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**Pressboard and presspaper for
electrical purposes—Part 2:
Methods of tests**

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for establishment of Japanese Industrial Standard submitted by Japan Electrical Insulating and Advanced Performance Materials Industrial Association (JEIA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

Consequently, **JIS C 2111**:2002 has been withdrawn and partially replaced with this Standard.

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JIS C 2305 series consists of the following 3 parts under the general title “*Pressboard and presspaper for electrical purposes*”:

Part 1: Definitions and general requirements

Part 2: Methods of tests

Part 3-1: Specification for individual materials—Pressboard

Pressboard and presspaper for electrical purposes—Part 2: Methods of tests

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **IEC 60641-2** published in 2004 with some modifications of the technical contents.

The portions with continuous sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with explanations is given in Annex JA.

1 Scope

This Standard specifies the test methods to be used in testing the pressboard for electrical purposes (hereafter referred to as “pressboard”) and the presspaper for electrical purposes (hereafter referred to as “presspaper”) to meet the requirements prescribed in the individual product standard.

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows:

IEC 60641-2:2004 *Pressboard and presspaper for electrical purposes—Part 2: Methods of tests* (MOD)

The symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and any revisions (including amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent editions (including amendments) shall be applied.

JIS B 7507 Vernier, dial and digital callipers

JIS C 2110:1994 Testing methods for electric strength of solid insulating materials

JIS C 2300-2:2010 Cellulosic papers for electrical purposes—Part 2: Methods of test

NOTE : Corresponding International Standard: IEC 60554-2:2001 *Cellulosic papers for electrical purposes—Part 2: Methods of test* (MOD)

JIS C 2320 Electrical insulating oils

JIS P 8113 Paper and board—Determination of tensile properties—Part 2: Constant rate of elongation method

NOTE : Corresponding International Standard: ISO 1924-2 *Paper and board—Determination of tensile properties—Part 2: Constant rate of elongation method (20 mm/min)* (IDT)

JIS P 8116 *Paper—Determination of tearing resistance—Elmendorf tearing tester method*

NOTE : Corresponding International Standard: ISO 1974:1990 *Paper—Determination of tearing resistance (Elmendorf method)* (MOD)

JIS P 8118 *Paper and board—Determination of thickness and density*

NOTE : Corresponding International Standard: ISO 534:1988 *Paper and board—Determination of thickness, density and specific volume* (MOD)

JIS P 8127:1998 *Paper and board—Determination of moisture content—Oven-drying method*

NOTE : Corresponding International Standard: ISO 287:1985 *Paper and board—Determination of moisture content of a lot—Oven-drying method* (MOD)

JIS R 3503 *Glass apparatus for chemical analysis*

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

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions apply.

3.1 specimen

rectangle of paper or board cut to given dimensions from sheets or rolls drawn from selected units

3.2 test piece

quantity of paper or board on which each single determination is carried out in accordance with the method of test

The test piece may be taken from a specimen; in some instances, it may be the specimen itself.

4 General notes on tests

4.1 Conditioning

Specimen is as follows.

- a) **For specimen with a thickness of <0.5 mm** Unless otherwise specified, the specimen after being cut, shall be conditioned for not less than 16 h in an atmosphere of $23\text{ °C} \pm 2\text{ °C}$ and $(50 \pm 5)\%$ relative humidity. Test pieces shall be cut from the specimen and tested in this atmosphere.
- b) **For specimen with a thickness of $\geq 0.5\text{ mm}$** Unless otherwise specified, the specimen after being cut, shall be conditioned for not less than 16 h in an atmosphere of $23\text{ °C} \pm 2\text{ °C}$ and $(50 \pm 5)\%$ relative humidity. Test pieces shall be cut from the specimen and tested in an atmosphere of $25\text{ °C} \pm 5\text{ °C}$ and $(50 \pm 10)\%$ relative humidity.

In case of dispute, the conditioning shall be $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and $(50 \pm 5)\%$ 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 $70\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for a period sufficient to ensure that the conditioning atmosphere produces a mass increase in the specimen.

NOTE : The rough indication for “drying for a period sufficient” shall be taken as moisture content of less than 4 %.

Where it is infeasible to bring the room where the test is performed to the atmospheric condition given above, the specimen shall be conditioned in a well-closed container in which the relative humidity is controlled to $(50 \pm 5)\%$, and then tested immediately in a room of temperature $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and relative humidity of $(50 \pm 10)\%$. In this case, the temperature and humidity at the time of the test shall be recorded.

4.2 Drying

Unless otherwise specified, test pieces shall be dried in a ventilated oven at $105\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. The relation between nominal thickness of press board and minimum drying time is shown in table 1.

Table 1 Relation between nominal thickness of press board and minimum drying time

Nominal thickness of press board mm	Minimum drying time h
0.5 max.	12
Over 0.5 up to and incl. 1.5	24
Over 1.5 up to and incl. 5	48
Over 5	72

4.3 Tolerances

When tolerances are not specified for the dimensions of the test piece, it is understood that these dimensions are taken to the nearest millimetre.

4.4 Test result

The result shall be expressed by the average. However, the central value may be used. In this case, that the central value has been used shall be clearly noted in the test report.

5 Dimensions

5.1 Thickness

For specimen with a grammage of less than 224 g/m^2 , use the procedure as described in **JIS P 8118**. For specimen with a grammage of 224 g/m^2 or more, use the following test:

5.1.1 Test apparatus

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 0.01 mm, enabling readings to be estimated to 0.002 mm. The pressure exerted on the test piece shall be 0.1 MPa to 0.3 MPa.

