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Evaluation et classification thermiques de l'isolation électrique

Thermal evaluation and classification of electrical insulation

Bureau Central de la Commission Electrotechnique Internationale

3, rue de Varembé

Genève, Suisse

Révision de la présente publication

Le contenu technique des publications de la CEI est constamment revu par la Commission afin d'assurer qu'il reflète bien l'état actuel de la technique.

Les renseignements relatifs à ce travail de révision, à l'établissement des éditions révisées et aux mises à jour peuvent être obtenus auprès des Comités nationaux de la CEI et en consultant les documents ci-dessous:

- **Bulletin de la CEI**
- **Annuaire de la CEI**
- **Catalogue des publications de la CEI**
  Publié annuellement

Terminologie

En ce qui concerne la terminologie générale, le lecteur se reportera à la Publication 50 de la CEI: Vocabulaire Electrotechnique International (VEI), qui est établie sous forme de chapitres séparés traitant chacun d'un sujet défini, l'Index général étant publié séparément. Des détails complets sur le VEI peuvent être obtenus sur demande.

Les termes et définitions figurant dans la présente publication ont été soit repris du VEI, soit spécifiquement approuvés aux fins de cette publication.

Symboles graphiques et littéraux

Pour les symboles graphiques, symboles littéraux et signes d'usage général approuvés par la CEI, le lecteur consultera:

— la Publication 27 de la CEI: Symboles littéraux à utiliser en électrotechnique;

— la Publication 617 de la CEI: Symboles graphiques pour schémas.

Les symboles et signes contenus dans la présente publication ont été repris des Publications 27 ou 617 de la CEI, soit spécifiquement approuvés aux fins de cette publication.

Publications de la CEI établies par le même Comité d'Etudes

L'attention du lecteur est attirée sur les pages 3 et 4 de la couverture, qui énumèrent les publications de la CEI préparées par le Comité d'Etudes qui a établi la présente publication.

Revision of this publication

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology.

Information on the work of revision, the issue of revised editions and amendment sheets may be obtained from IEC National Committees and from the following IEC sources:

- **IEC Bulletin**
- **IEC Yearbook**
- **Catalogue of IEC Publications**
  Published yearly

Terminology

For general terminology, readers are referred to IEC Publication 50: International Electrotechnical Vocabulary (IEV), which is issued in the form of separate chapters each dealing with a specific field, the General Index being published as a separate booklet. Full details of the IEV will be supplied on request.

The terms and definitions contained in the present publication have either been taken from the IEV or have been specifically approved for the purpose of this publication.

Graphical and letter symbols

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to:

— IEC Publication 27: Letter symbols to be used in electrical technology;

— IEC Publication 617: Graphical symbols for diagrams.

The symbols and signs contained in the present publication have either been taken from IEC Publications 27 or 617, or have been specifically approved for the purpose of this publication.

IEC publications prepared by the same Technical Committee

The attention of readers is drawn to pages 3 and 4 of the cover, which list IEC publications issued by the Technical Committee which has prepared the present publication.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

THERMAL EVALUATION AND CLASSIFICATION OF ELECTRICAL INSULATION

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, in collaboration with IEC Technical Committee No. 63: Insulation Systems.

This publication constitutes the second edition of IEC Publication 85 and replaces the first edition.

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

Six Months' Rule	Report on Voting
15B(CO)55	15B(CO)59

Further information can be found in the Report on Voting indicated in the table above.

Other IEC publications quoted in this publication:

Publication Nos. 216-1: Guide for the Determination of Thermal Endurance Properties of Electrical Insulating Materials. Part 1: General Procedures for the Determination of Thermal Endurance Properties, Temperature Indices and Thermal Endurance Profiles.

216-2: Part 2: List of Materials and Available Tests.

216-3: Part 3: Statistical Methods.

216-4: Part 4: Instructions for Calculating the Thermal Endurance Profile.

505: Guide for the Evaluation and Identification of Insulation Systems of Electrical Equipment.

610: Principal Aspects of Functional Evaluation of Electrical Insulation Systems: Ageing Mechanisms and Diagnostic Procedures.

611: Guide for the Preparation of Test Procedures for Evaluating the Thermal Endurance of Electrical Insulation Systems.

