IEC 61857-32

Edition 1.0 2019-10

INTERNATIONAL STANDARD

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Electrical insulation systems – Procedures for thermal evaluation – Part 32: Multifactor evaluation with increased factors during diagnostic testing

Systèmes d'isolation électrique – Procédures d'évaluation thermique – Partie 32: Évaluation multifactorielle avec facteurs augmentés pendant les essais de diagnostic

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ELECTRICAL INSULATION SYSTEMS – PROCEDURES FOR THERMAL EVALUATION –

Part 32: Multifactor evaluation with increased factors during diagnostic testing

FOREWORD

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

CDV	Report on voting
112/399/CDV	112/425A/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- withdrawn,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.

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INTRODUCTION

Accelerated ageing of an Electrical Insulation System [EIS] is intended to evaluate the thermal classification of the EIS. Many applications need to include the evaluation of other factors in addition to the thermal factor related to the application.

IEC 60505 provides four categories of stresses or ageing factors which influence the performance of products in use under a wide range of operating conditions. In IEC 60505, the factors are presented as Thermal [T], Electrical [E], Environmental [E], and Mechanical [M]. In this part of IEC 61857, Environmental [E] is replaced with Ambient [A] to remove possible confusion of having two factors represented by the same letter. For this document, the factors are presented with Thermal [T], Electrical [E], Ambient [A], and Mechanical [M].

This document provides the structure for evaluation of one or more of the three factors E, A and M by direct comparison to the baseline classification established by T. Without the baseline, any analysis is limited.

While similar, IEC 61857-32 and IEC 61857-33 have different structure and evaluation conditions. In IEC 61857-32, thermal exposure is the only intended ageing factor and additional stresses are only applied during the diagnostic portion of each test cycle. In IEC 61857-33, the stresses are applied continually at elevated temperatures.

ELECTRICAL INSULATION SYSTEMS – PROCEDURES FOR THERMAL EVALUATION –

Part 32: Multifactor evaluation with increased factors during diagnostic testing

1 Scope

This part of the 61857 series is focused on applications where other possible factors need to be incorporated to evaluate any influence on the performance of the electrical insulation system (EIS). Multi-factor evaluation is the most complex type of project to design and conduct. Clear guidelines are needed to give the user of this document a uniform approach and a method to analyse the test results.

This document is for applications where the stresses are some combination of other factors of influence identified in IEC 60505. The multi-factor stresses are applied during the diagnostic portion of each test cycle.

A few examples of other factors of influence or multi-factor stresses are:

– high vibration;
– submersion in oils, water, or solutions;
– voltage higher than the test voltage of the reference EIS;
– decreased cold shock temperature.

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 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 61858-2, *Electrical insulation systems – Thermal evaluation of modifications to an established electrical insulation system (EIS) – Part 2: Form-wound 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
baseline candidate EIS
EIS exposed to the same thermal ageing and conditioning as the reference EIS

3.2
reference EIS
EIS of a known or field proven design used to establish the thermal classification of the candidate EIS

3.3
EIS_{RT}
established thermal classification of the reference EIS

3.4
EIS_{CT}
assigned thermal classification of the candidate EIS based on the comparison to the reference EIS

4 Procedure

An overview of the structure is shown in Figure 1.