NOTE 1 In the case of a thin and soft specimen, the error due to pressure of a micrometer becomes comparable to 2 % of the measured value.

NOTE 2 The external micrometer specified in **JIS B 7502** satisfies this requirement.

5.1.2 Block for calibration

The block for calibration used for the check of a measuring instrument shall have an accuracy of within ± 0.001 mm of the nominal dimension. The designated thickness of the measuring instrument shall be within ± 0.005 mm of the thickness of the block for calibration.

5.1.3 Procedure

5.1.3.1 Thickness measurement at the time of sampling specimen

Measure the thickness of a specimen at the time of sampling at points not less than 20 mm from the edges of a test piece using the measuring instrument specified in 5.1.1. For the measurement, rotate the micrometer with a travel speed of about 0.05 mm/s, and after the measurement plane lightly touches the test piece surface in parallel, read the graduation on the third clicking noise of the ratchet. In the case of an automatic stop type, read the value at the time of stop.

For the pressboard, measure eight points in total, two points for each side.

For the presspaper in rolls, perform the measurement as specified in 5.1 of **JIS C 2300-2**. For the measurement in the width direction, five points per 1 m in width shall be measured.

In case of dispute for the measurement results, 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 pieces, each not less than 40 mm long. Condition the test pieces in accordance with 4.1 and measure the thickness of each specimen at a point near the centre of each test piece using the measuring instrument specified in 5.1.1.

5.1.3.2 Thickness measurement after conditioning

The thickness measurement after conditioning shall be performed according to the following procedure.

- Cut the test piece of 200 mm in the longitudinal direction (flow direction) and 250 mm in the width direction from both ends and the centre section of the original width specimen without creases, measure five points at a time in the test piece at almost equal intervals.
- Perform the measurement the specified number of times at almost equal intervals in the cross direction of the original width specimen without creases.

5.1.4 Results

The average shall be taken as the result and reported together with the minimum and the maximum.

5.2 Width and length of sheet

For the width and length of a sheet, spread the paper on a flat table, measure three points using a proper measuring gauge with an accuracy of 0.5 mm or more without tension applied and express by the average.

5.3 Width and diameter of roll

For the width and the outer diameter of a roll, and the outer diameter and inner diameter of a roll core, measure at three points obtained by trisecting the circumference of one roll as it is, using the vernier calliper specified in **JIS B 7507** or any measuring gauge equivalent or superior to this and express by the average.

6 Apparent density

6.1 General

For the measurement of apparent density, unless otherwise specified, any of the following methods may be used. The method used shall be recorded.

6.2 Method A

Obtain density by calculation from mass and volume of each of the three rectangular test pieces of an area not less than 100 cm². The mass shall be measured by an accuracy of $10^{-4} \times$ mass of test piece. Make two measurements of the length and two of the width of each test piece to an accuracy of 0.1 mm at points at least 12 mm from the corners. Determine the thickness by making eight measurements using the measuring instrument as indicated in **5.1.1** at not less than 20 mm from the edges and calculate the average of the measurements.

Calculate the apparent density by following formula:

$$\rho = \frac{m}{s \times l \times w} \times 10^3$$

where, ρ : apparent density (g/cm³);
 m : mass (g);
 s : average of 8 thickness measurements (mm);
 l : average of 2 length measurements (mm);
 w : average of 2 width measurements (mm).

Report all three values.

6.3 Method B

Cut three test pieces into pieces of about 200 mm × 250 mm or about 100 mm × 100 mm, or of a mass of about 2 g, and determine the apparent density from the volume and mass of each by calculation. Determine the thickness as specified in **5.1.3.2**. Measure each of the length and the width of the test piece at two or more points. Measure the mass with the higher accuracy than 0.5 % of the mass of the test piece.

6.4 Method C

Take the test piece of 2 g in mass from the specimen used for the thickness test or the test piece of the mass specified in the individual product standard into a weighing bottle specified in **JIS R 3503**, dry it at $105\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 3 h or more and determine the apparent density from the mass after cooling in a desiccators containing a moisture absorbent and the volume before heating. Determine the thickness as specified in **5.1.3.2**. Measure the mass with the higher accuracy than 0.5 % of the mass of the test piece.

7 Tensile strength and elongation

7.1 Principle

Measurement of the tensile force required under standardized test conditions to cause failure of test pieces measuring 15 mm in width and 250 mm in length cut from both directions of the specimen.

Calculate the tensile strength by the formula:

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

where, σ : tensile strength (MPa);
 F : force at the time of failure (N);
 w : width of the test piece (mm);
 a : thickness of the test piece (mm).

Calculate the elongation according to the formula:

$$E = \frac{D - D_0}{D_0} \times 100$$

where, E : elongation (%);
 D_0 : jaw separation (mm);
 D : separation at the time of failure (mm).

7.2 Determination with non-folded test pieces

This measurement may use any of following methods unless otherwise specified. Record the used method.

Tensile tester used shall be as described in **JIS P 8113** or any equivalent tester.

Cut nine test pieces of about 15 mm width and 250 mm length each in the machine direction and in the cross direction of the specimen. However, the number of test pieces may be as agreed between the parties concerned with delivery.

- a) **Method A** The jaw separation shall be $180\text{ mm} \pm 1\text{ mm}$. The pulling speed shall be $20\text{ mm/min} \pm 5\text{ mm/min}$ or such a speed that the breaking time becomes $20\text{ s} \pm 5\text{ s}$. However, when it is impossible to measure due to the large tensile strength, the width of the test piece may be made small as appropriate, or a testing machine of another type may be used. In this case, this shall be noted in the test report.