THERMAL EVALUATION AND CLASSIFICATION OF ELECTRICAL INSULATION

1. Scope

This publication describes the recognized system of thermal classes for the insulation of electrotechnical products. It considers the thermal evaluation of insulating materials and of insulation systems, their interrelationship and the influence of service conditions. It defines the responsibility for assigning thermal identification and classification.

2. General

2.1 *Thermal classes*

The endurance of the insulation of electrotechnical products is affected by many factors such as temperature, electrical and mechanical stresses, vibration, deleterious atmospheres and chemicals, moisture, dirt and radiation.

As the temperature in electrotechnical products is very often the dominating ageing factor on insulating materials and insulation systems, certain basic thermal classes are useful and have been recognized throughout the world. These thermal classes and the temperatures assigned to them are as follows:

Thermal class	*Temperature*
Y	90 °C
A	105 °C
E	120 °C
B	130 °C
F	155 °C
H	180 °C
200	200 °C
220	220 °C
250	250 °C

Temperatures over 250 °C should increase by 25 °C intervals and classes designated accordingly.

Note. — The old Class C which was used in I E C Publication 85 (1957) for all temperatures above 180 °C is replaced by the above thermal classes.

The use of the letters is not mandatory. However, the above relationship between letters and temperatures should be adhered to. If the contents of Sub-clause 2.1.5 are applied to particular equipment, alternative systems of identification may be used.

When a thermal class describes an electrotechnical product it normally represents the maximum temperature appropriate to that product under rated load and other conditions. Thus, the insulation subjected to this maximum temperature will need to have a thermal capability at least equal to the temperature associated with the thermal class of the product (but see Sub-clause 2.1.2).

Up to now the term "class" has been used to refer to insulating materials, insulation systems and products. I E C Publication 216: Guide for the Determination of Thermal Endurance Properties of Electrical Insulating Materials, has introduced the term "temperature index" for insulating materials, while I E C Publication 505: Guide for the Evaluation and Identification of Insulation Systems of Electrical Equipment, has introduced the term "identification" for insulation systems. The identification of systems is relevant only to the particular product for which the system is designed. The term "classification" may be reserved for electrotechnical products.

2.1.1 *Operating conditions*

Experience has proved that, under usual operating conditions, satisfactory economic life is obtained for electrotechnical products such as rotating machines, transformers, etc., designed and built in accordance with standards based on the temperatures in Sub-clause 2.1 making due allowance for factors peculiar to the product in question.

2.1.2 *Insulating materials in insulation systems*

The description of an electrotechnical product as being of a particular thermal class does not mean, and must not be taken to imply that each insulating material used in its construction is of the same thermal capability.

The temperature limit for an insulation system may not be directly related to the thermal capability of the individual materials included in it. In the system, the thermal performance of insulating materials may be improved by the protective character of the materials used with them. On the other hand, problems of incompatibility between materials may decrease the appropriate temperature limit of the system below that for the individual materials. Such problems should be investigated by functional tests.

2.1.3 *Temperature and temperature rise*

The temperatures quoted in this standard are the actual temperatures of the insulation and not the temperature rises of the electrotechnical product.

Standards for electrical equipment usually specify temperature rise rather than actual temperature. In establishing such standards, factors such as features of construction, thermal conductivity and thickness of insulation, accessibility of insulated parts, methods of ventilation, load characteristics etc., should be taken into account when considering the methods of measurement and the temperature rise to be permitted.

2.1.4 *Other factors of influence*

Apart from thermal factors, the ability of insulation to continue to fulfil its function is influenced by such conditions as mechanical stresses imposed upon it and its supporting structure, and by such factors as vibration and differential thermal expansion which may become of increasing importance as the size of the product increases. Moisture in the atmosphere and the presence of dirt, chemicals, or other contaminants may have injurious effects. All such factors should be taken into account when designing particular products and further guidance on this aspect may be found in I E C Publication 505.

2.1.5 *Insulation performance*

Actual performance in service depends on particular conditions, which may vary widely with, e.g., environmental exposure, duty cycles and type of product. Further, the intended performance in service depends on the relative importance of size, reliability, desired period of use of associated equipment and economic considerations.

For certain products it may be desirable to establish values of temperature rise which permit temperatures higher than those normally appropriate or which restrict the temperatures attained by the insulation to values lower than those normally appropriate. Such cases may arise because, for the purpose in question, a shorter or a longer life than normal is envisaged, or exceptional conditions of service exist.

