

Electrical insulating materials — Thermal endurance properties —

Part 5: Determination of relative thermal endurance index (RTE) of an insulating material

ICS 29.035.01

National foreword

This British Standard is the UK implementation of EN 60216-5:2008. It is identical to IEC 60216-5:2008. It supersedes BS EN 60216-5:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/112, Evaluation and qualification of electrical insulating materials and systems.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English version

**Electrical insulating materials -
Thermal endurance properties -
Part 5: Determination of relative thermal endurance index (RTE)
of an insulating material
(IEC 60216-5:2008)**

Matériaux isolants électriques -
Propriétés d'endurance thermique -
Partie 5: Détermination de l'indice
d'endurance thermique relatif (RTE)
d'un matériau isolant
(CEI 60216-5:2008)

Elektroisolierstoffe -
Eigenschaften hinsichtlich des
thermischen Langzeitverhaltens -
Teil 5: Bestimmung des relativen
thermischen Lebensdauer-Indexes (RTE)
von Elektroisolierstoffen
(IEC 60216-5:2008)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 112/89/FDIS, future edition 3 of IEC 60216-5, prepared by IEC TC 112, Evaluation and qualification of electrical insulating materials and systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60216-5 on 2008-05-01.

This European Standard supersedes EN 60216-5:2003.

EN 60216-5:2008 clarifies and corrects a few items and adds an Annex D which provides criteria for the selection of the reference (or reference EIM). EN 60216-5:2008 provides instructions for deriving a provisional estimate of the temperature up to which a material may give satisfactory performance in an application (by comparative thermal ageing with a material of known performance).

This standard is to be used in conjunction with EN 60216-1, EN 60216-2 and EN 60216-3.

The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2009-02-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2011-05-01 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60216-5:2008 was approved by CENELEC as a European Standard without any modification.

CONTENTS

1	Scope	4
2	Normative references	4
3	Terms, definitions, symbols, units and abbreviations	4
3.1	Terms, abbreviations, and definitions	5
3.2	Symbols and units	6
3.3	Objectives of RTE determination	7
4	Experimental procedures	7
4.1	Selection of reference EIM	7
4.2	Selection of diagnostic test for extent of ageing	8
4.3	Ageing procedures	8
5	Calculation procedures	9
5.1	Thermal endurance data – Calculation of intermediate parameters	9
5.2	Calculation of RTE	10
5.3	Statistical and numerical tests	10
5.3.1	Tests of IEC 60216-3	10
5.3.2	Precision of correlation time	11
5.3.3	Lower confidence interval of RTE	11
5.3.4	Extrapolation	12
6	Report	12
6.1	Results of statistical and numerical tests	12
6.2	Results	12
6.3	Report	12
7	Material testing by short-term thermal ageing	12
8	Insulation classification	13
	Annex A (informative) Repeatability of correlation time	14
	Annex B (informative) Thermal class assignment	17
	Annex C (informative) Computer program	19
	Annex D (informative) Selection of the reference EIM	20
	Annex ZA (normative) Normative references to international publications with their corresponding European publications	23
	Bibliography	22
	Figure 1 – Thermal endurance graphs	8
	Figure 2 – Unacceptable thermal endurance graphs	9
	Table 1 – Input parameters for the calculations concerning RTE	10
	Table B.1 – Thermal class equivalents for insulating material	17
	Table B.2 – F -function; $p = 0,05$	18
	Table B.3 – t -function	18

ELECTRICAL INSULATING MATERIALS – THERMAL ENDURANCE PROPERTIES –

Part 5: Determination of relative thermal endurance index (RTE) of an insulating material

1 Scope

This part of IEC 60216 specifies the experimental and calculation procedures to be used for deriving the relative thermal endurance index of a material from experimental data obtained in accordance with the instructions of IEC 60216-1 and IEC 60216-2. The calculation procedures are supplementary to those of IEC 60216-3.

Guidance is also given for assessment of thermal ageing after a single fixed time and temperature, without extrapolation.

