

Cellulosic papers for electrical purposes —

Part 2: Methods of test

The European Standard EN 60554-2:2002 has the status of a
British Standard

ICS 17.220.99; 29.035.10

National foreword

This British Standard is the official English language version of EN 60554-2:2002. It is identical with IEC 60554-2:2001. It supersedes BS 5626-2:1979 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/15, Insulating material, to Subcommittee GEL/15/3/9, Paper and press board, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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Part 2: Methods of test
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à usages électriques
Partie 2: Méthodes d'essai
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Zellulosepapiere für elektrotechnische
Zwecke
Teil 2: Prüfverfahren
(IEC 60554-2:2001)

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European Committee for Electrotechnical Standardization
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Foreword

The text of document 15C/1264/FDIS, future edition 2 of IEC 60554-2, prepared by SC 15C, Specifications, of IEC TC 15, Insulating materials, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60554-2 on 2002-04-01.

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Annexes designated "normative" are part of the body of the standard.
In this standard, annex ZA is normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60554-2:2001 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

IEC 60554 consists of the following parts, under the general title: *Cellulosic papers for electrical purposes*.

- Part 1: Definition and general requirements
- Part 2: Methods of test
- Part 3: Specifications for individual materials

CELLULOSIC PAPERS FOR ELECTRICAL PURPOSES –

Part 2: Methods of test

1 Scope

This part of IEC 60554 applies to cellulosic papers for electrical purposes. It specifies the methods of test to be used in testing cellulosic papers for electrical purposes to meet the requirements prescribed in the specification sheet of IEC 60554-3.

In this standard, reference is made in several places to ISO standards accompanied by a short description of the method used. It is to be understood that this short description is meant for identification purposes only and that all details should be taken from the ISO standard itself.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60554. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60554 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60216: *Guide for the determination of thermal endurance properties of electrical insulating materials*

IEC 60243-1: *Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60247:1978, *Measurement of relative permittivity, dielectric dissipation factor and d.c. resistivity of insulating liquids*

IEC 60250:1969, *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*

IEC 60296:1982, *Specification for unused mineral insulating oils for transformers and switchgear*

IEC 60450:1974, *Measurement of the average viscometric degree of polymerization of new and aged electrical papers*

IEC 60554-3, *Cellulosic papers for electrical purposes – Part 3: Specifications for individual materials*

ISO 287:1985, *Paper and board – Determination of moisture content – Oven-drying method*

ISO 534:1988, *Paper and board – Determination of thickness and apparent bulk density or apparent sheet density*

ISO 535:1991, *Paper and board – Determination of water absorptiveness – Cobb method*

ISO 536:1995, *Paper and board – Determination of grammage*

ISO 1924-1:1992, *Paper and board – Determination of tensile properties – Part 1: Constant rate of loading method*

ISO 1924-2:1994, *Paper and board – Determination of tensile properties – Part 2: Constant rate of elongation method*

ISO 1974:1990, *Paper – Determination of tearing resistance (Elmendorf method)*

ISO 2144:1997, *Paper, board and pulps – Determination of residue (ash) on ignition at 900 degrees C*

ISO 2758:1983, *Paper – Determination of bursting strength*

ISO 9964-3:1993, *Water quality – Determination of sodium and potassium – Part 3: Determination of sodium and potassium by flame emission spectrometry*

3 Definitions

For the purpose of this part of IEC 60554, the following definitions apply.

3.1

specimen

rectangle of paper cut to given dimensions from a reel or a sheet drawn from selected units

3.2

test piece

quantity of paper on which each single determination is carried out in accordance with the method of test. It may be taken from a specimen; in some instances it may be the specimen itself

4 General notes on tests

Unless otherwise specified, the specimen, after being cut, shall be conditioned for not less than 16 h in an atmosphere of $23\text{ °C} \pm 2\text{ K}$ and $50\% \pm 5\%$ relative humidity. Test pieces are cut from the specimen and tested in this atmosphere.