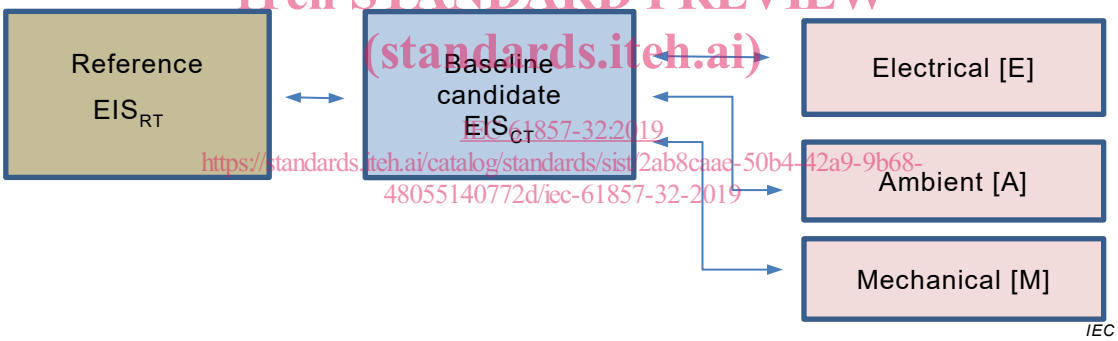


Figure 1 – Overview

5 Test objects

Test objects shall be in accordance with the test method selected from IEC TR 61857-2.

The design of test object(s) shall be in accordance with the test method selected. When part of the evaluation is to compare processing or alternate designs of the same functioning product, the modifications shall be part of the multifactor test object construction with all modifications documented in the report.

The preferred number of test objects is contained in the individual test method selected from IEC TR 61857-2.

6 EIS evaluation

The evaluation of the endurance of the candidate EIS and evaluation with multifactor stresses is separated into two parts.

Part 1: evaluation of the baseline candidate EIS under standard exposure, conditioning, and testing to establish the baseline performance.

Part 2: evaluation of the possible influence of other factors on the performance of the EIS by conducting a one-temperature side-by-side comparison with one set of test objects undergoing evaluation with standard exposure, conditioning, and testing and the second set of test objects undergoing evaluation with the same thermal exposure but including the other stress factor(s) during conditioning and/or testing.

The baseline candidate EIS and EIS undergoing evaluation with other/increased stresses are expected to utilize the same materials and be of the same design and construction. The only factor expected to be different between the two sets of test specimens/objects is the diagnostic stress during the diagnostic portion of the evaluation, unless the purpose of the test is to evaluate a manufacturing/process change.

7 Part 1: Baseline structure

7.1 General

Part 1 consists of the evaluation of a candidate system compared to a reference system or a pre-selected correlation time in accordance with one of the test methods selected from IEC TR 61857-2. The candidate and reference systems shall be evaluated in the same manner. This is essential for analysis of the results. In addition, all sets of test objects shall be of the same design and construction unless the purpose of the test is to evaluate design changes. The thermal class of the reference and candidate systems may be different. There is no requirement for the reference and candidate EIS to have the same thermal classification, as the thermal classification of the candidate EIS cannot be known until completion of the thermal ageing.

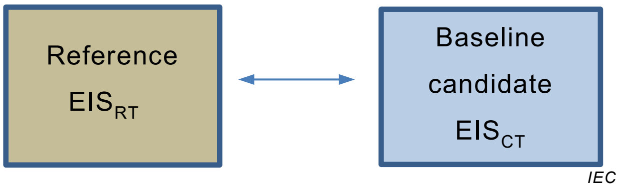
NOTE In a situation where no established reference EIS can be identified a preselected time coordinate is usable as the means to establish the thermal classification of the baseline candidate EIS.

The candidate EIS is evaluated to establish the thermal endurance performance by direct comparison to the selected reference EIS or pre-selected correlation time. The performance of the candidate EIS when exposed to thermal stress and conditions in accordance with the standard EIS test method(s) becomes the baseline needed to evaluate the influence of the additional stresses.

In Part 1, the reference EIS and baseline candidate EIS may have different thermal classes, which means that the thermal ageing temperatures used during the evaluation may be different. Part 2, for the evaluation of the baseline candidate EIS and the EIS which has increased/additional diagnostic factors, requires both EIS to be exposed to the same thermal ageing temperature for the same duration (thermal ageing hours) each cycle.

7.2 Illustration of the structure – Thermal evaluation

The candidate EIS performance is compared to a reference EIS to establish the thermal endurance of the candidate EIS as illustrated in Figure 2.



