
Pressboard and presspaper for electrical purposes

Part 2. Methods of test

Le carton comprimé et le papier comprimé à usages électriques
Partie 2. Méthodes d'essai

Preßspan und Preßpapier für elektrische Zwecke
Teil 2. Prüfverfahren

National foreword

This British Standard is identical with IEC Publication 641-2 'Specification for pressboard and presspaper for electrical purposes Part 2 : Methods of test' published in 1979 by the International Electrotechnical Commission (IEC). This British Standard is published under the direction of the General Electrotechnical Engineering Standards Committee.

The other Parts of this British Standard are as follows:

Part 1 Definitions and general requirements

Part 3 Specifications for individual materials (see note)

It is the intention that BS 5937 will ultimately replace BS 231 : 1975 'Pressboard for electrical purposes' and BS 3255 : 1975 'Presspaper for electrical purposes'. A decision on withdrawal of those standards will be taken after the publication of Part 3 'Specifications for individual materials'.

NOTE. Part 3 of this standard is still under consideration in the technical committee concerned.

Terminology and conventions. The text of the international standard has been approved as suitable for publication, without deviation, as a British Standard. Some terminology and certain conventions are not identical with those used in British Standards; attention is especially drawn to the following.

Where, in the introduction, the words 'standard is one of a series which' appear, they should read as 'Part of this British Standard'. In sentences 3 and 4 of the Introduction, the word 'series' should be read as 'British Standard'.

In clause 17, S_o and F in the formula are defined as 'specific gravity'. This term should be read as 'relative density'.

Scope. In the international standard, the scope is given in Part 1. For the purposes of this British Standard, the introduction in this Part should be understood as containing the scope of this Part.

In figures 3 and 5, the comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever page numbers are referred to in the text they are IEC page numbers.

Units. In 13.2, 15.2, 16.3, 16.4 and 19.2, liquid volumes have been given in 'cm³' (cubic centimetres). The unit symbol currently employed in British Standards is 'ml' (millilitre; 1 ml = 1 cm³).

In 7.2 the 'torr' is quoted as the unit for pressure (vacuum). For the purposes of this standard, as the quoted value is only approximate, 1 torr may be taken as 133 Pa.

Clarification of intention. In 18.4, reference is made in sentence 1 to 'the paper surface'. As the method is equally applicable to pressboard, this phrase should be read as 'the specimen surface'.

Cross-references

International standard	Corresponding British Standard
IEC 247 : 1967	BS 5737 : 1979 Method for the measurement of relative permittivity dielectric dissipation factor and d.c. resistivity of insulation liquids (Identical)
IEC 296 : 1969	BS 148 : 1972 Insulating oil for transformers and switchgear (Technically equivalent)
ISO/R 534-1967	BS 3983 : 1966 Methods for the determination of the thickness and bulk of paper (Technically equivalent)
ISO 1924-1976	BS 4415 : 1979 Method for the determination of tensile strength of paper and board (Identical)
ISO 1974-1974	BS 4468 : 1969 Method for the determination of the internal tearing resistance of paper (Technically equivalent)

Related British Standards for IEC 243 : 1967 and IEC 250 : 1969 are BS 2918 : 1957 and BS 2067 : 1953 respectively.

ISO/R 287 (for which BS 3433 : 1961 was a related standard) has now been superseded by ISO 287 : 1978 (BS 3433 : 1980 is an identical standard).

Additional information. Figures 2 and 4 employ the same apparatus and differ only in the specimen used. Figure 2 can be understood as 'folding of specimens for the test in clause 4' and figure 4 as 'folding of specimens for the test in clause 18'.

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British Standard

Pressboard and presspaper for electrical purposes

Part 2. Methods of test

INTRODUCTION

This standard is one of a series which deals with solid pressboard and presspaper, dyed or natural coloured, having a calendered or non-calendered finish and supplied in an unimpregnated condition.

Pre-compressed pressboard is included.

The series does not deal with strawboard or laminated material (made by combining two or more thicknesses of material with an adhesive).

The series will have three parts describing:

- 1. Definitions and general requirements.
- 2. Methods of test.
- 3. Specifications for individual materials.

