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Corrugated pressboard and presspaper for electrical purposes –

Part 2: Methods of test

Cartons et papiers comprimés ondulés à usages électriques –

Partie 2: Méthodes d'essais

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CORRUGATED PRESSBOARD AND PRESSPAPER FOR ELECTRICAL PURPOSES –

Part 2: Methods of test

FOREWORD

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International Standard IEC 61628-2 has been prepared by subcommittee 15C: Specifications, of IEC technical committee 15: Insulating materials.

This consolidated version of IEC 61628-2 consists of the first edition (1998) [documents 15C/992/FDIS and 15C/1008/RVD] and its amendment 1 (2007) [documents 15/293/CDV and 15/340/RVC].

The technical content is therefore identical to the base edition and its amendment(s) and has been prepared for user convenience.

It bears the edition number 1.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This part of IEC 61628 is one of a series which deals with corrugated pressboard and presspaper for electrical purposes.

This series consists of three parts:

– IEC 61628-1:1997, *Corrugated pressboard and presspaper for electrical purposes – Part 1: Definitions, designations and general requirements*

– IEC 61628-2:1998, *Corrugated pressboard and presspaper for electrical purposes – Part 2: Methods of test*

– IEC 61628-3,— *Corrugated pressboard and presspaper for electrical purposes – Part 3: Specification for individual materials* (under consideration)

CORRUGATED PRESSBOARD AND PRESSPAPER FOR ELECTRICAL PURPOSES –

Part 2: Methods of test

1 Scope

This part of IEC 61628 gives methods of test applicable for the materials classified in IEC 61628-1.

2 Normative reference

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60641-2:2004, *Pressboard and presspaper for electrical purposes – Part 2: Methods of test*

3 General note on tests

It is recommended to use a high-speed band saw with a cut width less than 1 mm to make the test specimens. The burrs made by cutting should be carefully removed.

Unless otherwise specified, the test specimens after being cut, shall be conditioned according to IEC 60641-2.

4 Type and dimension of corrugation

The shape and type of corrugation are defined by wavelength, maximum amplitude, the length of horizontal parts, angle of slope and the board thickness out of which the corrugated material is made (see figures 1a and 1b).

The following tests are made on the material as received.

4.1 Wavelength

4.1.1 Procedure

Cut at least three test samples, each test sample having a length greater than three complete wavelengths.

With a pencil, mark the starting line of the first wavelength and the end line of the last wavelength (minimum three wavelengths).

(The best starting and end line of a wavelength is the line of maximum amplitude for a sine type corrugation and the centre of a horizontal part in an angular type corrugation.)

Lay the test sample on a flat surface with no strain applied.

Measure with a ruler (precise to 0,5 mm) the distance between the pencil lines.

Divide the measured value by the number of wavelengths between the lines.

4.1.2 Results

Report the mean, minimum and maximum values of the measurements.

4.2 Amplitude

4.2.1 Procedure

Cut at least nine specimens, each being (100 ± 10) mm wide, and one-and-a-half to two wavelengths in length, so that two full bottom peaks are included.

Lay the test specimens on a flat surface with no strain applied.

With a gauge (precise to 0,1 mm), measure the distance between the highest point and the lowest point.

4.2.2 Results

Report the mean, minimum and maximum values of the measurements.

4.3 Length of horizontal parts of corrugation

4.3.1 Procedure

On at least three different corrugations, mark with a pencil the vertical projections of the theoretical points where the oblique parts of the corrugation meet the horizontal part. The pencil marks shall be positioned on a line in the direction of the corrugation wavelength. Measure the distance between the pencil marks with a calliper precise to 0,1 mm (distance *E* in figure 1b).

Repeat the measurements at the opposite side of the sheet to measure the distance *D* in figure 1b.

Because *D* and *E* may be intentionally different, both measurements shall be reported.

4.3.2 Results

Report for *D* and *E* the mean, minimum and maximum values of the measurements.

4.4 Angle of slope

4.4.1 Procedure

Cut at least three specimens, each being (100 ± 10) mm wide, and one-and-a-half to two wavelengths in length, so that two full bottom peaks are included.

Lay the test sample on a flat surface with no strain applied.

With an adequate protractor (precise to 0,5°), measure the two angles α of the central corrugation.

4.4.2 Results

Report the mean, minimum and maximum values of the measurements.

4.5 Thickness of board

4.5.1 Procedure

With an external screw type micrometer as described in IEC 60641-2, make at least nine different measurements of the board thickness with an accuracy of ± 0,01 mm at points where the corrugation curve is flat, or in the area of the inflection point for a sine type corrugation.

NOTE Measures on the horizontal flat part should be avoided as the board thickness may have been affected by the direct action of the forming press when mechanical pressure has been used to manufacture the corrugated material.

4.5.2 Results

Report the mean, minimum and maximum values of the measurements.

5 Moisture content

Moisture content shall be determined according to IEC 60641-2.

6 Dimensional changes on drying

6.1 Change of amplitude

6.1.1 Procedure (see figure 2)

Cut three specimens (50 ± 5) mm wide and five wavelengths long and condition them according to IEC 60641-2.

