

SLOVENSKI STANDARD

SIST HD 611.1 S1:1998

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Guide for the determination of thermal endurance properties of electrical insulating materials - Part 1: General guidelines for ageing procedures and evaluation of test result (IEC 60216-1:1990)

Guide for the determination of thermal endurance properties of electrical insulating materials -- Part 1: General guidelines for ageing procedures and evaluation of test results

Leitlinie zur Bestimmung der thermischen Langzeiteigenschaften von Elektroisolierstoffen -- Teil 1: Allgemeine Leitlinie für Warmlagerungsverfahren und für die Auswertung von Prüfergebnissen

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Guide pour la détermination des propriétés d'endurance thermique de matériaux isolants électriques -- Partie 1: Guide général relatif aux méthodes de vieillissement et à l'évaluation des résultats d'essai

Ta slovenski standard je istoveten z: HD 611.1 S1:1992

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HARMONIZATION DOCUMENT

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ENGLISH VERSION

Guide for the determination of thermal endurance properties of electrical insulating materials
Part 1: General guidelines for ageing procedures and evaluation of test results
(IEC 216-1:1990)

Guide pour la détermination des propriétés d'endurance thermique de matériaux isolants électriques
Première partie: Guide général relatif aux méthodes de vieillissement et à l'évaluation des résultats d'essais
(CEI 216-1:1990)

Leitlinie zur Bestimmung der thermischen Langzeiteigenschaften von Elektroisolierstoffen
Teil 1: Allgemeine Leitlinien für Warmlagerungsverfahren und für die Auswertung von Prüfergebnissen
(IEC 216-1:1990)

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This Harmonization Document was approved by CENELEC on 1992-06-16. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for implementation of this Harmonization Document on a national level.

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

This Harmonization Document exists in three official versions (English, French, German).

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

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FOREWORD

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 216-1:1990 could be accepted without textual changes, has shown that no common modifications were necessary for the acceptance as Harmonization Document.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as HD 611.1 S1 on 16 June 1992.

The following dates were fixed:

- latest date of announcement
of the HD at national level (doa) 1992-12-01
- latest date of publication of
a harmonized national standard (dop) 1993-06-01
- latest date of withdrawal of
conflicting national standards (dow) 1993-06-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annex ZA is normative.

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ENDORSEMENT NOTICE

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The text of the International Standard IEC 216-1:1990 was approved by CENELEC as a Harmonization Document without any modification.

ANNEX ZA (normative)

OTHER INTERNATIONAL PUBLICATIONS QUOTED IN THIS STANDARD
WITH THE REFERENCES OF THE RELEVANT EUROPEAN PUBLICATIONS

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

IEC Publication -----	Date ----	Title -----	EN/HD -----	Date ----
85	1984	Thermal evaluation and classification of electrical insulation	HD 566 S1	1990
212	1971	Standard conditions for use prior to and during the testing of solid electrical insulating materials	HD 437 S1	1984
216		Guide for the determination of thermal endurance properties of electrical insulating materials		
216-2	1990	Part 2: Choice of test criteria	HD 611.2 S1	1992
216-3		Part 3: Instructions for calculating thermal endurance characteristics		
216-3-1	1990	Section One: Calculations using mean values of normally distributed complete data	HD 611.3.1 S1	1992
216-3-2	-	Section Two: Calculation procedures for normally distributed results from destructive test procedures (under consideration)	-	-
216-3-3	-	Section Three: Calculations for incomplete data: proof test results up to and including the median time to end-point (equal test groups) (under consideration)	-	-
216-3-4	-	Section Four: Calculations for relative temperature indices (under consideration)	-	-
216-4		Part 4: Ageing Ovens		
216-4-1	1990	Section One: Single-chamber ovens	HD 611.4.1 S1	1992
216-5	1990	Part 5: Guidelines for the application of thermal endurance characteristics	HD 611.5 S1	1992

IEC Publication -----	Date -----	Title -----	EN/HD -----	Date -----
493		Guide for the statistical analysis of ageing test data		
493-1	1974	Part 1: Methods based on mean values of normally distributed test results	-	-
505	1975	Guide for the evaluation and identification of insulation systems of electrical equipment	-	-
611	1978	Guide for the preparation of test procedures for evaluating the thermal endurance of electrical insulation systems	-	-

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NORME
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**CEI
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216-1**

Quatrième édition
Fourth edition
1990-05

**Guide pour la détermination des propriétés
d'endurance thermique
de matériaux isolants électriques**

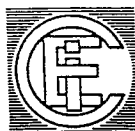
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**Première partie:
Guide général relatif aux méthodes
de vieillissement et à l'évaluation
des résultats d'essai**

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**Guide for the determination of thermal
endurance properties of
electrical insulating materials**

**Part 1:
General guidelines for ageing procedures and
evaluation of test results**



Numéro de référence
Reference number
CEI/IEC 216-1: 1990

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

GUIDE FOR THE DETERMINATION OF THERMAL ENDURANCE PROPERTIES OF ELECTRICAL INSULATING MATERIALS

Part 1: General guidelines for ageing procedures and evaluation of test results

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by Sub-Committee 15B: Endurance Tests, of IEC Technical Committee No. 15: Insulating materials.