1. General notes on tests

Unless otherwise specified, the test specimens, after being cut, shall be conditioned in an atmosphere of 23 ± 2 °C and 50% r.h. and then tested in this atmosphere. Unless otherwise specified, the tolerance in the r.h. shall be $\pm 5\%$ and the conditioning period shall be not less than 16 h. In case of dispute, the conditioning shall be approached from the dry side after drying at 70 °C for a period sufficient to ensure that the conditioning atmosphere produces a weight increase in the test specimen; the duration of the conditioning in relation to the nominal thickness shall be:

nominal thickness (mm)	≤ 0.5	≤ 1.0	≤ 2.0	≤ 3	> 3
time (h)	48	72	96	120	240

2. Thickness

2.1 Test apparatus

- 2.1.1 An external screw type micrometer having measuring faces of 6 mm to 8 mm diameter. The measuring faces shall be flat to within 0.001 mm and parallel to within 0.003 mm. The pitch of the screw shall be 0.5 mm and the graduations shall be 50 divisions of 0.01 mm, enabling readings to be estimated to 0.002 mm. The pressure exerted on the specimens shall be 0.1 MPa to 0.2 MPa (10 N/cm² to 20 N/cm²).

- 2.1.2 A dead weight dial-type micrometer having two ground and lapped concentric circular surfaces flat to within 0.001 mm and parallel to within 0.003 mm. The upper surface shall be 6 mm to 8 mm in diameter. The lower surface shall be larger than the upper surface. The upper surface shall move on the axis perpendicular to the surfaces. The dial shall be graduated to read directly to 0.002 mm. The frame of the micrometer shall be of such rigidity that a force of 15 N applied to the dial housing, out of contact with either the weight or the presser foot spindle, will produce a deflection of the frame not greater than 0.002 mm as indicated on the micrometer dial. The pressure exerted on the specimen shall be 0.1 MPa (10 N/cm²).
- 2.1.3 The setting gauge used to check the instruments shall be accurate to within ± 0.001 mm of nominal size. The thickness indicated by the instruments shall not differ by more than 0.005 mm from the gauge block.

2.2 Procedure

Measure the thickness of the pressboard or the presspaper in the as received condition using one of the instruments described in Sub-clause 2.1 at points not less than 20 mm from the edges.

For boards, the number of measurements shall be eight, two along each edge. For presspaper in rolls, ISO Recommendation R 534 may be followed. When measuring across the width, the number of measurements shall be five per metre width.

In case of dispute, cut a strip 40 mm wide across the full width of the material and, from this strip, at eight equally spaced positions, cut eight test specimens, each not less than 40 mm long. Condition the test specimens in accordance with Clause 1 and measure the thickness of each specimen at a point near the centre of each test specimen using the instrument described in Sub-clause 2.1.2.

2.3 Results

Report the central value of the measurements and the minimum and maximum values obtained.

3. Apparent density

The test shall be carried out on three conditioned specimens; one determination is made on each of the three specimens.

Use rectangular specimens of area not less than 100 cm² and determine the mass of each to an accuracy of 1 mg. Calculate the area of each test piece from two measurements of length and two of width taken at points at least 12 mm from the corners.

Determine the thickness by making eight measurements with one of the instruments described in Sub-clause 2.1 at points equally spaced round the sides and at least 20 mm from the edges and calculate the mean value.

Express the apparent density (the mass/volume ratio) as grams per cubic centimetre.

The central value is taken as the result; the other two are reported.

4. Tensile strength and elongation

Principle

Measurement of the tensile force required under standardized test conditions to cause failure of specimens 15 mm by 250 mm cut from both directions of the material.

The tensile strength in newtons per square millimetre is calculated by the formula:

$$\sigma = \frac{F}{w \cdot a}$$

where:

F = force in newtons

w = width of the specimen in millimetres

a = thickness of the specimen in millimetres

4.1 *Determination with unfolded specimens*

Tensile strength and elongation shall be measured according to the method described in ISO Standard 1924.

Deviations from ISO Standard 1924:

- Nine measurements are made on test pieces cut in the machine direction and in the cross machine direction.
- The central values are taken as the results, the highest and lowest values are reported.

4.2 *Determination with folded specimens*

The specimens are bent over by hand in the middle of their length and at right angles to the longitudinal edge of the specimen as shown in Figure 1a, page 39. They are then fed through the rollers of the folding apparatus illustrated in Figure 2, page 39, with the longitudinal edge of the specimen lying against the guide. Following this, the folded specimen is bent by hand as shown in Figure 1b, page 39, and again passed through the rollers of the folding apparatus. For this purpose, the rollers should grip the specimen about 20 mm in front of the fold. After unfolding, the specimen is tested according to Sub-clause 4.1.