The life of insulation is dependent to a considerable extent upon the degree of exclusion of oxygen, moisture, dirt and chemicals. Therefore, at a given temperature, the life of the insulation may be longer if it is suitably protected than if it is freely exposed to industrial atmospheres. The use of chemically inert gases, or liquids, as cooling or protective media may increase the temperature capability of insulation.

In addition to the ageing which insulation undergoes, some materials when heated above a certain temperature, soften and otherwise degrade but may recover their initial properties again on cooling. The user of such materials should satisfy himself that they are suitable in the above respect for the duties to be imposed on them.

2.2 *Responsibility for selection and assignment*

The responsibility for the selection of appropriate materials and systems lies with the manufacturer of the electrotechnical product. Only experience or adequate acceptable tests provide bases for assigning rational temperature limits for the insulation. Service experience is an important basis for the selection of materials and systems. Where new materials and systems are involved, appropriate tests are the basis for this selection (see also Clause 4).

3. Thermal evaluation of insulating materials

Many insulating materials of the same generic type are available in a number of variants of different thermal endurance capability. Therefore, the generic chemical designation of an insulating material is inadequate to characterize its thermal capability.

When applying materials for the insulation of electrotechnical products, their individual thermal endurance characteristics may be affected by the way in which they are combined with others. The thermal capability of materials used for insulation of electrotechnical products also depends strongly on the special functions they will be called upon to fulfil.

In respect of the use in electrotechnical products, material evaluation serves two purposes: one is to obtain evaluation of a material to be used as a component in an electrical insulation system, the other is to evaluate a material to be used alone or as part of a simple combination to become an insulation system.

Generally, tests and experience are recognized as the acceptable basis for the thermal evaluation of insulating materials.

When the basis of experience is used, care is required to ensure that it is relevant. Yet it may often be valid to translate experience from one type of application to another. Methods appropriate for establishing the relevance of service experience are to be prepared.

Considerable progress has been made in the development of tests to evaluate materials. Reference should be made to the following I E C publications:

216: Guide for the Determination of Thermal Endurance Properties of Electrical Insulating Materials.

216-1: Part 1: General Procedures for the Determination of Thermal Endurance Properties, Temperature Indices and Thermal Endurance Profiles.

216-2: Part 2: List of Materials and Available Tests.

216-3: Part 3: Statistical Methods.

216-4: Part 4: Instructions for Calculating the Thermal Endurance Profile.

Note. — This work is continuing. New parts and amendments of the listed publications are in preparation. Please see the current catalogue of I E C publications for up-to-date list.

While the complete documents above should be considered, the following definitions may be helpful.

a) *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.

b) *temperature index: TI*
The number corresponding to the temperature in degrees Celsius derived from the thermal endurance relationship at a given time, normally 20 000 h.

c) *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.

d) *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.

Different temperature indices and halving intervals for a single material may be obtained when different types of test criteria and end points — electrical, mechanical, etc. — are used for the thermal endurance graph. Different temperature indices and halving intervals may indicate differing thermal capabilities and so determine the way the material is used and the function it may perform.

Tests on standard specimens may give results different from those which might be obtained from tests on the material in the form in which it is to be used. Thus, the results of insulation system tests may be used to verify the suitability of the material for the application concerned.

4. Thermal evaluation of insulation systems

The preferred basis for assessing the thermal endurance of an insulation system is relevant service experience. Where this experience does not exist, appropriately designed functional tests should be carried out. For this purpose, a service proven system is needed to be used as a reference insulation system.

A reference insulation system should be described by the responsible Technical Committee on the basis of service experience. The Committee should establish guidelines for the particular equipment to explain how an insulation system with a record of service experience can be used as a reference. The use of such guidelines should enable the Committee to replace previous definitions of classes which were based on material descriptions.

For evaluating new insulation systems by comparison with reference systems, specific test procedures will be developed by the responsible Technical Committees, when these Committees deem standardization to be necessary.

Very few test procedures have so far been standardized and in general it is the responsibility of the product manufacturer to devise and execute suitable tests where standardized tests do not exist.

Before designing suitable tests, reference should be made to the following I E C publications and documents:

505: Guide for the Evaluation and Identification of Insulation Systems for Electrical Equipment.

610: Principal Aspects of Functional Evaluation of Electrical Insulation Systems: Ageing Mechanisms and Diagnostic Procedures.

