
Guide for the determination of thermal endurance properties of electrical insulating materials - Part 3: Instructions for calculating thermal endurance characteristics - Section 1: Calculations using mean values of normally distributed complete data (IEC 60216-3-1:1990)

Guide for the determination of thermal endurance properties of electrical insulating materials -- Part 3: Instructions for calculating thermal endurance characteristics -- Section 1: Calculations using mean values of normally distributed complete data

iTeh STANDARD PREVIEW

Leitlinie zur Bestimmung der thermischen Langzeiteigenschaften von Elektroisolierstoffen -- Teil 3: Vorschriften zur Berechnung der thermischen Langzeitkennwerte -- Hauptabschnitt 1: Berechnung mit Hilfe von Mittelwerten für normalverteilte, vollständige Daten

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Guide pour la détermination des propriétés d'endurance thermique de matériaux isolants électriques -- Partie 3: Instructions pour le calcul des caractéristiques d'endurance thermique -- Section 1: Calculs basés sur les valeurs moyennes des résultats complets normalement distribués

Ta slovenski standard je istoveten z: HD 611.3.1 S1:1992

ICS:

29.035.01	Izolacijski materiali na splošno	Insulating materials in general
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SIST HD 611.3.1 S1:1998	en
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UDC 621.315.61:620.193.94

Descriptors: Insulating material, thermal endurance test, thermal characteristics, calculation, statistical analysis, test results

ENGLISH VERSION

Guide for the determination of thermal endurance properties of electrical insulating materials
Part 3: Instructions for calculating thermal endurance characteristics
Section One: Calculations using mean values of normally distributed complete data
(IEC 216-3-1:1990)

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

Troisième partie: Instructions pour le calcul des caractéristiques d'endurance thermique

Section un: Calculs basés sur les valeurs moyennes des résultats complets normalement distribués

(CEI 216-3-1:1990)

Leitlinie zur Bestimmung der thermischen

Langzeiteigenschaften von Elektroisolistoffen

Teil 3: Vorschriften zur Berechnung der thermischen Langzeitkennwerte

Hauptabschnitt 1: Berechnung mit Hilfe von Mittelwerten für normalverteilte, vollständige Daten

(IEC 216-3-1:1990)

<https://standards.iteh.ai/catalog/standards/sist/7cbbbcf9-a3da-404a-ac0e-aaa7d845d1eb/sist-hd-611-3-1-s1-1998>

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

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

FOREWORD

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 216-3-1:1990 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 611.3.1 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 216-3-1:1990 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
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216		Guide for the determination of thermal endurance properties of electrical insulating materials		
216-1	1990	Part 1: General guidelines for ageing procedures and evaluation of test results	HD 611.1 S1	1992
216-2	1990	Part 2: Choice of test criteria	HD 611.2 S1	1992
216-3-2	-	Part 3: Instructions for calculating thermal endurance characteristics Section Two: Calculation procedures for normally distributed results from destructive test procedures (under consideration)	-	-
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	-	-

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NORME
INTERNATIONALE
INTERNATIONAL
STANDARD

CEI
IEC
216-3-1

Troisième édition
Third edition
1990-08

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

Troisième partie:

Instructions pour le calcul des caractéristiques
d'endurance thermique

Section 1 — Calculs basés sur les valeurs
moyennes des résultats complets normalement
distribués

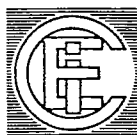
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Guide for the determination of thermal
endurance properties of electrical insulating
materials

Part 3:

Instructions for calculating thermal endurance
characteristics

Section 1 — Calculations using mean values of
normally distributed complete data



Numéro de référence
Reference number
CEI/IEC 216-3-1: 1990

DESKO MATERIAL IZOLACIJSKI, IZOLACIJA ELEKTRIČNA, DOBA TRAJANJA, DOLOČANJE, NAVODILO

CONTENTS

	Page
FOREWORD	5
PREFACE	5
INTRODUCTION	7
Clause	
1. Scope and object	7
2. Calculation principles	9
3. Instructions for deriving thermal endurance indices	13
FIGURES	25
APPENDIX A — List of symbols	29
APPENDIX B — Worked example	33
APPENDIX C — Fractiles of the χ^2 , t and F distributions	37
APPENDIX D — BASIC program for thermal endurance	39

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SIST HD 611.3.1 S1:1998

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 3: Instructions for calculating thermal endurance characteristics

Section 1 — Calculations using mean values of normally distributed complete data

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.

