

# NORME INTERNATIONALE INTERNATIONAL STANDARD

CEI  
IEC

60085

Troisième édition  
Third edition  
2004-06

---

---

**Isolation électrique –  
Classification thermique**

**Electrical insulation –  
Thermal classification**

© IEC 2004 Droits de reproduction réservés — Copyright - all rights reserved

Aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'éditeur.

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland  
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: [inmail@iec.ch](mailto:inmail@iec.ch) Web: [www.iec.ch](http://www.iec.ch)



Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

CODE PRIX  
PRICE CODE

H

Pour prix, voir catalogue en vigueur  
For price, see current catalogue

COPYRIGHT © IEC. NOT FOR COMMERCIAL USE OR REPRODUCTION

COPYRIGHT © IEC. NOT FOR COMMERCIAL USE OR REPRODUCTION

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSULATION –  
THERMAL CLASSIFICATION

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60085 has been prepared by subcommittee 15E: Methods of test, of IEC technical committee 15: Insulating materials.

This third edition cancels and replaces the second edition, published in 1984, and constitutes a technical revision. This new edition distinguishes between thermal classes for electrical insulation systems and electrical insulating materials.

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

FDIS	Report on voting
15E/232/FDIS	15E/237/RVD

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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

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

## ELECTRICAL INSULATION – THERMAL CLASSIFICATION

### 1 Scope

This standard gives guidance on the application of international standards in assigning a thermal class to electrical insulating materials (EIM) or simple combinations of such materials (IEC 60216-1), to electrical insulation systems (IEC 62114) and to insulation for electrical devices.

### 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 60216-1, *Electrical insulating materials – Properties of thermal endurance – Part 1: Ageing procedures and evaluation of test results*

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

IEC 60216-6, *Electrical insulating materials – Thermal endurance properties – Part 6: Determination of thermal endurance indices (TI and RTE) of an insulating material using the fixed time frame method*

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

IEC 62114, *Electrical insulation systems – Thermal classification*

### 3 Terms and definitions

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

#### 3.1

##### **electrical insulating material**

##### **EIM**

solid with negligibly low electric conductivity, or a simple combination of such materials, used to separate conducting parts at different electrical potential in electrical devices

NOTE 1 In English, the term "insulating material" is sometimes used in a broader sense to designate also insulating liquids and gases.

NOTE 2 For testing purposes, electrodes may be applied on material specimens without this combination formally constituting an EIS to be tested as such.

**3.2****simple combination of electrical insulating materials**

combination of EIM delivered in joint state for production of devices

NOTE For example a flexible material consisting of paper laminated on polyethylene terephthalate film (IEC 60626) constitutes a "simple combination" in this sense. EIMs combined during the manufacturing process of a device do not constitute "simple combinations" in this sense.

**3.3****electrical insulation system****EIS**

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

**3.4****thermal class**

designation of an EIM/EIS equal to the numerical value of the maximum used temperature in degrees Celsius for which the EIM/EIS is appropriate

NOTE It may be necessary to assign different thermal classes to the same EIM/EIS for different service conditions. The description of an electrotechnical product as being of a particular thermal class does not mean, and must not be taken to imply that each insulating material used in its construction is of the same thermal capability.

**3.5****relative thermal endurance index****RTE**

numerical value of the temperature in degrees Celsius at which the estimated time to endpoint of the candidate material is the same as the estimated time to endpoint of the control material at a temperature equal to its assessed thermal endurance (ATE)

**3.6****assessed thermal endurance index****ATE**

numerical value of the temperature in degrees Celsius, up to which the control material possesses known, satisfactory service performance in the specified application

NOTE 1 The value of the ATE may vary between applications for the same material.

NOTE 2 Sometimes referred to as "absolute" thermal endurance index.

**3.7****candidate material**

material for which an estimate of the thermal endurance is required to be determined

NOTE The determination is made by simultaneous thermal ageing of the material and a control material.

**3.8****control material**

material with known thermal endurance, preferably derived from service experience, used for comparative tests with the candidate material

**4 Thermal endurance evaluation and classification**

The thermal classification for insulation materials cannot be applied to an insulation system of which they are components, unless the validity thereof is proved. Vice versa, the thermal classification of a material cannot be deduced from the thermal class of an insulating system of which it is a component.