It replaces the third edition, published in 1987.

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

Six Months' Rule	Reports on Voting	Two Months' Procedure	Reports on Voting
15B(CO)62 15B(CO)62A	15B(CO)69 15B(CO)69A	15B(CO)80 and 80A	15B(CO)85

Full information on the voting for the approval of this standard can be found in the Voting Reports indicated in the above table.

The following IEC publications are quoted in this standard:

Publications Nos.: 85 (1984):	Thermal Evaluation and Classification of Electrical Insulation.
212 (1971):	Standard Conditions for Use prior to and during the Testing of Solid Electrical Insulating Materials.
216:	Guide for the determination of thermal endurance properties of electrical insulating materials.
216-2 (1990):	Part 2: Choice of test criteria.
216-3:	Part 3: Instructions for calculating thermal endurance characteristics.
216-3-1 (1990):	Section One – Calculations using mean values of normally distributed complete data.
216-3-2 (xxx):	Section Two – Calculation procedures for normally distributed results from destructive test procedures (Under consideration).
216-3-3 (xxx):	Section Three – Calculations for incomplete data: proof test results up to and including the median time to end-point (equal test groups) (Under consideration).
216-3-4 (xxx):	Section Four – Calculations for relative temperature indices (Under consideration).
216-4:	Part 4: Ageing ovens.
216-4-1 (1990):	Section One – Single-chamber ovens.
216-5 (1990):	Part 5: Guidelines for the application of thermal endurance characteristics.
493:	Guide for the Statistical Analysis of Ageing Test Data.
493-1 (1974):	Part 1: Methods based on mean values of normally distributed test result.
505 (1975):	Guide for the Evaluation and Identification of Insulation Systems of Electrical Equipment.
611 (1978):	Guide for the Preparation of Test Procedures for Evaluating the Thermal Endurance of Electrical Insulation Systems.

GUIDE FOR THE DETERMINATION OF THERMAL ENDURANCE PROPERTIES OF ELECTRICAL INSULATING MATERIALS

Part 1: General guidelines for ageing procedures and evaluation of test results

INTRODUCTION

IEC methods to determine and express the thermal endurance of electrical insulating materials reveal a clear trend which may be described as follows:

- The original listing of the thermal capabilities of a number of widely used materials based on service experience is no longer satisfactory due to the accelerating pace of polymer and electrical insulation technology.
- Test procedures have been developed which enable the validity of the underlying physical model to be verified. A complete test programme for materials produces the temperature index (TI) which is a one-point characteristic. Alternatively, comparative tests produce the relative temperature index (RTI) which characterizes the performance of the test material relative to that of the known reference material. RTI was originally supported by a certain input from service experience. An additional feature is to improve the reproducibility between laboratories.
- The one-point presentation does not permit a complete description of a material's thermal endurance relationship. Therefore, a composite index called the Thermal Endurance Profile (TEP) was introduced in the second edition of IEC Publication 216-1. This was done because it was recognized that both the slope of the thermal endurance graph and the confidence of the experimental test data are important and relevant.
- Since the regular inclusion of a figure representing the statistical confidence is not of major practical importance, the present edition — maintaining the verification of the confidence of the test data — emphasizes just the two indices TI and RTI. The slope of the thermal endurance graph is now explicitly given by means of the easily comprehensible halving interval (HIC). This permits the deletion of the TEP.

Note. — Regarding the Thermal Endurance Profile TEP of the Second edition, see Appendix D of this publication.

IEC Publication 216 consists of five parts:

Part 1: General guidelines for ageing procedures and evaluation of test results.

Part 2: Choice of test criteria.

Part 3: Instructions for calculating thermal endurance characteristics.

Part 4: Ageing ovens.

Part 5: Guidelines for the application of thermal endurance characteristics.

The relevant statistical methods will be found in IEC Publication 493.

Note. — This work may be continued. For revisions and new parts, see the current catalogue of IEC Publications for an up-to-date list.