In case of dispute, the conditioning atmosphere shall be $23\text{ °C} \pm 1\text{ K}$ and $50\% \pm 2\%$ relative humidity and shall be approached from the dry side (after drying at 70 °C to a moisture content less than 4 %).

Unless otherwise specified, the number of specimens shall be three.

Unless otherwise specified, the central values of the measurements shall be taken as the result and the highest and lowest values shall be reported.

5 Thickness

Thickness shall be measured in accordance with ISO 534 with the exceptions given below.

5.1 Determination of the thickness of single sheets of paper (ISO 534)

a) *Principle*

The method is based on the use of a precision dial micrometer to measure the thickness of a single sheet when a static load is applied.

The static load to be applied shall correspond to a pressure of $100 \text{ kPa} \pm 10 \text{ kPa}$.

b) *Exceptions*

The test shall be carried out on three conditioned test pieces, one determination being made on each of the three test pieces. One determination consists in five measurements, one at each corner and one in the centre of the test piece.

The results are given in microns.

Where thickness is determined across the width to establish the variation over the width, the details of this procedure will be found in IEC 60554-3.

5.2 Determination of mean thickness of paper

Principle

The method is based on the use of a precision dial micrometer to measure the thickness of a stack composed of a minimum of five sheets.

The static load to be applied shall correspond to a pressure of $100 \text{ kPa} \pm 10 \text{ kPa}$.

The test shall be carried out on three conditioned test pieces, each composed of a minimum of five sheets measuring $250 \text{ mm} \times 250 \text{ mm}$ taken from one single specimen, one determination being made on each of the three test pieces. One determination consists of five measurements, one at each corner and one in the centre of the test piece.

For narrow material where the width is less than the stipulated 250 mm , the five measurements on each stack shall be made at approximately equal intervals on a specimen measuring 400 mm in length.

The results are given in terms of the thickness of a single sheet in microns.

Where thickness is determined across the width to establish the variation over the width, the details of this procedure will be found in IEC 60554-3.

6 Substance (mass per square metre, basic weight or grammage)

Paper grammage shall be measured according to the method described in ISO 536 with the following exceptions:

- clauses 5 and 6 of ISO 536 are ignored;

- the test shall be carried out on three conditioned test pieces, one determination being made on each of the three test pieces;
- the mass is to be determined to an accuracy of 0,5 % on conditioned test pieces of not less than 500 cm².

Principle

The area of each test piece and its mass are measured and the mass per unit expressed in grams per square metre is calculated, all measurements being made on conditioned test pieces.

Where grammage is determined across the width to establish the variation over the width, the details of this procedure will be found in IEC 60554-3.

7 Apparent density

The thickness and grammage are determined on each of three test pieces in accordance with clauses 5 and 6. For each test piece the apparent density is calculated. The apparent density is expressed in grams per cubic centimetre.

8 Tensile strength and elongation

Tensile strength and elongation shall be measured according to one of the methods described in ISO 1924 with the following exceptions (the method to be used shall be indicated in IEC 60554-3):

- measurements are made on nine test pieces cut from the machine direction and on nine others cut from the cross direction;
- the central value of the measurements, in each direction, is taken as the result and the highest and the lowest values in each direction are reported;
- alternatively, the results can be expressed as the breaking length in metres rounded to the nearest 100 m.

Principle

Measurement of the tensile force required to cause failure of test pieces 15 mm by approximately 250 mm, cut from both directions of the paper, when applied under standard test conditions.

9 Internal tearing resistance

Internal tearing resistance shall be measured according to the method described in ISO 1974. The single-tear tester shall be used with the following exceptions:

- measurements are made on nine test pieces cut from the machine direction and nine others from the cross direction.

Principle

Rectangular test pieces having a single cut leaving 43 mm length to be torn. Measurement of the energy required to tear this.