

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Electrical insulation systems – Thermal evaluation of modifications to an established wire-wound EIS**

**Systèmes d'isolation électriques – Evaluation thermique des modifications apportées à un système d'isolation électrique éprouvé à enroulements à fil**

IEC 61858:2008

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICAL INSULATION SYSTEMS –  
THERMAL EVALUATION OF MODIFICATIONS TO  
AN ESTABLISHED WIRE-WOUND EIS**

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This third edition cancels and replaces the second edition, published in 2004 by IEC TC 98: Electrical insulation systems (EIS). It constitutes an editorial revision.

The text of this standard is based on the following documents:

CDV	Report on voting
112/90/CDV	112/98/RVC

Full information on the voting for the approval of this standard 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.

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## INTRODUCTION

This International Standard describes procedures for the evaluation of changes to an established electrical insulation system (EIS) for wire-wound electrotechnical devices and the effect of these changes on the thermal classification of the established EIS.

General principles for evaluation and qualification of EIS can be found in IEC 60505. Unless the procedures of this standard indicate otherwise, the principles of IEC 60505 should be followed.

The thermal classification of an EIS is established either by known service life, in accordance with IEC 60505, or evaluated in accordance with IEC 61857 (all parts).

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# ELECTRICAL INSULATION SYSTEMS – THERMAL EVALUATION OF MODIFICATIONS TO AN ESTABLISHED WIRE-WOUND EIS

## 1 Scope

This International Standard lists the required test procedures for qualification of modifications of an established electrical insulation system (EIS) with respect to its thermal classification. This standard is applicable to EIS used in wire-wound electrotechnical devices. The test procedures are comparative in that the performance of a candidate EIS is compared to that of a reference EIS, which has proven service experience in accordance with IEC 60505 or has been evaluated by one of the procedures given in the IEC 61857 series.

## 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 60172, *Test procedure for the determination of the temperature index of enamelled winding wires*

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

IEC 60317-3, *Specifications for particular types of winding wires – Part 3: Polyester enamelled round aluminium wire, class 155*

IEC 60317-4, *Specifications for particular types of winding wires – Part 4: Solderable polyurethane enamelled round copper wire, class 130*

IEC 60317-7, *Specifications for particular types of winding wires – Part 7: Polyimide enamelled round copper wire, class 220*

IEC 60317-8, *Specifications for particular types of winding wires – Part 8: Polyesterimide enamelled round copper wire, class 180*

IEC 60317-13, *Specifications for particular types of winding wires – Part 13: Polyester or polyesterimide overcoated with polyamide-imide enamelled round copper wire, class 200*

IEC 60317-15, *Specifications for particular types of winding wires – Part 15: Polyesterimide enamelled round aluminium wire, class 180*

IEC 60317-16, *Specifications for particular types of winding wires – Part 16: Polyester enamelled rectangular copper wire, class 155*

IEC 60317-19, *Specifications for particular types of winding wires – Part 19: Solderable polyurethane enamelled round copper wire, overcoated with polyamide, class 130*



IEC 60317-20, *Specifications for particular types of winding wires – Part 20: Solderable polyurethane enamelled round copper wire, class 155*

IEC 60317-21, *Specifications for particular types of winding wires – Part 21: Solderable polyurethane enamelled round copper wire overcoated with polyamide, class 155*

IEC 60317-22, *Specifications for particular types of winding wires – Part 22: Polyester or polyesterimide enamelled round copper wire overcoated with polyamide, class 180*

IEC 60317-23, *Specifications for particular types of winding wires – Part 23: Solderable polyesterimide enamelled round copper wire, class 180*

IEC 60317-25, *Specifications for particular types of winding wires – Part 25: Polyester or polyesterimide overcoated with polyamide-imide enamelled round aluminium wire, class 200*

IEC 60317-29, *Specifications for particular types of winding wires – Part 29: Polyester or polyesterimide overcoated with polyamide-imide enamelled rectangular copper wire, class 200*

IEC 60317-30, *Specifications for particular types of winding wires – Part 30: Polyimide enamelled rectangular copper wire, class 220*

