SLOVENSKI STANDARD
SIST ENV 61072:1998

01-junij-1998

Methods of test for evaluating the resistance of insulating materials against the initiation of electrical trees (IEC 61072:1991)

Methods of test for evaluating the resistance of insulating materials against the initiation of electrical trees

Prüfverfahren zur Bewertung der Widerstandsfestigkeit von Isolierstoffen gegen die Entstehung von elektrischem 'Treeing'

Méthodes d'essais pour évaluer la résistance des matériaux isolants à la formation d'arborescences électriques

Ta slovenski standard je istoveten z: **ENV 61072:1993**

ICS:

29.035.01	Izolacijski materiali na splošno	Insulating materials in general

SIST ENV 61072:1998 **en**

EUROPEAN PRESTANDARD

PRENORME EUROPEENNE

EUROPÄISCHE VORNORM

ENV 61072

October 1993

UDC 621.315.6:620.1

Descriptors: Electrical insulating materials, solid electrical insulating materials, test, endurance electrical test, electrical resistance, ambient test, electrical discharge, electrical trees

ENGLISH VERSION

Methods of test for evaluating the resistance of insulating materials against the initiation of electrical trees
(IEC 1072:1991)

Méthodes d'essais pour évaluer la résistance des matériaux isolants à la formation d'arborescences électriques

(CEI 1072:1991)

Prüfverfahren zur Bewertung der Widerstandsfestigkeit von Isolierstoffen gegen die Entstehung von elektrischem "Treeing"
(IEC 1072:1991)

This European Prestandard (ENV) was approved by CENELEC on 1993-09-22 as a prospective standard for provisional application. The period of validity of this ENV is limited initially to three years. After two years the members of CENELEC will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard (EN).

CENELEC members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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

Ref. No. ENV 61072:1993 E

FOREWORD

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 1072:1991 could be accepted without textual changes, has shown that no common modifications were necessary for the acceptance as European Prestandard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as ENV 61072 on 22 September 1993.

The following date was fixed:

- latest date of announcement of the ENV at national level (doa) 1994-03-01

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given only for information. In this standard, annexes A and B are informative and annex ZA is normative.

ENDORSEMENT NOTICE

The text of the International Standard IEC 1072:1991 was approved by CENELEC as a European Prestandard without any modification.

ANNEX ZA (normative)

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

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE : 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
60-1	1989	High-voltage test techniques Part 1: General definitions and test requirements (corrigenda March 1990 and March 1992)	HD 588.1 S1	1991
60-3	1976	High-voltage test techniques Part 3: Measuring devices	-	-
270	1981	Partial discharge measurements	-	-

RAPPORT TECHNIQUE
TECHNICAL REPORT

CEI
IEC
1072

Première édition
First edition
1991-12

Méthodes d'essais pour évaluer la résistance des matériaux isolants à la formation d'arborescences électriques

Methods of test for evaluating the resistance of insulating materials against the initiation of electrical trees

Bureau Central de la Commission Electrotechnique Internationale 3, rue de Varembé Genève, Suisse

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE T

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

METHODS OF TEST FOR EVALUATING THE RESISTANCE OF INSULATING MATERIALS AGAINST THE INITIATION OF ELECTRICAL TREES

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.

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

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

Six Months' Rule	Report on Voting
15B(CO)68	15B(CO)75

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

This document is being issued in the technical report (type 2) series of publications as a "prospective standard for provisional application" in the field of electrical endurance because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the IEC Central Office.

A review of this technical report (type 2) will be carried out not later than three years after its publication with the options of: extension for another three years; convertion into an International Standard; or withdrawal.

Annexes A and B form an integral part of this Technical Report.

INTRODUCTION

a) *General remarks*

A preparatory working group has been set up on electrical endurance. One of the given tasks was to prepare methods for assessing the electrical treeing endurance of insulating materials and simple combinations thereof.