Key

EIS$_{RT}$ established thermal classification of the reference EIS

EIS$_{CT}$ assigned thermal classification of the candidate EIS based on comparison to the reference EIS

Figure 2 – Illustration of the establishment of the thermal classification of the candidate EIS

7.3 Example of thermal evaluation of a candidate EIS

The thermal evaluation of a candidate EIS typically consists of the exposure of test objects to a minimum of three thermal ageing temperatures (one set of test objects per temperature, per EIS being evaluated). The thermal ageing temperatures, number of test objects, etc. are indicated in the appropriate EIS test method selected from IEC TR 61857-2.

Temperature 1 = highest

Temperature 2 = middle

Temperature 3 = lowest

The total number of sets of test objects needed = 3 reference + 3 candidate = 6 sets.

Table 1 provides an example showing the comparison of the performance of a possible reference EIS to the performance of a possible candidate EIS.

Annex A provides an example of test data for a reference EIS with an example of the plotting of the reference EIS data in Annex B.

Annex C provides an example of test data for a candidate EIS with an example of the plotting of the candidate EIS data in Annex D.

Table 1 – Example of a reference EIS and candidate EIS; performance at temperature and thermal classification

Thermal ageing temperatures	**Reference life at temperature** [hours]	**Candidate life at temperature** [hours]
Highest = 240 °C	H_R = 350	H_Y = 480
Middle = 220 °C	M_R = 1 600	M_Y = 1 900
Lowest = 200 °C	L_R = 5 700	L_Y = 6 900
Thermal rating	Thermal index = 180 °C Correlation time based on known thermal index = 29 239 h	Relative thermal index = 181 °C RTI based on comparison to the reference system correlation time

8 Part 2: Evaluation of other factors

8.1 General

Part 2 includes the one-temperature comparison of a baseline EIS to a multi-factor EIS.

The multi-factor evaluation requires one set of test objects for the baseline EIS and a set of test objects for each additional stress or change in diagnostic level to be evaluated (one set per factor/evaluation). Prior to the start of the program, each potential factor should be identified for potential inclusion into the total test program.

Once the thermal classification of the baseline candidate EIS has been established, the assigned rating of the EIS does not change under the multifactor evaluation. The multifactor evaluation is used to determine the potential impact of other factors on the performance of the established EIS, which can be of value in end product design, manufacturing, or for potential use of the EIS in specific applications.

8.2 Selection of the ageing temperature for the one-temperature comparison

The temperature selected shall reflect the expected operating temperature. When the expected operating temperature is not known, the middle ageing temperature used to evaluate the candidate EIS during comparison to a reference EIS shall be used. The preferred temperature selected is one which resulted in a life in the range of 1 000 h to 1 500 h during the baseline candidate evaluation. Table 2 provides an example of ageing temperature selection for the one-temperature comparison.

Table 2 – Example of ageing temperature selection for the one-temperature comparison

Thermal ageing temperatures	Baseline candidate life at temperature [hours]	One-temperature comparison – Selected thermal ageing temperature
Highest = 240 °C	H_Y = 480	230 °C
Middle = 220 °C	M_Y = 1 900	Based on the known life at temperature and using the 10 °rule, thermal ageing at 230 °C should result in a life of approximately 900 h to 1 000 h
Lowest = 200 °C	L_Y = 6 900	

All evaluations for the influence of additional factors are made by comparison of the thermal performance of the multifactor candidate EIS to the thermal performance of the baseline candidate EIS_{CT} as the thermal factor is common to all combinations. Comparisons shall establish the influence of the additional factors on the EIS. Comparison is not made to the reference EIS_{RT}, which was used to establish the thermal rating and performance of the baseline candidate EIS_{CT}.

The thermal exposure at elevated temperature is separated into ageing cycles. The thermal exposure and ageing cycles shall be the same for the baseline candidate and multifactor candidate.

If agreed upon, evaluation of the multifactor candidate compared to the baseline candidate and comparison of the baseline candidate to the reference may be conducted concurrently.