791: Performance Evaluation of Insulation Systems Based on Service Experience and Functional Tests.

More detailed recommendations concerning the design of thermal evaluation test procedures are given in:

611: Guide for the Preparation of Test Procedures for Evaluating the Thermal Endurance of Electrical Insulation Systems.

In selecting the individual components of an insulation system, some guidance may be obtained from the thermal evaluation of the materials alone (see Clause 3).

For a material to be recognized as suitable for use in a particular insulation system, it is sufficient to demonstrate satisfactory performance by appropriate system tests or by experience, irrespective of the thermal endurance of the material by itself.

For very simple and simply stressed insulation systems, the responsible Technical Committee may decide whether functional tests according to I E C Publication 611 are required or whether the simpler case of evaluation from materials' thermal endurance data according to I E C Publication 216 would produce satisfactory results. If it is necessary to evaluate the suitability of insulating materials for application in electrotechnical products then comparative tests should be performed using service proven materials as reference.

For the case of very simple and simply stressed insulation systems, it is recommended that the responsible Technical Committee provide information about service-proven materials for specific applications. Alternatively, it should provide rules on how to evaluate relevant experience which could be used to classify materials.

As long as the responsible Technical Committees do not present standardized procedures suitable for comparative evaluation, the responsibility to choose acceptable test procedures remains with the manufacturer of the product.

5. Classification

For the classification of electrotechnical products and their insulation, see Sub-clause 2.1, in particular Sub-clause 2.1.5, and Clause 4.

When an insulating material, simple combination, or an insulation system has been shown by test or from service experience to be capable of operating successfully at a particular temperature in a particular application it may be assigned the appropriate thermal class selected from the list in Sub-clause 2.1.

Publications de la CEI préparées par le Comité d'Etudes n° 15

85 (1984) Evaluation et classification thermiques de l'isolation électrique.

93 (1980) Méthodes pour la mesure de la résistivité transversale et de la résistivité superficielle des matériaux isolants électriques solides.

112 (1979) Méthode pour déterminer les indices de résistance et de tenue au cheminement des matériaux isolants solides dans des conditions humides.

167 (1964) Méthodes d'essai pour la détermination de la résistance d'isolement des isolants solides.

212 (1971) Conditions normales à observer avant et pendant les essais de matériaux isolants électriques solides.

216: – Guide pour la détermination des propriétés d'endurance thermique de matériaux isolants électriques.

216-1 (1974) Première partie: Méthodes générales pour la détermination des propriétés d'endurance thermique, des indices de température et des profils d'endurance thermique.

216-2 (1974) Deuxième partie: Liste des matériaux et des essais existants.

216-3 (1980) Troisième partie: Méthodes statistiques.

216-4 (1980) Quatrième partie: Instructions pour le calcul du profil d'endurance thermique.

243 (1967) Méthodes d'essai recommandées pour la détermination de la rigidité diélectrique des matériaux isolants solides aux fréquences industrielles.

250 (1969) Méthodes recommandées pour la détermination de la permittivité et du facteur de dissipation des isolants électriques aux fréquences industrielles, audibles et radioélectriques (ondes métriques comprises).

290 (1969) Evaluation de l'endurance thermique des vernis isolants électriques par la méthode de la bobine hélicoïdale.

343 (1970) Méthodes d'essai recommandées pour la détermination de la résistance relative des matériaux isolants à la rupture diélectrique par les décharges superficielles.

345 (1971) Méthode d'essai pour la résistance d'isolement et la résistivité transversale des matériaux isolants à des températures élevées.

370 (1971) Méthode d'essai pour l'évaluation de la stabilité thermique des vernis isolants par l'abaissement de la rigidité diélectrique.

371: – Spécification pour les matériaux isolants à base de mica.

371-1 (1980) Première partie: Définitions et prescriptions générales.

371-2 (1973) Deuxième partie: Méthodes d'essais.

371-3: – Troisième partie: Spécifications pour matériaux particuliers.

371-3-1 (1973) Feuille 1: Matériaux rigides à base de mica pour entre-lames de collecteurs.

371-3-3 (1983) Feuille 3: Matériaux rigides de mica pour appareils de chauffage.

377: – Méthodes pour la détermination des propriétés diélectriques de matériaux isolants aux fréquences supérieures à 300 MHz.