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This standard has been prepared by Sub-Committee 15B: Endurance tests, of IEC Technical Committee No. 15: Insulating materials. [SIST HD 611.3.1 S1:1998](https://standards.iteh.ai/catalog/standards/sist/611-3-1-s1-1998)

This third edition replaces IEC Publications 216-3 (1980) and 216-4 (1980). <https://standards.iteh.ai/catalog/standards/sist/611-3-1-s1-1998>

The text of this standard is based on the following documents: [aaa7d845d1eb/sist-hd-611-3-1-s1-1998](https://standards.iteh.ai/catalog/standards/sist/611-3-1-s1-1998)

Six Months' Rule	Report on Voting
15B(CO)73	15B(CO)83

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

Other IEC Publications quoted in this standard:

- Publications Nos. 216: Guide for the determination of thermal endurance properties of electrical insulating materials.
- 216-1 (1990): Part 1: General guidelines for ageing procedures and evaluation of test results.
- 216-2 (1990): Part 2: Choice of test criteria.
- 216-3-2: Part 3: Instructions for calculating thermal endurance characteristics, Section 2 — Calculation procedures for normally distributed results from destructive test procedures. (Under consideration.)
- 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.

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

Part 3: Instructions for calculating thermal endurance characteristics

Section 1 — Calculations using mean values of normally distributed complete data

INTRODUCTION

IEC Publication 216: Guide for the determination of thermal endurance properties of electrical insulating materials, is composed of several parts:

Part 1: General guidelines for ageing procedures and evaluation of test results (IEC Publication 216-1).

Part 2: Choice of test criteria (IEC Publication 216-2).

Part 3: Instructions for calculating thermal endurance characteristics (IEC Publication 216-3).

Part 4: Ageing ovens (IEC Publication 216-4).

Part 5: Guidelines for application of thermal endurance characteristics (IEC Publication 216-5).

This Part consists of four sections based upon mean values of normally distributed test results. Further sections may be added to take account of other statistical procedures, for example extreme value statistics for those cases where mean value treatments are inadequate. However, there is at present insufficient experience to enable these methods to be used in thermal endurance standards.

The following sections of Part 3 are in preparation. Each section will consist exclusively of calculation instructions. The relevant statistical theory will be found in the appropriate part of IEC Publication 493.

Section 2: Calculation procedures for normally distributed results from destructive test procedures (IEC Publication 216-3-2).

Section 3: Calculations for incomplete data: proof test results up to and including the median time to end-point (equal test groups) (IEC Publication 216-3-3).

Section 4: Calculations for relative temperature indices (IEC Publication 216-3-4).

1. Scope and object

This part of IEC Publication 216 gives instructions for calculation of thermal endurance characteristics from data obtained in accordance with IEC Publications 216-1 and 216-2.

Section 1 gives the main sequence calculation scheme for complete normally distributed data, in accordance with the statistical principles set out in IEC Publication 493-1, to which

reference should be made for the mathematical background details. A graphical derivation is also included.

Worked examples, a computer program written in "BASIC" and appropriate statistical tables are given in the appendices.

2. Calculation principles

2.1 Statistical principles

The calculation procedures and instructions given in Clause 3 are based upon the principles and assumptions set out in IEC Publication 493-1. The assumptions made may be expressed in simple form as follows (see IEC Publication 493-1, Sub-clause 3.7.1):

- 1) The relation between the mean of the logarithms of the times taken to reach a given end-point ("mean time to end-point") and the reciprocal thermodynamic (absolute) ageing temperature is linear.
- 2) The values of the deviations of the logarithms of the times to end-point from this linear relation are normally distributed with a variance which is independent of the ageing temperature.

