

# SLOVENSKI STANDARD

## SIST EN 60216-6:2010

01-februar-2010

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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 60216-6:2006)

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Elektroisolierstoffe - Eigenschaften hinsichtlich des thermischen Langzeitverhaltens - Teil 6: Bestimmung der thermischen Langzeitkennwerte (TI und RTE) eines Isolierstoffes unter Anwendung des Festzeitrahmenverfahrens (IEC 60216-6:2006)

Matériaux isolants électriques - Propriétés d'endurance thermique - Partie 6: Détermination des indices d'endurance thermique (TI et RTE) d'un matériau isolant en utilisant la méthode de trame de durées fixes (fixed time frame) (IEC 60216-6:2006)

**Ta slovenski standard je istoveten z: EN 60216-6:2006**

### ICS:

29.035.01	Izolacijski materiali na splošno	Insulating materials in general
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**SIST EN 60216-6:2010**

**en,fr**

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 60216-6**

November 2006

ICS 17.220.99; 29.035.01

Supersedes EN 60216-6:2004

English version

**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 60216-6:2006)**

Matériaux isolants électriques -  
Propriétés d'endurance thermique  
Partie 6: Détermination des indices  
d'endurance thermique (TI et RTE)  
d'un matériau isolant en utilisant  
la méthode de "trame de durées fixes  
(fixed time frame)"  
(CEI 60216-6:2006)

Elektroisolierstoffe -  
Eigenschaften hinsichtlich des  
thermischen Langzeitverhaltens  
Teil 6: Bestimmung der thermischen  
Langzeitkennwerte (TI und RTE)  
eines Isolierstoffes unter Anwendung  
des Festzeitrahmenverfahrens  
(IEC 60216-6:2006)

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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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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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 112/28/FDIS, future edition 2 of IEC 60216-6, 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 60216-6 on 2006-09-01.

This European Standard supersedes EN 60216-6:2004.

The significant technical change with respect to EN 60216-6:2004 is as follows:

EN 60216-6:2006 has been supplemented by Annex G and the corresponding software.

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) | 2007-06-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn   | (dow) | 2009-09-01 |

Annex ZA has been added by CENELEC.

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## **Endorsement notice**

The text of the International Standard IEC 60216-6:2006 was approved by CENELEC as a European Standard without any modification.

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## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60212	- <sup>1)</sup>	Standard conditions for use prior to and during the testing of solid electrical insulating materials	HD 437 S1	1984 <sup>2)</sup>
IEC 60216-1	2001	Electrical insulating materials - Properties of thermal endurance Part 1: Ageing procedures and evaluation of test results	EN 60216-1	2001
IEC 60216-2	- <sup>1)</sup>	Electrical insulating materials - Thermal endurance properties Part 2: Determination of thermal endurance properties of electrical insulating materials - Choice of test criteria	EN 60216-2	2005 <sup>2)</sup>
IEC 60216-3	2002	Electrical insulating materials - Thermal endurance properties Part 3: Instructions for calculating thermal endurance characteristics	EN 60216-3 <sup>3)</sup>	2002
IEC 60216-4-1	- <sup>1)</sup>	Electrical insulating materials - Thermal endurance properties Part 4-1: Ageing ovens - Single-chamber ovens	EN 60216-4-1	2006 <sup>2)</sup>
IEC 60216-4-2	- <sup>1)</sup>	Electrical insulating materials - Thermal endurance properties Part 4-2: Ageing ovens - Precision ovens for use up to 300 °C	EN 60216-4-2	2000 <sup>2)</sup>
IEC 60216-4-3	- <sup>1)</sup>	Electrical insulating materials - Thermal endurance properties Part 4-3: Ageing ovens - Multi-chamber ovens	EN 60216-4-3	2000 <sup>2)</sup>
IEC 60216-5	- <sup>1)</sup>	Electrical insulating materials - Thermal endurance properties Part 5: Determination of relative thermal endurance index (RTE) of an insulating material	EN 60216-5	2003 <sup>2)</sup>

<sup>1)</sup> Undated reference.

<sup>2)</sup> Valid edition at date of issue.