The experimental data may in principle be obtained using destructive, non-destructive or proof tests, although destructive tests have been much more extensively employed. Data obtained from non-destructive or proof tests may be “censored”, in that measurement of times taken to reach the endpoint may have been terminated at some point after the median time but before all specimens have reached end-point (see IEC 60216-1).

Guidance is given for preliminary assignment of a thermal class for an insulating material, based upon the thermal ageing performance.

The calculation procedures of this standard also apply to the determination of the thermal class of an electrical insulation system when the thermal stress is the prevailing ageing factor.

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 60216-1:2001, *Electrical insulating materials – Properties of thermal endurance – Part 1: Ageing procedures and evaluation of test results*

IEC 60216-2, *Electrical insulating materials – Thermal endurance properties – Part 2: Determination of thermal endurance properties of electrical insulating materials – Choice of test criteria*

IEC 60216-3:2006, *Electrical insulating materials – Thermal endurance properties – Part 3: Instructions for calculating thermal endurance characteristics*

3 Terms, definitions, symbols, units and abbreviations

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

3.1 Terms, abbreviations, and definitions

3.1.1

electrical insulating material

EIM

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

3.1.2

assessed thermal endurance index

ATE

numerical value of the temperature in degrees Celsius, up to which the reference EIM 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.

3.1.3

candidate EIM

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 reference EIM.

3.1.4

reference EIM

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

3.1.5

central second moment of a data group

sum of the squares of the differences between the data values and the value of the group mean divided by the number of data in the group

3.1.6

correlation time

estimated time to endpoint of the reference EIM at a temperature equal to its assessed thermal endurance (ATE) in degrees Celsius

3.1.7

degrees of freedom

number of data values minus the number of parameter values

3.1.8

standard error

standard error of an estimate of the true value of a data group property is the value of the standard deviation of the hypothetical sampling population of which the group property may be considered to be a member

NOTE 1 For the group mean it is equal to the group standard deviation divided by the square root of the number of data in the group, and indicates the uncertainty in the true value of the mean.

NOTE 2 This standard is concerned only with means and the difference between two means (see Clause A.2).

3.1.9

standard deviation

square root of the variance of a data group or sub-group

3.1.10**relative thermal endurance index****RTE**

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

3.1.11**variance of a data group**

sum of the squares of the deviations of the data from a reference level defined by one or more parameters, divided by the number of degrees of freedom

NOTE The reference level may, for example, be a mean value (1 parameter) or a line (2 parameters, in this standard, the slope and the intercept with the y axis).

3.2 Symbols and units

a_A	Regression coefficient (y-intercept) of thermal endurance equation for reference EIM
a_B	Regression coefficient (y-intercept) of thermal endurance equation for candidate EIM
b_A	Regression coefficient (slope) of thermal endurance equation for reference EIM
b_B	Regression coefficient (slope) of thermal endurance equation for candidate EIM
X	Variable for statistical analysis equal to $1/(\vartheta + \theta_0)$
Y	Variable for statistical analysis equal to $\ln(\tau)$
ϑ	Ageing temperature in determination of RTE
θ_0	Temperature on Kelvin scale equal to 0 °C
τ	Time to endpoint
τ_c	Estimated time to endpoint of reference EIM at a temperature equal to ATE ("correlation time")
$\mu_{2(A)}$	Central second moment of x values for reference EIM
$\mu_{2(B)}$	Central second moment of x values for candidate EIM
n_A	Number of y values for reference EIM data
n_B	Number of y values for candidate EIM data
T	Student's t distributed stochastic variable
S	Standard error of the difference of two means
s_A^2	Variance of y values for reference EIM data
s_B^2	Variance of y values for candidate EIM data
$\bar{x}_A$	General mean of x -values for reference EIM data
$\bar{x}_B$	General mean of x -values for candidate EIM data
$\bar{y}_A$	General mean of y -values for reference EIM data
$\bar{y}_B$	General mean of y -values for candidate EIM data
θ_A	Temperature in degrees Celsius equal to ATE
θ_B	Temperature in degrees Celsius equal to RTE