5. Internal tearing resistance

Internal tearing resistance shall be measured according to the method described in ISO Standard 1974.

A single tear tester shall be used.

Deviations from ISO Standard 1974:

- Nine specimens are taken from each direction.
- The central values are taken as results, the highest and lowest values are reported.

Principle

Measurement of the energy required to tear rectangular specimens having a single cut leaving a 43-mm length to be torn.

6. Edge tearing resistance

6.1 Test apparatus

An edge tear stirrup (see Figure 5, page 41) shall be used, attached to the tensile testing apparatus as described in Clause 4. The edge tear stirrup consists of a thin steel plate (A) which forms a horizontal plate supported on edge by the ends of a stirrup-shaped frame.

The thin metal tang of the stirrup frame is fastened in the lower clamp of the tension testing machine, so that the vertical centre line of the stirrup coincides with the line connecting the midpoints of the upper and lower clamps. The horizontal plate is removable from the stirrup frame and two plates of different thickness are supplied for use with materials of different thickness ranges. One plate has a thickness of 1.25 ± 0.05 mm and one plate a thickness of 2.50 ± 0.05 mm. The edge of the plate forms a shallow V-notch, the sides of which subtend an angle of $150 \pm 1^\circ$. The sides of the V-notch are semicircular in cross-section and shall be smooth and straight.

6.2 Test pieces

Nine test pieces shall be cut in the machine direction and nine in the cross machine direction, 15 mm to 25 mm in width and not less than 250 mm in length.

The test pieces shall be conditioned according to Clause 1.

6.3 Procedure

Attach a plate of the proper thickness to the stirrup frame. The plate with the thickness of 1.25 ± 0.05 mm is to be used for material of up to 0.75 mm in thickness and the plate with the thickness of 2.50 ± 0.05 mm for thicker materials.

Fasten the thin tang of the stirrup in the lower clamp (see note) of the tension-testing machine so that the vertical centre line of the stirrup coincides with the line connecting the mid-points of the upper and lower clamps of the testing machine, and so that the sides of the V-notch are symmetrically located with the line through the mid-points of the clamps.

Note. — The stirrup may be fastened in the upper clamp, if desired. This procedure will require rebalancing the tension-testing machine to compensate for the mass of the stirrup.

Place the lower clamp of the machine so that the lower edge of the upper clamp is about 90 mm above the V-notched plate.

Thread the test piece through the stirrup, under the plate, and bring the two ends together and fasten them in the upper clamp.

In this operation, most of the slack in the test piece is taken up, but care shall be exercised not to apply a tearing force to the test piece. Make the application of the first increments of load to the

test piece very slowly if possible, to minimize abnormal strains due to inertia effects. Increase the load so that tearing starts in 5 s to 15 s and record this load in newtons.

6.4 Results

Report the central values for each of the two directions in newtons, mentioning the thickness of the plate used, the rate of loading and the width and thickness of the test pieces.

7. Compressibility

7.1 Principle

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

7.2 Test specimens

A quantity of material sufficient to prepare the required test specimens is dried in an oven at $105 \pm 2^\circ\text{C}$ for 4 h. The oven is then evacuated at approximately 1 torr. The complete drying period is 24 h.

7.3 Requirements of the test equipment

The area of the test specimens under compression shall be at least 625 mm^2 . The height of the specimen (pad) shall be at least 25 mm with a maximum of 85 mm.

The bedding pressure shall be 1 N/mm^2 and shall be applied for 5 min.

The final pressure shall be 20 N/mm^2 and shall be applied for 5 min. Then the pressure shall be reduced to 1.0 N/mm^2 and applied for 5 min.

7.4 Results

Compressibility:

$$C = \frac{h_0 - h_1}{h_0} \times 100\%$$

Residual strain:

$$R.S. = \frac{h_0 - h_2}{h_0} \times 100\%$$

Reversible amount of compressibility:

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

where:

h_0 = thickness of the pad under bedding pressure

h_1 = thickness of pad under final load

h_2 = thickness of the pad after reducing the final pressure to the bedding pressure