<sup>3)</sup> EN 60216-3 is superseded by EN 60216-3:2006, which is based on IEC 60216-3:2006.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60493-1	1974	Guide for the statistical analysis of ageing test - data Part 1: Methods based on mean values of normally distributed test results		-

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# NORME INTERNATIONALE INTERNATIONAL STANDARD

**CEI  
IEC**

**60216-6**

Deuxième édition  
Second edition  
2006-05

## **Matériaux isolants électriques – Propriétés d'endurance thermique –**

### **Partie 6: Détermination des indices d'endurance thermique (TI et RTE) d'un matériau isolant en utilisant la méthode de «trame de durées fixes (fixed time frame)»**

[SIST EN 60216-6:2010](https://standards.iteh.ai/catalog/standards/sist/cbb92162-45fc-4be0-8bf8-6224110207/sist-en-60216-6-2010)

<https://standards.iteh.ai/catalog/standards/sist/cbb92162-45fc-4be0-8bf8-6224110207/sist-en-60216-6-2010>

## **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**

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Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

CODE PRIX  
PRICE CODE

**X**

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

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**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**

## 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.
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International Standard IEC 60216-6 has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems.

This second edition cancels and replaces the first edition, published in 2003. This edition constitutes a technical revision.

The significant technical changes with respect to the previous edition are as follows.

- This new edition has been supplemented by Annex G and the corresponding software.

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

FDIS	Report on voting
112/28/FDIS	112/32/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.

IEC 60216, under the general title *Electrical insulating materials – Thermal endurance properties*, consists of the following parts:

- Part 1: Ageing procedures and evaluation of test results
- Part 2: Determination of thermal endurance properties of electrical insulating materials – Choice of test criteria
- Part 3: Instructions for calculating thermal endurance characteristics
- Part 4: Ageing ovens
- Part 5: Determination of relative thermal endurance index (RTE) of an insulating material
- Part 6: Determination of thermal endurance indices (TI and RTE) of an insulating material using the fixed time frame protocol

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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; <https://standards.iteh.ai/catalog/standards/sist/cbb92162-45fc-4be0-8bf8-cf23fa1820f7/sist-en-60216-6-2010>
- withdrawn;
- replaced by a revised edition, or
- amended.

## 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

#### 1 Scope

This part of IEC 60216 specifies the experimental and calculation procedures for deriving the thermal endurance characteristics, temperature index (TI) and relative thermal endurance index (RTE) of a material using the “fixed time frame method (FTFM)”.

In this protocol, the ageing takes place for a small number of fixed times, using the appropriate number of ageing temperatures throughout each time, the properties of the specimens being measured at the end of the relevant time interval. This differs from the procedure of IEC 60216-1, where ageing is conducted at a small number of fixed temperatures, property measurement taking place after ageing times dependent on the progress of ageing.

The diagnostic tests employed in the fixed time frame method are restricted to destructive tests. The method has not as yet been applied to non-destructive or proof test procedures.

Both the TI and the RTE determined according to the FTFM protocol are derived from experimental data obtained in accordance with the instructions of IEC 60216-1 and IEC 60216-2 as modified in this standard. The calculation procedures and statistical tests are modified from those of IEC 60216-3 and IEC 60216-5.

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#### 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 60212, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

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 60216-3:2002, *Electrical insulating materials – Thermal endurance properties – Part 3: Instructions for calculating thermal endurance characteristics*

IEC 60216-4-1, *Electrical insulating materials – Thermal endurance properties – Part 4-1: Ageing ovens – Single-chamber ovens*

IEC 60216-4-2, *Electrical insulating materials – Thermal endurance properties – Part 4-2: Ageing ovens – Precision ovens for use up to 300 °C*

IEC 60216-4-3, *Electrical insulating materials – Thermal endurance properties – Part 4-3: Ageing ovens – Multi-chamber ovens*

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

IEC 60493-1:1974, *Guide for the statistical analysis of ageing test data – Part 1: Methods based on mean values of normally distributed test results*

### 3 Terms, definitions, symbols and abbreviated terms

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

#### 3.1 Terms, abbreviations and definitions

##### 3.1.1

##### **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 ATE of a specific material may vary between different applications of the material.