Two treeing tests are generally used to compare the resistance of solid insulating materials against the initiation of electrical trees under dry conditions and using short-time stressing. They are described in this report. The methods differ mainly in the electrode arrangement and in the time intervals during which voltage is applied:

- method A, the single-needle test, described in section 2 of this report, employs a point-to-plane geometry and consecutive voltage steps of 1 min duration until tree initiation has occurred;
- method B, the double-needle test, described in section 3, employs two opposing cylindrical electrodes, one sharpened to a point, the other with a hemispherical end. The voltage is applied to virgin specimens for a period of 1 h at different stress levels.

As a first step towards testing of resistance against electrical treeing, the electrode arrangements described in sections 2 and 3 have been evaluated in a round robin test under conditions of short-time (1 min) stressing. The test results and a short discussion of the same are given in annex B.

In summary, it can be concluded that treeing tests to determine the resistance to initiation of electrical trees under short-time stressing and performed under well-defined conditions using commercial needle electrodes give statistically valid and reproducible results. Since there is no obvious advantage to either one of the two tests, both methods can be recommended without preference.

It should be pointed out that endurance against treeing does not necessarily correlate with the short-time tree inception voltage. Therefore treeing tests using the above-mentioned electrode arrangements have been performed to find out whether, or how closely, an elevated tree inception voltage corresponds to a prolonged tree inception time at constant lower stresses. The results are such that at the present stage of knowledge, the extension of the methods described in sections 2 and 3 to testing the long-term endurance of insulating materials against treeing is far too operator-dependent to meet IEC needs. It was decided that, at present, there is no justification for continuing the attempt to prepare an IEC test method for the long-term treeing endurance of insulating materials. Further research in this field is required. It was emphasized that such work should certainly be continued elsewhere, as the importance of the long-term treeing endurance of insulating materials is recognized, and methods to assess it under laboratory conditions would certainly be useful.

b) *Test methods for evaluating resistance to tree inception*

When solid organic dielectrics are subjected to sufficiently high and non-uniform electrical gradients, failure generally occurs through a mechanism called treeing.

In materials with different molecular structures, this electrical treeing process initiates at different levels of stress, indicating different degrees of resistance to tree initiation.

Trees that grow by a degradation mechanism resulting from high and non-uniform electrical gradients or from partial discharges are called electrical trees to distinguish them from electrochemical and water trees which are quite different.

Electrical treeing, when it occurs in high voltage insulation, often starts at corners of electrodes, asperities and conducting particles which are regions of intense localized electrical stress. Treeing tests use needle electrodes to simulate such field enhancements.

The reproducibility of measured characteristic properties, in this case the characteristic voltage and the divergent field life, depends on many factors. Some of these have been identified as follows:

- differences in the geometry of the needle point;
- residual strains or orientation in the specimen produced by needle insertion;

- inclusions or voids in the specimen;
- agents included in the specimens which may exude or spread out on the surface producing a film which is sufficiently conductive to alter the electric field around the needle point;
- differences in thermal history or processing, specifically for materials containing volatile components which can affect the susceptibility to treeing.

METHODS OF TEST FOR EVALUATING THE RESISTANCE OF INSULATING MATERIALS AGAINST THE INITIATION OF ELECTRICAL TREES

SECTION 1: GENERAL

1.1 Scope and object

This Technical Report describes two methods for evaluating and comparing the resistance of solid dielectric materials to the initiation of tree-like patterns, i.e. a network of tubular channels wherein partial discharges may occur, during short-time stressing, with a highly divergent electric field.

The tests are primarily used at power frequencies (48 Hz - 62 Hz).

The tests are generally carried out at room temperature. If other temperatures are desired, these should not exceed the range of normal use of the material to be tested.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Technical Report. At the time of publication of this Technical Report, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Technical Report are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60-1: 1989, *High-voltage test techniques - General definitions and test requirements.*

IEC 60-3: 1976, *High-voltage test techniques - Part 3: Measuring devices.*

IEC 270: 1981, *Partial discharge measurements.*

1.3 Definitions

For the purpose of this Technical Report, the following definitions apply:

electrical tree: Tree-like network of tubular channels in a solid dielectric material formed by a degradation mechanism resulting from high and non-uniform electrical gradients or partial discharges.

electrical treeing: Formation of electrical trees.

treed (adjective): Presenting tree-like patterns.