377-1 (1973) Première partie: Généralités.

377-2 (1977) Deuxième partie: Méthodes de résonance.

394: – Tissus vernis à usages électriques.

394-1 (1972) Première partie: Définitions et conditions générales.

394-2 (1972) Deuxième partie: Méthodes d'essai.

394-3: – Troisième partie: Spécifications pour matériaux individuels.

394-3-1 (1976) Feuille 1: Vernis oléorésineux - support coton, OR/C.

426 (1973) Méthodes d'essais pour la détermination de la corrosion électrolytique en présence de matériaux isolants.

450 (1974) Mesure du degré de polymérisation moyen viscosimétrique de papiers neufs et vieillis à usage électrique.

454: – Spécifications pour rubans adhésifs sensibles à la pression à usages électriques.

454-1 (1974) Première partie: Conditions générales.

454-2 (1974) Deuxième partie: Méthodes d'essai.

454-2A (1978) Premier complément.

454-3: – Troisième partie: Spécifications pour les matériaux particuliers.

454-3-1 (1976) Feuille 1: Conditions applicables au chlorure de polyvinyle plastifié avec adhésif non thermodurcissable.

454-3-2 (1981) Feuille 2: Conditions applicables aux rubans de polyester (PETP) avec adhésif thermodurcissable.

454-3-3 (1981) Feuille 3: Conditions applicables aux rubans de polyester (PETP) avec adhésif non thermodurcissable.

454-3-4 (1978) Feuille 4: Conditions applicables au papier cellulosique crêpé avec adhésif thermodurcissable.

454-3-5 (1980) Feuille 5: Prescriptions applicables au papier cellulosique avec adhésif thermodurcissable.

(Suite au verso)

IEC publications prepared by Technical Committee No. 15

85 (1984) Thermal evaluation and classification of electrical insulation.

93 (1980) Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials.

112 (1979) Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions.

167 (1964) Methods of test for the determination of the insulation resistance of solid insulating materials.

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.

216-1 (1974) Part 1: General procedures for the determination of thermal endurance properties, temperature indices and thermal endurance profiles.

216-2 (1974) Part 2: List of materials and available tests.

216-3 (1980) Part 3: Statistical methods.

216-4 (1980) Part 4: Instructions for calculating the thermal endurance profile.

243 (1967) Recommended methods of test for electric strength of solid insulating materials at power frequencies.

250 (1969) Recommended methods for the determination of the permittivity and dielectric dissipation factor of electrical insulating materials at power, audio and radio frequencies including metre wavelengths.

290 (1969) Evaluation of the thermal endurance of electrical insulating varnishes by the helical coil bond test.

343 (1970) Recommended test methods for determining the relative resistance of insulating materials to breakdown by surface discharges.

345 (1971) Method of test for electrical resistance and resistivity of insulating materials at elevated temperatures.

370 (1971) Test procedure for thermal endurance of insulating varnishes — Electric strength method.

371: – Specification for insulating materials based on mica.

371-1 (1980) Part 1: Definitions and general requirements.

371-2 (1973) Part 2: Methods of test.

371-3 – Part 3: Specifications for individual materials.

371-3-1 (1973) Sheet 1: Rigid mica materials for commutator separators.

371-3-3 (1983) Sheet 3: Specification for rigid mica materials for heating equipment.

377: – Methods for the determination of the dielectric properties of insulating materials at frequencies above 300 MHz.

377-1 (1973) Part 1: General.

377-2 (1977) Part 2: Resonance methods.

394: – Varnished fabrics for electrical purposes.

394-1 (1972) Part 1: Definitions and general requirements.

394-2 (1972) Part 2: Methods of test.

394-3: – Part 3: Specifications for individual materials.

394-3-1 (1976) Sheet 1: Oleoresinous varnish - cotton base, OR/C.

426 (1973) Test methods for determining electrolytic corrosion with insulating materials.

450 (1974) Measurement of the average viscometric degree of polymerization of new and aged electrical papers.

454: – Specifications for pressure-sensitive adhesive tapes for electrical purposes.

454-1 (1974) Part 1: General requirements.

454-2 (1974) Part 2: Methods of test.

454-2A (1978) First supplement.

454-3: – Part 3: Specifications for individual materials.