IEC 60317-34, *Specifications for particular types of winding wires – Part 34: Polyester enamelled round copper wire, class 130 L*

IEC 60317-42, *Specifications for particular types of winding wires – Part 42: Polyester-amide-imide enamelled round copper wire, class 200*

IEC 60317-46, *Specifications for particular types of winding wires – Part 46: Aromatic polyimide enamelled round copper wire, class 240*

IEC 60317-47, *Specifications for particular types of winding wires – Part 47: Aromatic polyimide enamelled rectangular copper wire, class 240*

IEC 60317-51, *Specifications for particular types of winding wires – Part 51: Solderable polyurethane enamelled round copper wire, class 180*

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

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

IEC 61857 (all parts), *Electrical insulation systems – Procedures for thermal evaluation*

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

### **3 Terms and definitions**

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

#### **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

**3.2**  
**electrical insulating material**  
**EIM**

material with negligibly low electric conductivity, used to separate conducting parts at different electrical potentials

**3.3**  
**candidate EIS**

EIS under evaluation to determine its service capability (thermal)

**3.4**  
**reference EIS**

established EIS evaluated on the basis of either a known service experience record or a known comparative functional evaluation

**3.5**  
**EIS assessed thermal endurance index**  
**EIS ATE**

numerical value of temperature in degrees Celsius for the reference EIS as derived from known service experience or a known comparative functional evaluation

**3.6**  
**EIS relative thermal endurance index**  
**EIS RTE**

numerical value of the temperature in degrees Celsius of the candidate EIS which is relative to the known EIS ATE of a reference EIS, when both EIS are subjected to the same ageing and diagnostic procedures in a comparative test

**4 General considerations**

This standard provides relatively low cost and short-time methods by which the user can make modifications to an established EIS by evaluating

- a) the impact on the thermal life of the EIS if the thickness of an EIM is changed,
- b) the compatibility, under thermal stress, of a substituted EIM,
- c) the compatibility, under thermal stress, of other components used in intimate contact with an established EIS.

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

There may be more than one EIS in a particular apparatus. These EIS may have different thermal classes.

The following overview (Figure 1) is a flow chart for guidance in selecting the proper clauses for evaluation.

