IEC 60763-2

Edition 2.0 2007-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Specification for laminated pressboard – Part 2: Methods of test

Spécification pour cartons comprimés et contrecollés – Partie 2: Méthodes d'essai

IEC 60763-2:2007

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

R

ICS 17.220.99; 29.035.10

ISBN 978-2-88910-287-7

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SPECIFICATION FOR LAMINATED PRESSBOARD –

Part 2: Methods of test

FOREWORD

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International Standard IEC 60763-2 has been prepared by IEC technical committee 15: Solid electrical insulating materials.

This second edition cancels and replaces the first edition published in 1991 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

a) The standard has generally been revised editorially and brought into line with IEC 60641-2.
b) The test method for the determination of the internal ply strength has been replaced with an alternative method.
c) The test method for the determination of the thermal resistance has been enlarged in its scope.

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This bilingual version, published in 2009-06, corresponds to the English version.

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

FDIS	Report on voting
15/360/FDIS	15/373/RVD

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

The French version of this standard has not been voted upon.

The list of all parts of the IEC 60763 series, under the general title *Specification for laminated pressboard*, can be found on the IEC website.

The committee has decided that the contents of this publication 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- withdrawn;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
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INTRODUCTION

This International Standard deals with laminated pressboard as defined in Clause 2 of IEC 60763-1.

IEC 60641 applies to pressboard which is not laminated, and the material covered by this International Standard is made from sheets conforming to the requirements of that publication.

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SPECIFICATION FOR LAMINATED PRESSBOARD –

Part 2: Methods of test

1 Scope

This part of IEC 60763 gives methods of test applicable for the material classified in IEC 60763-1.

2 Normative references

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 60243-1:1998, *Electrical strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60247:2004, *Insulating liquids – Measurement of relative permittivity, dielectric dissipation factor (tan δ) and d.c. resistivity*

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 60296:2003, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

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

IEC 60763-1:1983, *Specification for laminated pressboard – Part 1: Definitions, classification and general requirements*

IEC 61125:1992, *Unused hydrocarbon-based insulating liquids – Test methods for evaluating the oxidation stability*

IEC 62021-1:2003, *Insulating liquids – Determination of acidity – Part 1: Automatic potentiometric titration*

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

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

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3 Conditioning of test specimens

Since the conditioning of laminated pressboard is very time-consuming, the material is tested either as received or dried. Only in case of dispute shall the material be conditioned according to the following procedure.

The conditioning shall be made at 23 °C ± 2 K and (50 ± 5) % relative humidity until the moisture content of the specimen reaches 5,5 % to 8 %. The conditioning shall be approached from the dry side after drying at 70 °C ± 5 K for a period sufficient to ensure that the conditioning atmosphere produces a mass increase in the specimen.

4 Drying of test specimens

4.1 Method A (preferable)

The test specimens shall be dried at 105 °C ± 2 K for (24 ± 1) h in an oven with forced air circulation and subsequently at 105 °C ± 2 K for (48 ± 2) h in a vacuum chamber at a residual pressure of not more than 1 kPa. The specimens shall then be removed and allowed to cool in a desiccator before the test.

4.2 Method B

Test specimens shall be dried in a ventilated oven at 105 °C ± 2 K for (168 ± 8) h at atmospheric pressure. When test pieces of the specified size are dried according to method B, test results similar to the test results obtained after drying according to method A may be expected.

5 Dimensions

5.1 Thickness

5.1.1 Test apparatus

An external screw-type micrometer having measuring faces of 6 mm to 8 mm diameter shall be used for testing. The measuring faces shall be flat to within 0,001 mm and parallel to within 0,003 mm. The micrometer shall be graduated in divisions of 0,01 mm and have an accuracy of ± 0,005 mm. The pressure exerted on the specimens shall be 0,1 MPa to 0,3 MPa.

5.1.2 Procedure

The thickness of the laminated pressboard sheet shall be measured to the nearest 0,01 mm in the as-received condition at eight points, two along each edge, but not less than 20 mm from the edge.

In case of dispute, a strip (40 ± 1) mm wide shall be cut across the full width of the sheet and, from this strip, at eight equally spaced positions eight test specimens shall be cut, each not less than 40 mm long. The test specimens shall be conditioned in accordance with Clause 3 and the thickness of each measured at a point near the centre of each test specimen.

5.1.3 Result

The central value of the eight measurements shall be taken as the result, and the minimum and maximum values obtained shall be reported.

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5.1.4 Flatness

When any laminated pressboard sheet is placed without restraint, concave side up, on a flat surface, the departure at any point of the upper surface of the sheet from a light straight edge of (1000 ± 10) mm or (500 ± 5) mm, laid in any direction upon it, shall not exceed the value given in IEC 60763-3 appropriate to the material, its thickness and length of straight edge. The mass of the straight edge shall not exceed (500 ± 5) g.

6 Mechanical tests

6.1 Flexural strength and load to produce a standard deflection

6.1.1 General

The test shall be carried out with the load applied perpendicular to the laminations.

6.1.2 Test specimens

Rectangular strips (20 ± 1) mm wide and of a length of not less than 20 times the measured thickness shall be used. The thickness is that of the board under test except that, when the measured thickness of a test piece exceeds 20 mm, the thickness shall be reduced to (20 ± 1) mm, one face of the test piece being left intact.