NOTE 2 ATE is sometimes referred to as "absolute" thermal endurance index.

##### 3.1.2

##### **ageing temperature**

temperature in degrees Celsius at which a group of specimens is thermally aged

##### 3.1.3

##### **end-point temperature**

temperature in degrees Celsius at which a specimen is considered to have reached end-point after ageing for a specified time

##### 3.1.4

##### **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.

##### 3.1.5

##### **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****95 % confidence limit**

statistical parameter, calculated from test data, which with 95 % confidence constitutes an upper or lower limit for the true value of a quantity estimated by statistical analysis

NOTE 1 This implies that there is only 5 % probability that the true value of the quantity estimated is actually larger (or smaller) than the upper (or lower) confidence limit.

NOTE 2 In other connections, confidence values other than 95 % may sometimes be used, e.g. in the linearity test for destructive test data.

**3.1.7****control material**

material with known assessed thermal endurance index (ATE), preferably derived from service experience, used as a reference for comparative tests with the candidate material

**3.1.8****correlation coefficient**

number expressing the completeness of the relation between members of two data sets, equal to the covariance divided by the square root of the product of the variances of the sets

NOTE 1 The value of its square is between 0 (no correlation) and 1 (complete correlation).

NOTE 2 In this standard, the two data sets are the values of the independent variable and the means of the corresponding dependent variable groups.

**3.1.9****correlation time (RTE)**

estimated time to end-point of the control material at a temperature equal to its ATE in degrees Celsius

**3.1.10****correlation time (TI)**

hypothetical time to end-point used to calculate TI

NOTE Its usual value is 20 000 h.

**3.1.11****covariance (of data sets)**

for two sets of data with equal numbers of elements where each element in one set corresponds to one in the other, sum of the products of the deviations of the corresponding members from their set means, divided by the number of degrees of freedom

**3.1.12****degrees of freedom**

number of data values minus the number of parameter values

**3.1.13****destructive test**

diagnostic property test, where the test specimen is irreversibly changed by the property measurement, in a way which precludes a repeated measurement on the same specimen

NOTE An example of a destructive test is measurement of electric strength. An example of a non-destructive test is measurement of tg  $\delta$ .

**3.1.14****end-point line**

line parallel to the temperature axis intercepting the property axis at the end-point value

**3.1.15****halving interval****HIC**

numerical value of the temperature interval in kelvins which expresses the halving of the time to end-point taken at a time equal to TI

**3.1.16****regression analysis**

process of deducing the best fit line expressing the relation of corresponding members of two data groups by minimizing the sum of squares of deviations of members of one of the groups from the line

**3.1.17****regression coefficients**

coefficients of the equation of the best fit line derived by regression analysis

**3.1.18****relative thermal endurance index****RTE**

estimate of the thermal endurance of a candidate material, made by thermal ageing simultaneously with the control material, as described in this standard

NOTE The value of RTE is the value of the temperature in degrees Celsius at which the estimated time to end-point of the candidate material is the same as the estimated time to end-point of the control material at a temperature equal to its ATE.

**3.1.19****significance**

probability of a value of a statistical function greater than a specified value

NOTE The value is equal to  $(1-p)$  where  $p$  is the cumulative distribution function value. Significance is conventionally printed in upper case ( $P$ ).

**3.1.20****standard deviation**

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

**3.1.21****standard error of an estimate of the true value of a data group property**

value of the standard deviation of the hypothetical sampling population of which the group property may be considered to be a member

NOTE For an estimate of the group mean, the standard error 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 estimate of the true value of the mean. This standard is concerned only with means and the difference between two means.

**3.1.22****temperature index****TI**

numerical value of the temperature in degrees Celsius derived from the thermal endurance relationship at a time of 20 000 h (or other specified time)

**3.1.23****temperature group (of specimens)**

number of specimens being exposed together to thermal ageing at the same temperature in the same oven

NOTE Where there is no risk of ambiguity, either temperature groups or test groups may be referred to simply as "groups".

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