound EIS*

IEC TS 61934, *Electrical insulating materials and systems – Electrical measurement of partial discharges (PD) under short rise time and repetitive voltage impulses*

IEC 62068, *Electrical insulating materials and systems – General method of evaluation of electrical endurance under repetitive voltage impulses*

IEC TS 62101, *Electrical insulation systems – Short-time evaluation of combined thermal and electrical stresses*

IEC TS 62332-1, *Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components – Part 1: General requirements*

IEC TS 62332-2, *Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components – Part 2: Simplified test*

3 Terms and definitions

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

3.1
completed product
production unit or prototype

EXAMPLE Such as the stator or rotor section of a rotating machine, a coil for a transformer or solenoid or similar design which is a usable product.

3.2
test/lab model
test object constructed with all essential electrical insulating materials and processing expected to be used in manufacturing of a completed product

3.3
rotating machinery
motor or generator

3.4
encapsulated device
electrotechnical device embedded in resin in order to ensure its safe operation

EXAMPLE Resin:

– as an integral component needed to provide safe operation of the electrotechnical device; and/or
– fills the void between the coil windings and metal parts which can be at earth (ground) potential; and/or
– in designs where the resin provides the outer electrical insulation barrier once the moulding shell or moulding housing is removed.

4 General information

4.1 Purpose of the evaluation

The most essential aspect to be used in the design and development of the project is to define the purpose of the evaluation.

If the purpose is to establish the thermal classification of the EIS to be used in the manufacturing of products, the selected test method shall be one which evaluates the thermal decomposition characteristic of the EIS.

If the purpose of the project is to evaluate more than the thermal classification, which can also include expected stresses related to the application such as:

– processing,

– design,
– construction,

the selected test method shall include the specific multi-factor evaluation characteristics. Tables 1 to 4 present the list of test methods.

4.2 Test objects

There are two levels or types of test objects which can be used in the design and development of a project to evaluate the performance of the EIS used in a completed product.

The evaluation can be conducted with test objects being:

a) completed products
   – The completed product can be a rotating machine covering motors and generators.
   – The completed product can be a solenoid coil or transformer with no moving components.
b) lab models: models can be pre-production units or lab sized models.

   In addition to the basic information, the intended operating voltage shall be included in the selection process.
   – Low-voltage: the most common value for the operating supply voltage is 600 VAC or below.
   – Medium or High voltage: operating voltage above 600 VAC except for the form-wound designs which are not separated by operating voltage.

4.3 Test stresses

As presented in IEC 60505, there are four main areas of possible concern in the design and development of an EIS evaluation:

– thermal
– electrical
– environmental
– mechanical

The selection of the appropriate test method shall include the specific aspects needed.

5 Design and development of the scope of work for the EIS evaluation

Evaluation and thermal classification of an EIS for use in a completed product should be focused on thermal decomposition as the single or most dominant cause of decomposition and breakdown of the EIS. This type of project is not intended to evaluate other factors of possible product failure which may be part of the real world application.

Evaluation and classification of an EIS project for use in the evaluation of a completed product with the inclusion of processing, design and/or construction is expected to have more than thermal decomposition as a measurable factor. This can also be described as multi-factor testing.

6 Test methods for the evaluation and classification of EIS

Type of test objects: for each test method in Table 1 test objects shall be:

a) completed products or
b) lab models.

Unless stated, the specific test method is limited to one category of test object.

Table 1 provides IEC Standards (test methods) for the evaluation of thermal stresses in air, type of property being evaluated, test parameters and examples of common applications for the test method.

Table 2 provides IEC Standards (test methods) for the modification of an established EIS.

Table 3 provides IEC Standards (test methods) for special environment applications.

Table 4 provides IEC Standards (test methods) for the evaluation of new materials, new processes, alternate designs and other aspects, the evaluation of which is beneficial, prior to the start of long-term thermal ageing.