Five tests shall be carried out on specimens cut in machine direction (direction A) and five in cross-machine direction (direction B). (See definitions of directions A and B given in Figure 1.)

If the machine direction is not known, five specimens shall be cut with their length parallel to one of the edges of the sheet and five specimens at right angle thereto. The set of test specimens giving the highest value of flexural strength is deemed to have been cut with the length in machine direction.

6.1.3 Test apparatus

Universal testing apparatus designed to bend a test piece of given dimensions at an appropriate constant rate of bending and to measure the force and the deflection at midpoint of the test piece. A test rig for the determination of the three-point bending strength.

6.1.4 Conditioning

Test specimens shall be dried in accordance with Clause 4.

6.1.5 Procedure

After cooling in a desiccator, the width of the test specimen shall be immediately measured with an accuracy of ± 0,1 mm and the thickness with an accuracy of ± 0,02 mm, and the test specimen shall be immediately placed lengthwise symmetrically across two parallel supports. Where one surface has been removed, the original, intact surface shall rest on the two supports.

Where they are in contact with the test specimen, the surfaces of the supports shall have a radius of (5 ± 0,2) mm. The distance between the supports shall be 16 times the nominal thickness of the test specimen and shall be measured with an accuracy of ± 0,5 %. The load shall be applied across the width of the test specimen by means of a loading member parallel with, and mid-way between, the supports. The radius of the end of the loading member shall be (5 ± 0,2) mm.

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The load shall be increased steadily from zero to rupture by relative movement of the loading member and the supports at a constant rate. This rate of movement (which is the rate of deflexion of midpoint of the test specimen) shall be (5 ± 0,5) mm/min.

The load at a standard deflection of 0,4 mm shall be noted.

The maximum load shall be noted.

6.1.6 Results

The flexural strength σ_f in MPa of the test specimen shall be calculated as follows:

$$\sigma_f = \frac{1{,}5 \cdot F \cdot L}{bh^2}$$

where

F is the maximum load (in N);

L is the distance between the supports (in mm);

b is the width of the test specimen (in mm);

h is the thickness of the test specimen (mm).

The flexural strength and load to produce the standard deflection in the machine and cross-machine direction shall be reported, as the central value of the results from the five test specimens, cut in each direction.

6.2 Apparent modulus of elasticity in flexure

The apparent modulus of elasticity in flexure E in MPa can be calculated from the load at 0,4 mm deflection according to 6.1.4 using the following formula:

$$E_B = \frac{L^3}{4b \cdot h^3} \cdot \frac{F}{0{,}4}$$

where

L is the distance between the supports (in mm);

b is the width of the test specimen (in mm);

h is the thickness of the test specimen (in mm);

F is the load at deflection of 0,4 mm (in N).

The apparent modulus of elasticity in flexure in the machine and cross-machine direction shall be reported, as the central value of the results from the five test specimens, cut in each direction.

7 Compressibility

7.1 Principle

To determine the compressibility of laminated pressboard, a stack of test pieces shall be subjected to a low pressure (bedding pressure), followed by an increase of the pressure to a defined value (final pressure). The percentage change in the thickness of the pad is a measure of the compressibility of the material.

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Subsequently, the pressure shall be decreased again to the bedding pressure. The percentage changes in the thickness of the pad allows the calculation of the reversible/residual compressibility of the material.

7.2 Test apparatus

Universal testing apparatus designed to compress a test piece of given dimensions at an appropriate constant rate of compression and to measure the compressive force and the deflection of the test piece. A test rig with parallel steel plates, parallel within 0,2 mm, and an area greater than the area of the test piece itself.

7.3 Test pieces

A sufficient number of square test pieces with an edge length of (25 ± 0,5) mm shall be cut. The number of test pieces shall be chosen so that three stacks of a height of 25 mm to 85 mm can be made. For materials of a thickness greater than 85 mm, the specimens shall be machined only on one face to a thickness of (85 ± 0,25) mm. All edges of the test specimens shall be free of burrs. The test pieces shall be dried in accordance with Clause 4.

7.4 Procedure

A stack of test pieces shall be placed between the plates of the test rig. A bedding pressure of (1 ± 0,1) MPa shall be applied for at least 5 min and then the height h_0 of the stack shall be measured with an accuracy of ± 0,1 mm.

The pressure shall be increased to (20 ± 0,1) MPa. During this operation, the rate of displacement of the moving plate shall be (5 ± 1) mm per minute. This pressure shall be maintained for 5 min minimum.

The difference in height Δh_1 from h_0 of the stack shall be measured with an accuracy of ±0,01 mm.

The pressure shall be reduced to (1 ± 0,1) MPa and kept for not less than 5 min.

The difference in height Δh_2 from h_0 of the stack shall be measured with an accuracy of ± 0,01 mm after the bedding pressure has been restored.

7.5 Results

The following calculated values shall be reported.

Compressibility (in %):

$$C = \frac{\Delta h_1}{h_0} \times 100$$

Residual amount of the compressibility (in %):

$$C_{\text{res}} = \frac{\Delta h_2}{\Delta h_1} \times 100$$

Reversible amount of the compressibility (in %):

$$C_{\text{rev}} = \frac{\Delta h_1 - \Delta h_2}{\Delta h_1} \times 100$$

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