#### 4.1 Electrical insulating materials (EIM)

Electrical insulating materials and simple combinations of insulating materials shall be evaluated in accordance with IEC 60216-5 or IEC 60216-6 and refer to expected service conditions.

#### 4.2 Electrical insulation systems (EIS)

Electrical insulation systems shall be evaluated in accordance with IEC 61857-1 and classified in accordance with IEC 62114.

### 5 Thermal class

Since the temperature in electrotechnical devices is very often the dominant ageing factor affecting electrical insulating materials, certain basic thermal classes are useful and are recognized as such internationally. Where a thermal class is specified for an electrical insulating material, this means the maximum used temperature in degrees Celsius for which the EIM is appropriate.

Table 1 – Thermal classification of electrical insulating materials

RTE	Thermal class	Previous designation
< 90	70	
>90-105	90	Y
>105-120	105	A
>120-130	120	E
>130-155	130	B
>155-180	155	F
>180-200	180	H
>200-220	200	
>220-250	220	
>250	250	

NOTE This table gives the thermal class designations corresponding to different temperature intervals of the RTE for an EIM. The capital letters in the 3<sup>rd</sup> row refer to the class designations in the earlier edition of IEC 60085 (1984). The designation "Y" applies also to RTE values below 90.

The thermal class attributed to a material used in an insulation system does not automatically imply that the thermal class of the system is the same as for that material, or for the material with the lowest class designation in case more than one material with different class designations are used in the system.

## Bibliography

IEC 60093, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

IEC 60216-2, *Electrical insulating materials – Thermal endurance properties – Part 2: Guide for the determination of thermal endurance properties of electrical insulating materials – Choice of test criteria*<sup>1</sup>

IEC 60216-3, *Electrical insulating materials – Thermal endurance properties – Part 3: Instructions for calculating thermal endurance characteristics*

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

IEC 60243-2, *Electrical strength of insulating materials – Test methods – Part 2: Additional requirements for tests using direct voltage*

IEC 60243-3, *Electrical strength of insulating materials – Test methods – Part 3: Additional requirements for 1,2/50  $\mu$ s impulse tests*

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 60345, *Method of test for electrical resistance and resistivity of insulating materials at elevated temperatures*

IEC 60377-1, *Methods for the determination of the dielectric properties of insulating materials at frequencies above 300 MHz – Part 1: General*

IEC 60377-2, *Methods for the determination of the dielectric properties of insulating materials at frequencies above 300 MHz – Part 2: Resonance methods*

IEC 60626-1, *Combined flexible materials for electrical insulation – Part 1: Definitions and general requirements*

IEC 60626-2, *Combined flexible materials for electrical insulation – Part 2: Methods of test*

IEC 60626-3, *Combined flexible materials for electrical insulation – Part 3: Specifications for individual materials*

IEC 61006, *Electrical insulating materials – Methods of test for the determination of the glass transition temperature*

IEC 61074, *Determination of heats and temperatures of melting and crystallization of electrically insulating materials by differential scanning calorimetry*

ISO 75 (all parts), *Plastics – Determination of temperature of deflection under load*

ISO 178, *Plastics – Determination of flexural properties*

---

<sup>1</sup> Under consideration.

ISO 306, *Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST)*

ISO 527 (all parts), *Plastics – Determination of tensile properties*

ISO 899 (all parts), *Plastics – Determination of creep behaviour*

ISO 3146, *Plastics – Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods*

ISO 6721 (all parts), *Plastics – Determination of dynamic mechanical properties*

ISO 11248, *Plastics – Thermosetting moulding materials – Evaluation of short-term performance at elevated temperatures*

ISO 11357 (all parts), *Plastics – Differential scanning calorimetry (DSC)*

ISO 11358, *Plastics – Thermogravimetry (TG) of polymers – General principles*

ISO 11359 (all parts), *Plastics – Thermomechanical analysis (TMA)*

ISO 14679, *Adhesives – Measurement of adhesion characteristics by a three-point bending method*

---