Place the specimens on a flat steel plate the dimensions of which shall exceed the dimensions of the specimen by at least 50 mm. Place a second flat rigid plate of calibrated thickness *T*, 50 mm wide and of sufficient length to cover all the corrugations, on top of the specimen. The weight of this plate shall guarantee that all the corrugations are in flat contact with both top and bottom plate and shall be defined in the specification sheets of IEC 61628-3.

NOTE The weight of the plate can be adjusted by additional weights added on top of it.

If all the corrugations of any specimen are not in contact with top and bottom plate under this pre-load, the specimen shall be discarded.

The amplitude of the corrugation of the specimen is measured by means of a gauge precise to 0,1 mm with a semi-spherical sensor in the following way:

– lower the sensor of the gauge on to the bottom steel plate and adjust the pointer to zero;
– set the sensor on the top plate and read the measured values at three different points near the centre of the plate and form the mean of these three measures.

Record this value as value *B* for each specimen.

Remove and dry the test specimens in a ventilated oven at 105 °C ± 5 K for (48 ± 1) h. After cooling at room temperature in a desiccator, repeat the measurements as above.

Record for each specimen the new value as *C*.

6.1.2 Calculation

The change of amplitude is calculated as a percentage of the original amplitude and is given by the formula:

$$\text{change of amplitude} = \frac{C - B}{B - T} \times 100$$

There is normally an increase of amplitude after drying.

6.1.3 Results

Report the mean value obtained. Minimum and maximum values should also be reported.

6.2 Lengthwise and crosswise dimensional changes

6.2.1 Procedure

Cut three specimens (250 ± 0,5) mm × (250 ± 0,5) mm and condition them according to IEC 60641-2. Place the specimen on a flat steel plate of at least 300 mm × 300 mm. A second flat rigid plate of the same dimension is placed on top of the specimen. Its mass, which will be defined in the specification sheets of IEC 61628-3, shall guarantee that all corrugations are in contact with both top and bottom plates.

Measure the lengthwise and crosswise dimensions with a calliper precise to 0,1 mm (or equivalent) at two different positions.

Record the mean value of the two measurements as the initial dimensions of the specimen.

Remove and dry the test specimens in a ventilated oven at 105 °C ± 5 K for (48 ± 1) h. After cooling at room temperature in a desiccator, repeat the measurements as above.

6.2.2 Results

The dimensional changes lengthwise and crosswise are calculated for each specimen as the per cent change in dimensions from those of the original conditioned specimen. Report all calculated values and the means of the lengthwise and crosswise values.

7 Compressive strength and compression modulus

7.1 Purpose and principle of the test

The purpose of the test is to calculate the compressive strength and the compression modulus of the material when the corrugation is submitted to a force applied on the corrugation and perpendicular to the original plane of the corrugated material.

The perpendicular force is applied with the ends of the test specimens subjected to total restraint (see figure 3).

7.2 Test specimens

Cut five test specimens (50 ± 0,5) mm wide and five full wavelengths long unless the wavelength is <10 mm, in which case a number of wavelengths to give a total length ≥50 mm shall be used. If the wavelength is >60 mm, it is permitted to use three full wavelengths instead of five. The ends of the test specimens are cut within 1 mm of the crest of a corrugation, or in case of a angular type corrugation, within 1 mm of the centre line of a flat horizontal part.

The two end cuts shall be parallel to the corrugation and to each other within 0,1 mm.

Condition the test specimens in accordance with IEC 60641-2.

7.3 Test apparatus

The test apparatus shall consist of:

– a compression tester which will measure and record graphically the applied force with an accuracy of ±1 % and the crosshead movement with a magnification of at least 10 times. The crosshead speed shall be such that the end point of the test is reached within 10 s to 30 s;

– a test specimen holder, (an example is shown in figure 3);

– a pressure plate whose dimensions cover completely all the crests of the specimen's corrugations.

7.4 Procedure

– Place the test specimen in the test holder.

– Adjust the mobile end of the holder so that both ends touch evenly the ends of the test specimen without exerting any lateral force.

– Place the pressure plate on the test specimen.

– With a calliper precise to 0,1 mm, measure the distance *L* between the pressure plate and the bottom end part of the holder. Six measurements shall be made: three on each side of the test specimen, one at each end and one at the centre of each side. *L* shall be recorded as the mean value of these six measurements.

NOTE The pressure plate should be centred approximately on the test specimen and the pressure foot applied centrally to the pressure plate. The offset of the axis of the load application from the centre of the test specimen should be less than 5 mm.

– Record the force and the crosshead movement up to the point when the force increases sharply after collapse (see figure 4).

7.5 Calculation

The force of failure is the value of the force at the first turning point (maximum or point of inflection) at each force/movement graph.

The compressive strength of the test specimen is the force at failure divided by the projected area of the test specimen and is usually expressed in megapascals (MPa).

The compression modulus is calculated as follows:

On the graph (see figure 4) mark the points A and B where the force reaches 25 % and 50 % of the force at failure. Draw a straight line through A and B. This line crosses the deflection axis at point C, at a distance λ from the origin.