Table 1 – Evaluation for thermal stresses in air

Test method	Type of property being evaluated	Test parameters	Examples of common applications
IEC 61857-1 with IEC 61857-21	Thermal	Low-voltage, random-wound intended for commercial products expected to operate at low voltages.	Applications include coils, motors, transformers, generators operating on supply lines at rated voltages. Most EIS tested at 600 VAC. The maximum test/operating voltage for this method is 1 kVAC.
IEC 61857-1.with IEC 61857-22	Thermal	Low-voltage encapsulated wire-wound coil designs for commercial products expected to operate at low voltages.	Applications include encapsulated coils, motors, transformers, generators operating on supply lines at rated voltages. Most EIS tested for a maximum operation of 600 VAC. This test method is not intended to cover cast-coil for power/distribution transformers.
(under consideration)	Thermal	Low-voltage applications for the categories defined in IEC 61857-1, IEC 61857-21 and IEC 61857-22 except the applications with an expected operating life being less than 5 000 hours of thermal ageing which are required when following the procedures of IEC 61857-21 and IEC 61857-22.	Applications include encapsulated coils, motors, transformers, generators operating on supply lines at rated voltages. Most EIS tested for a maximum operation of 600 VAC. This test method is not intended to cover cast-coil for power/distribution transformers.
IEC 60034-18-21	Thermal	For all operating voltages of large rotating machinery using round wire in random-wound coil designs.	Applications include rotating machines such as motors and generators operating on supply lines at rated voltages. Most EIS tested at 600 VAC. The maximum test/operating voltage for this method is 1 kVAC.
IEC 60034-18-31	Thermal	For all operating voltages of large rotating machinery using shaped winding wire/conductor in form-wound coil designs.	Applications are limited, as stated in the title, to rotating machinery. The Formette test objects are limited to a maximum test voltage of 15 kV; operating voltage of 6,9 kV. Evaluations conducted using completed motors or generators shall be defined based on the construction and expected operating voltage.
(under consideration)	Thermal and environmental compatibility	For special applications to expand EIS evaluated under IEC 61857-1, IEC 61857-21 and IEC 61857-22 where the evaluation of long term performance is essential.	Applications include encapsulated coils, motors, transformers, generators operating on supply lines at rated voltages. Most EIS tested for a maximum operation of 600 VAC. This test method is not intended to cover cast-coil for power/distribution transformers.
IEC TS 62101	Thermal and electrical	Electrical insulation systems – Short-time evaluation of combined thermal and electrical stresses.	Applications include encapsulated coils, motors, transformers, generators operating on supply lines at rated voltages. Most EIS tested for a maximum operation of 600 VAC. This test method is not intended to cover cast-coil for power/distribution transformers.
NOTE Low-voltage refers to 600 VAC unless stated otherwise for a specific test method.			

Table 2 – Standards for the modification of an established EIS

Test method	Type of property being evaluated	Test parameters	Examples of common applications
IEC 61858-1	Evaluation of modifications to an established low-voltage, random-wound EIS	Restricted to EIS evaluated for low-voltage applications when tested and thermally rated in accordance with IEC 61857-1, IEC 61857-21 and IEC 61857-22.	Applications are defined in the IEC 61857 test methods. The voltage limits are not modified or changed by this test method.
IEC 61858-2	Evaluation of modifications to an established form-wound EIS	For larger rotating machinery using form-wound coils for all operating voltages tested in accordance with IEC 60034-18-21 and IEC 60034-18-31.	Applications are defined in the IEC 60034-18-21 and IEC 60034-18-31 test methods. The voltage limits are not modified or changed by this test method.

Table 3 – Standards for special environmental applications

Test method	Type of property being evaluated	Test parameters	Examples of common applications
IEC TS 62332-1	Thermal and environmental compatibility	Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components – Part 1: General requirements	Oil-immersed transformers
IEC TS 62332-2	Thermal and environmental compatibility	Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components – Part 2: Simplified test	Oil-immersed transformers
IEC 62332-3 (under consideration)	Thermal and environmental compatibility	Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components – Part 3: Hermetic Motor-Compressors	Motors, compressors and coolants

Table 4 – For evaluation prior to the start of long-term thermal ageing

Test method	Type of property being evaluated	Test parameters	Examples of common applications
IEC 62068	Electrical	Electrical insulating materials and systems – General method of evaluation of electrical endurance under repetitive voltage impulses.	There are no preset limits on test or operating voltages. The test and operating voltages are determined by the design and construction of the test objects.
IEC 61934	Electrical	Electrical insulating materials and systems – Electrical measurement of partial discharges (PD) under short rise time and repetitive voltage impulses.	There are no preset limits on test or operating voltages. The test and operating voltages are determined by the design and construction of the test objects.

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