The best estimates of the coefficients of the linear relationship are obtained by the method of least squares, and the confidence limits associated with an estimate using this linear relationship are obtained by using the methods of generalized regression analysis.

2.2 Data for analysis

2.2.1 The experimental data are obtained as values of temperature ($\theta^\circ\text{C}$) and time to end-point (t hours). Each value is transformed to an x or y value:

$x_i = 1 / (\theta_i + 273)$ value (i) of reciprocal thermodynamic (absolute) temperature

$y_{ij} = \log(t_{ij})$ log of value (j) of time in i 'th ageing group (i)

$n_i =$ number of y values in group (i)

$k =$ number of groups

In most cases the number of test specimens at each test temperature is identical, but even if the endurance test is planned with different numbers n_i of y values in the temperature groups, the analysis can be carried out as described below.

In general, the time to end-point shall be determined for all specimens so that all y_{ij} values are available, otherwise the following analysis is not valid. In exceptional cases where one or a few y values are missing for chance reasons, that is, independently of the time to end-point of the specimen, for instance in the case where a specimen is spoiled during handling, it is permissible to carry out the analysis, but the incident should be mentioned in the test report.

* In principle, calculations may be made using Napierian (base e) or Briggsian (base 10) logarithms, as long as the choice is consistent throughout. For this reason, the symbol $\log(y)$ is used throughout, except in Sub-clause 3.1.4.

In order to enable some intermediate results to be comparable with those of the second edition of IEC Publication 216, the computer program (Appendix D) uses logarithms to base 10.

The values of t_{ij} are obtained by direct observation in the case of non-destructive tests or proof tests. In the case of destructive tests they are estimated by the procedures given in IEC Publication 216-3-2.

2.2.2 The data to be used in the common calculation are derived from the primary data as follows.

For each group of y values, the mean, \bar{y}_i , and variance s_{i1}^2 are calculated

$$\bar{y}_i = \sum_{j=1}^{n_i} y_{ij} / n_i \quad (1)$$

$$s_{i1}^2 = \left(\sum_{j=1}^{n_i} y_{ij}^2 - n_i \bar{y}_i^2 \right) / (n_i - 1) \quad (2)$$

2.3 Statistical tests

Three tests are included in the calculation procedure.

- a) Variance equality (Bartlett's χ^2) test.
- b) Linearity (F) test.
- c) Dispersion (confidence interval) test.

Tests b) and c) may detect deviations from ideal behaviour which are statistically significant but which are too small to have serious practical consequences. Procedures are included to meet these circumstances.

2.3.1 Bartlett's χ^2 test

Inequalities of variance, other than major inequalities, are not considered to lead to serious errors either of temperature index or confidence interval. The value of χ^2 is calculated, and if this value is greater than that corresponding to a significance level of 0.05, the values of χ^2 and its significance level are reported.

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2.3.2 F -test for linearity

The F ratio is the ratio of the variance of the deviations of the ageing group means from the regression line (s_2^2 , see equation (11)) to the variance within the ageing groups (s_1^2 , see equation (10)). A high value of F may result either from high values of the deviations from the regression line or from low values of the variance of data within the groups.

The F ratio is tested against tabulated values F_0 at a significance level of 0.05.

In the case of data of very small dispersion, it is possible for a non-linearity to be detected as statistically significant which is of little practical importance.

In order that a result may be obtained even where the F test has failed in this way, a procedure is included as follows:

- a) Increase the value of the variance within the ageing groups (s_1^2) so that the F test gives a result which is just acceptable, that is substitute s_1^2 by an adjusted value $(s_1^2)_a = s_1^2 (F/F_0)$, see Sub-clause 3.1.5 b).
- b) Use this adjusted value to calculate the lower confidence limit of the result, TC_a .
- c) If the lower confidence interval ($TI-TC_a$) is found acceptable ($TI-TC_a \leq 0.6$ HIC, see Sub-clause 2.3.3) the non-linearity is deemed to be of no practical importance.