SECTION ONE — GENERAL

1. Scope

This standard gives principles of test procedures to evaluate the thermal endurance of electrical insulating materials and simple combinations of such materials; it describes the conditions to be observed during the various tests and shows the basic analysis methods to derive the temperature index, the relative temperature index and the halving interval, from the test results. Attention is given to test data which do not completely satisfy the requirements of linearity and dispersion of the thermal endurance relationship.

Note. — Throughout the rest of this standard the term "insulating materials" is always taken to mean "insulating material(s) and simple combination(s) of such materials".

2. General considerations

Thermal endurance tests serve the purpose of revealing how prolonged exposure to elevated temperature produces irreversible degradation of the properties of insulating materials. Of importance are those electrical and mechanical properties on which the appropriate functioning of the insulation in actual operation depends, and which may deteriorate due to thermal ageing.

Note. — However, other properties which change reversibly with temperature without thermal ageing may, singly or in combination, be the limiting factor in practice. In such cases other evaluation methods not within the scope of thermal endurance testing will be applied.

According to current practice, the thermal endurance of insulating materials is assessed by exposure to three or more ageing temperatures higher than the expected temperature index. The results of such exposure can often be described by a linear (Arrhenius) relationship between the logarithm of the time taken to reach a certain degree of property change and the reciprocal thermodynamic (absolute) temperature. See Appendix A.

A calculation based on the Arrhenius relationship or a graphical estimation on the thermal endurance graph is used to estimate endurance times inside or outside the range of exposure temperatures.

It sometimes happens that the thermal endurance relationship is non-linear in the temperature range of interest. If such a relationship is well established, the evaluation of the thermal capability of materials may still be possible, see Clauses 7, 8 and 13 and Appendix C of this part.

The properties of a material subjected to thermal ageing may not all deteriorate at the same rate. Consequently, a material may be assigned more than one thermal endurance index derived, for example, from the measurement of different properties. See I E C Publication 216-2.

Although thermal endurance characteristics, while giving guidance on materials, should not by themselves be taken to predict the relationship between temperature and performance of an insulation system in service, such a relationship is sometimes used without adequate justification. It is emphasized that thermal endurance characteristics of materials should only be related to operating temperatures when a relationship has been established by other tests, or service experience. See also I E C Publication 216-5 and the following publications:

- I E C Publication 85.
- I E C Publication 505.
- I E C Publication 611.

3. Principles of evaluation and definitions

The test procedures covered by this guide apply to insulating materials and simple combinations thereof before they are fabricated into insulating structures identified with specific parts of electric equipment.

A distinction between such material tests and tests to evaluate the performance of insulation systems is necessary for two main reasons. Firstly, the details of the particular use of a material cannot be known to its manufacturer. Secondly, the performance of an insulation system cannot generally be predicted from that of its component materials.

The procedures covered by this guide produce information on the long-term characteristics of materials which provide the manufacturer of electrotechnical products with guidance for the selection of materials for further evaluation and application.

Note. — Results of tests on familiar, widely used materials are compiled for convenient reference in *IEEE Trans. El. Ins.* vol. EI-17 (1982) No. 1, pp. 53-63, so that comparisons between new and old materials can be made. Such compilations need to be updated periodically.

The following definitions shall apply:

- 1) *Temperature index (TI)*
The number corresponding to the temperature in degrees Celsius derived from the thermal endurance relationship at a given time, i.e. 20 000 h, unless otherwise specified.
- 2) *Relative temperature index (RTI)*
The temperature index of a test material obtained from the time which corresponds to the known temperature index of a reference material when both materials are subjected to the same ageing and diagnostic procedures in a comparative test (see Figure 3).
- 3) *Halving interval (HIC)*
The number corresponding to the temperature interval in degrees Celsius which expresses the halving of the time to end-point taken at the temperature of the TI or the RTI.
- 4) *Thermal endurance graph (Arrhenius graph)*
A graph in which the logarithm of time to reach a specified end-point in a thermal endurance test is plotted versus the reciprocal thermodynamic (absolute) test temperature.

The derivation of HIC is given in Sub-clause 12.2. HIC is an approximate measure of the slope of the thermal endurance graph. See Appendix B.

The standardized procedure for the thermal evaluation of an insulating material consists of a sequence of steps. Some of these steps are slightly different depending on whether TI or RTI is to be determined. These steps are marked with an asterisk and the differences are explained in the clause to which reference is made.

- a)* Preparing suitable specimens appropriate for the intended property measurements. See Clauses 6 and 7.
- b)* Subjecting groups of specimens to ageing at several fixed levels of elevated temperature, either continuously or cyclically for a number of periods between which the specimens are normally returned to a standard temperature, usually room temperature. See Clause 8.