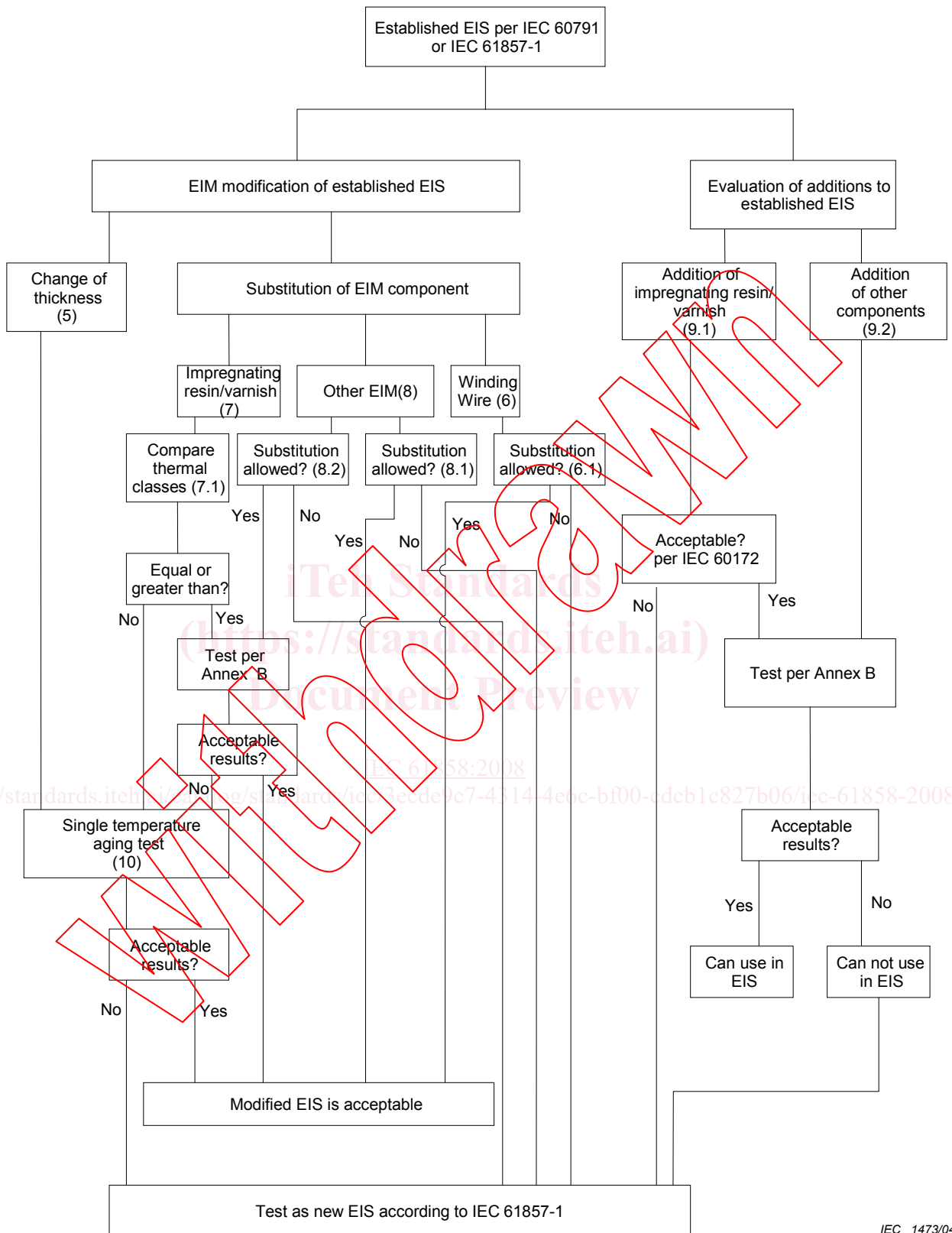


Figure 1 – Overview of evaluation methods

## 5 Evaluation of the change of thickness of an EIM

### 5.1 Samples

Representative samples of the established EIS (the reference EIS) and of the EIS with reduced EIM thickness(es) (the candidate EIS) shall be evaluated in accordance with Clause 10.

### 5.2 Acceptance

A candidate EIS that meets the acceptance criteria according to Clause 10 shall be assigned the same thermal class as the established EIS.

If the results of the candidate EIS testing are outside the acceptance criteria according to Clause 10, then full thermal ageing in accordance with IEC 61857-1 shall be conducted in order to establish its thermal class.

NOTE Full thermal ageing may be accomplished by testing at additional temperatures, according to IEC 61857-1.

## 6 Substitution of winding wire

### 6.1 General

Substitution of a winding wire evaluated in the established EIS can be made without additional testing when one or more of the following conditions have been met:

- a) the winding wire conforms to an IEC 60317 specification having the same chemical composition, according to the Annex A groupings, as the winding wire evaluated in the established EIS but is of a different size or shape;
- b) the winding wire conforms to an IEC 60317 specification having the same chemical composition, according to the Annex A groupings, as the winding wire evaluated in the established EIS and has an equal or higher thermal class;
- c) the winding wire is a bare conductor insulated with one of the EIM evaluated as part of the established EIS in accordance with IEC 61857-1. The thickness to be used shall be such that the electrical stress per unit thickness is not greater than the stress to which the EIM was subjected during the ageing test.

NOTE For substitution of an alternate EIM, refer to Clause 8.

### 6.2 Substitution of enamel

For chemical composition substitution criteria, refer to Annex A.

### 6.3 Substitution of conductor material

An established EIS, which has been evaluated with copper as the conductor, may use either copper or aluminium conductor.

An established EIS, which has been evaluated with aluminium as the conductor, may use either aluminium or copper conductor, provided the thermal performance of the substitute winding wire has been established to be equal to or better than the winding wire evaluated.

### 6.4 Alternate winding wire

Winding wires that do not meet the criteria in 6.1 or 6.2 shall be evaluated in accordance with IEC 61857-1.

Examples would include either bondable winding wire, conductor insulated with an EIM not included in the established EIS, or lead wire used as an alternate winding wire.