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Electrical insulation systems – Procedures for thermal evaluation – Part 31: Applications with a designed life of 5 000 h or less

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ELECTRICAL INSULATION SYSTEMS – PROCEDURES FOR THERMAL EVALUATION –

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FOREWORD

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International Standard IEC 61857-31 has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems.

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

CDV	Report on voting
112/356/CDV	112/375/RVC

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.

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 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- withdrawn,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.

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

INTRODUCTION

IEC 61857-1 provides the general structure to be followed for an electrical insulation system (EIS) evaluation and classification.

IEC TR 61857-2 provides guidelines to identify the application and to select the preferred test method based on the application.

This part of IEC 61857 provides a test method for EIS applications, such as the automotive industry, when the designed life is 5 000 h or less.

The selection of this test method can be decided by the end product application.

ELECTRICAL INSULATION SYSTEMS – PROCEDURES FOR THERMAL EVALUATION –

Part 31: Applications with a designed life of 5 000 h or less

1 Scope

This part of IEC 61857 establishes an EIS evaluation for applications with a designed life of 5 000 h or less. This test method follows the procedures of IEC 60505 and is modified based on the range of designed life.

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 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 TR 61857-2, *Electrical insulation systems – Procedures for thermal evaluation – Part 2: Selection of the appropriate test method for evaluation and classification of electrical insulation systems*

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)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61857-1 and the following 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
designed life
expected application time which is proposed or decided by an end user, an industrial manufacturer, etc., regardless of the duty cycle, continual or intermittent

3.2
thermal endurance
TE
maximum designed temperature for the selected time coordinate

3.3
average life
AL
mean value of life

4 EIS evaluation

Procedure A (see Clause 6) is intended for EIS with a designed life of 1 500 h or less, subjecting one set of test objects to one-temperature ageing at 10 K above the maximum design temperature. The average life of the set under evaluation shall be at least 1 500 h.

Procedure B (see Clause 6) is intended for EIS with a designed life of 5 000 h or less, subjecting one set of test objects to one-temperature ageing at 10 K above the maximum design temperature. The ageing time in Procedure A may be increased up to 5 000 h to correspond to the designed life of the EIS. The average life of the set under evaluation shall be at least 1 500 h.

Procedure C (see Clause 6) is intended for EIS with a designed life of 5 000 h or less, subjecting two sets of test objects to two-temperature ageing at 20 K to 30 K and 30 K to 35 K above the maximum design temperature.

The test results determined by either Procedure A, Procedure B or Procedure C described in Clause 6 can be expanded to larger full thermal evaluations in accordance with IEC 61857 (all parts), if the additional thermal ageing is started prior to the completion of the thermal ageing according to this document. When expanded to a full thermal ageing, the work undertaken according to this document is referred to as a screening test portion of the full thermal ageing. Also, IEC 61857-1 and IEC TR 61857-2 may require a reference EIS to be included in the evaluation for establishing a relative thermal endurance (RTE) rating. When expansion is needed, an evaluation with regard to other applications shall require the addition of a reference EIS in accordance with an EIS method selected from IEC TR 61857-2.

5 Test objects

The test objects and test equipment shall be in accordance with the appropriate test method selected from IEC TR 61857-2.

6 Test procedures

6.1 Procedure A: Establishing a TE for applications with a designed life of 1 500 h or less: one-temperature ageing

Follow the procedures of the selected test method. For the selected test method, one test cycle consists of:

– thermal ageing subcycle according to IEC 60505,
– conditioning subcycle according to IEC TR 61857-2, for example IEC 61857-21 or IEC 61857-22, and
– diagnostic testing in accordance with the procedures of the test method selected from IEC TR 61857-2. The selected ageing temperature shall be 10 K above the maximum design temperature.

The average life of the set under evaluation shall be at least 1 500 h.

To accumulate at least 1 500 h prior to the breakdown of the EIS the ageing cycle shall be 168 h.

NOTE 168 hours (one week) is used for accumulating more than 1 500 ageing hours in nine ageing cycles.

If the set of test objects exceeds the original test time of 1 500 h the test may be terminated as the target was achieved or the thermal ageing may be continued to achieve an expanded goal.

6.2 Procedure B: Establishing a TE rating for applications with a designed life of 5 000 h or less: one-temperature ageing

The one-temperature ageing described in Procedure A can be extended to accumulate additional hours. The set undergoing thermal evaluation under Procedure A can be extended to a time coordinate of up to 5 000 h.

6.3 Procedure C: Establishing a TE rating for applications with a designed life of 5 000 h or less: two-temperature ageing

For these two-temperature ageing applications, the recommendation is for two sets of the candidate EIS test objects to undergo test cycles at each of two elevated ageing temperatures. One test cycle consists of

– thermal ageing subcycle according to IEC 60505,

– conditioning subcycle, and

– diagnostic testing in accordance with the procedures of the test method selected from IEC TR 61857-2 with the following selected ageing temperatures:

  - the lower temperature shall be 20 K to 30 K above the expected thermal class value, and
  - the higher ageing temperature shall be 30 K to 35 K above the expected thermal class value.

7 Data analysis

7.1 Analysis – Test Procedures A and B (See 6.1 and 6.2)

The thermal classification is evaluated and established when there are no failed test objects and no breakdown of the EIS prior to accumulating the specific number of hours. No projection is needed or made with the accumulated single data point. The application expected life is reached prior to the failure of the EIS undergoing the thermal ageing exposure.

If any specimens have a failure of the EIS prior to accumulation of the selected number of hours, the TE shall be established by using the average life (AL) of the set of test objects. The AL is calculated in accordance with the procedure given in IEC 61857-1.

The EIS TE value assigned to the candidate EIS is defined as EIS TE x/y where

x is the established thermal class (expressed in ºC),

y is the specified time interval for this rating (expressed in hours).

EXAMPLE: EIS TE 180 ºC/1 200 h or EIS TE 155 ºC/1 200 h or EIS TE 200 ºC/1 500 h.

7.2 Analysis – Test Procedure C (See 6.3)

To establish a pattern, the life of the set of test objects aged at the higher ageing temperature shall be completed. The set at the lower temperature can be completed or discontinued while still under ageing. When the higher ageing temperature is completed with the lower ageing temperature discontinued, the TE value is a conservative value.

Use the test results from both ageing temperatures. Project the results using both sets of results and project to the time coordinate needed.

The EIS TE value assigned to the candidate EIS is defined as EIS TE x/y where

x is the calculated thermal class (expressed in ºC),

y is the specified time interval for this rating (expressed in hours).

EXAMPLE: EIS TE 180 ºC/2 000 h or EIS TE 155 ºC/3 000 h or EIS TE 200 ºC/3 500 h.

8 Test report

The report of the results of this test shall include all records, relevant details of the test, and analysis, including:

- reference to this document;
- description of the EIS tested;
- ageing temperatures and ageing periods;
- prediagnostic conditioning and diagnostic tests used with applied test or stressed levels, for each EIS;
- number of test objects at each temperature for each EIS;
- method of obtaining the ageing temperatures (including oven type, etc.);
- rate of air replacement, if applicable;
- individual times to end-of-life, and mode of failure;
- mean log times to end-of-life for each ageing temperature;
- EIS RTE/thermal class of the candidate EIS.