454-3-1 (1976) Sheet 1: Requirements for plasticized polyvinyl chloride with non-thermosetting adhesive.

454-3-2 (1981) Sheet 2: Requirements for polyester film tapes (PETP) with thermosetting adhesive.

454-3-3 (1981) Sheet 3: Requirements for polyester film tapes (PETP) with non-thermosetting adhesive.

454-3-4 (1978) Sheet 4: Requirements for cellulosic paper, crêped, with thermosetting adhesive.

454-3-5 (1980) Sheet 5: Requirements for cellulosic paper with thermosetting adhesive.

(Continued overleaf)

Publications de la CEI préparées par le Comité d'Etudes nº 15

455 : — Spécification relative aux composés résineux polymérisables sans solvant utilisés comme isolants électriques.
455-1 (1974) Première partie : Définitions et conditions générales.
455-1A (1980) Premier complément : Principe de classification des composés résineux polymérisables.
455-2 (1977) Deuxième partie : Méthodes d'essai.
Modification nº 1 (1982).

455-3 : — Troisième partie : Spécifications pour les matériaux particuliers.
455-3-1 (1981) Feuille 1 : Composés résineux époxydes sans charge.

464 : — Spécification relative aux vernis isolants contenant un solvant.
464-1 (1976) Première partie : Définitions et conditions générales.
464-2 (1974) Deuxième partie : Méthodes d'essai.

493 : — Guide pour l'analyse statistique de données d'essai de vieillissement.
493-1 (1974) Première partie : Méthodes basées sur les valeurs moyennes de résultats d'essais normalement distribués.

544 : — Guide pour la détermination des effets des rayonnements ionisants sur les matériaux isolants.
544-1 (1977) Première partie : Interaction des rayonnements.
544-2 (1979) Deuxième partie : Méthodes d'irradiation.
544-3 (1979) Troisième partie : Méthodes d'essais pour la détermination des effets permanents.

554 : — Spécification pour papiers cellulosiques à usages électriques.
554-1 (1977) Première partie : Définitions et conditions générales.
Modification nº 1 (1983).
554-2 (1977) Deuxième partie : Méthodes d'essai.
Modification nº 1 (1982).

554-3 : — Troisième partie : Spécifications pour matériaux particuliers.
554-3-1 (1979) Feuille 1 : Papier pour usage électrique général.
554-3-2 (1983) Feuille 2 : Papier pour condensateurs.
554-3-3 (1980) Feuille 3 : Papier crêpé.
554-3-4 (1979) Feuille 4 : Papier électrolytique pour condensateurs.
587 (1977) Méthode d'essai pour évaluer la résistance au cheminement et à l'érosion des matériaux isolants électriques utilisés dans des conditions ambiantes sévères.
589 (1977) Méthodes d'essai pour la détermination des impuretés ioniques dans les matériaux isolants électriques par extraction par des liquides.

626 : — Spécification pour matériaux combinés souples destinés à l'isolement électrique.
626-1 (1979) Première partie : Définitions et prescriptions générales.
626-2 (1978) Deuxième partie : Méthodes d'essai.

641 : — Spécification pour le carton comprimé et le papier comprimé à usages électriques.
641-1 (1979) Première partie : Définitions et prescriptions générales.
641-2 (1979) Deuxième partie : Méthodes d'essai.
648 (1979) Méthode d'essai de coefficients de frottement des films et feuilles de matière plastique utilisés comme isolants électriques.

667 : — Spécification pour les fibres vulcanisées à usages électriques.
667-1 (1980) Première partie : Définitions et prescriptions générales.
667-2 (1982) Deuxième partie : Méthodes d'essais.

672 : — Spécification pour matériaux isolants à base de céramique ou de verre.
672-1 (1980) Première partie : Définitions et classification.
672-2 (1980) Deuxième partie : Méthodes d'essai.

674 : — Spécification pour les films en matière plastique à usages électriques.
674-1 (1980) Première partie : Définitions et prescriptions générales.

684 : — Spécification pour gaines isolantes souples.
684-1 (1980) Première partie : Définitions et prescriptions générales.
699 (1981) Méthode d'essai destinée à l'évaluation du pouvoir agglomérant des vernis d'imprégnation par la méthode du faisceau de fils.
707 (1981) Méthodes d'essai pour évaluer l'inflammabilité des matériaux isolants électriques solides soumis à une source d'allumage.

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