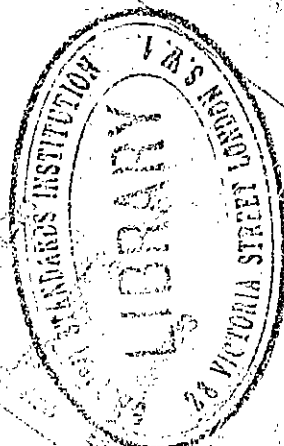


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BRITISH STANDARD 1137 : 1949

Synthetic-resin
Bonded-paper Sheets
for use at
Power Frequencies



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BRITISH STANDARDS INSTITUTION

Incorporated by Royal Charter

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THIS BRITISH STANDARD, having been approved by the Electrical Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on June 22nd, 1949.

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First revision, June, 1949.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

The figures in British measures are to be regarded as the standard. Approximate metric equivalents are given for the convenience of users in countries in which the metric system has been generally adopted.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over one thousand, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook.

British Standards are revised, when necessary, either by the issue of amendment slips or revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or edition.

Users wishing to be kept informed of any alteration to this standard should notify Sales Department of the Institution, giving the number and title of the standard.

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CO-OPERATING ORGANIZATIONS

The Electrical Industry Standards Committee,* under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:—

- * Admiralty
- * Air Ministry
 - Association of Consulting Engineers
 - Association of Supervising Electrical Engineers
- * British Electrical and Allied Manufacturers' Association
- * British Electrical and Allied Industries Research Association
- British Electricity Authority
- British Electrical Development Association
- British Railways
- Cable Makers' Association
- Electrical Contractors' Association (Incorporated)
- Electric Lamp Manufacturers' Association
- Electric Light Fittings Association
- * General Post Office
- Home Office
- Institution of Electrical Engineers
- Ministry of Fuel and Power
- * Ministry of Labour and National Service
- * Ministry of Supply
- Ministry of Works
- * National Physical Laboratory
- Public Transport Association
- * Radio Industry Council

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:—

British Plastics Federation
National Federation of Associated Paint, Colour and Varnish Manufacturers

* The Electrical Industry Standards Committee is the British National Committee of the International Electrotechnical Commission.

BRITISH STANDARD SPECIFICATION FOR SYNTHETIC-RESIN BONDED-PAPER SHEETS FOR USE AS ELECTRICAL INSULATION AT POWER FREQUENCIES

FOREWORD

This British Standard is based on technical data provided by the British Electrical and Allied Industries Research Association, and supersedes B.S. 316 and B.S. 547 in so far as they apply to sheets. A separate standard (B.S. 1314) has been issued for thermo-plastic synthetic-resin bonded-paper tubes.

With a view to the reduction of testing to a minimum, this standard is divided into mandatory and optional clauses, the former being limited to the tests necessary for the rejection of inferior material.

The principal alterations in this (1949) revision of the standard are as follows:—

Three alternative types of specimen are permitted for determination of tensile strength, and details of suitable grips for holding the specimens in the testing machine are included (Appendix E).

An alternative type of electrode (tin foil) is permitted for determination of power factor at 50 c/s. Tin foil electrodes, attached to the specimen by petroleum jelly, are mandatory for power factor tests at 1000 c/s (Appendix J).

A separate British Standard for synthetic-resin bonded-paper material for use at high frequencies is in preparation.

SPECIFICATION

SCOPE

1. This British Standard refers only to Types I, II and III thermo-setting synthetic-resin bonded-paper sheets as defined below. The limits given in the present standard cover Types I and III sheets only, except for flatness and tolerance on thickness which apply to Type II sheets also; further investigation is required before limits for other properties can be set for Type II material.

The range of thicknesses of each type is from $\frac{1}{64}$ in. up to and including 1 in.

The sheets covered by this standard are intended for electrical insulating purposes for use with direct current, and with alternating current of frequencies up to 100 cycles per second only.

If the material is required suitable for punching, this should be stated by the purchaser with the enquiry and/or order.

It is not intended that these materials shall necessarily comply with the requirements of all the clauses in the standard. The clauses in Part One are mandatory, and material purporting to be 'British Standard' shall comply with the requirements of these clauses. Material which fulfils the requirements of the mandatory clauses shall be deemed to comply with the standard.

When a purchaser requires material to comply with any of the optional clauses of the standard, this shall be stated with the enquiry and/or

order, the particular clauses being specified. When a material is required to comply with any of the optional clauses, any test carried out shall be made in accordance with the appropriate method described herein.

The density of the sheets covered by the standard may be taken as 20 cu. in. to the pound (1.384 g./cm.³) for all types of material. Density is not a guide to the quality of a sheet.

DEFINITIONS

SYNTHETIC-RESIN BONDED-PAPER SHEETS

2. For the purpose of this British standard, the term 'synthetic-resin bonded-paper sheet' denotes a sheet, board or plate made from paper or paper pulp treated with synthetic-resin of thermo-setting type and bonded together under the influence of heat and pressure.

The three types of sheet covered by this standard are distinguished as follows:—

(2.1) *Type I.* Type I synthetic-resin bonded-paper sheet is characterized by relatively low water absorption, high electrical resistivity in humid atmosphere and good machining properties.

NOTE. Type I sheet corresponds to Grade I material which was previously covered by B.S. 547 : 1934.

(2.2) *Type II.* Type II synthetic-resin bonded-paper sheet has greater mechanical strength than Type I material, and the water absorption is intermediate between the values of Types I and III sheets.

(2.3) *Type III.* Type III synthetic-resin bonded-paper sheet is mechanically stronger and has considerably higher water absorption than Type I material but has inferior machining properties. Type III sheet is suitable for general electrical purposes in dry situations in air or under oil.

NOTE. Type III sheet corresponds to Grade II material which was previously covered by B.S. 316 : 1929.

DIRECTION OF APPLICATION OF STRESS

3. (3.1) *Flatwise direction.* The term 'flatwise direction' denotes that the electrical and/or mechanical stress is applied in a direction normal to the laminae of the sheet.

(3.2) *Edgewise direction.* The term 'edgewise direction' denotes that the electrical and/or mechanical stress is applied to the edge of the sheet in a direction parallel to the plane of the laminae of the sheet.

(3.3) *Lengthwise direction.* The term 'lengthwise direction' (or 'direction A') denotes that the principal axis of the specimen and the direction in which the mechanical stress is applied are in the machine direction of the paper.*

(3.4) *Crosswise direction.* The term 'crosswise direction' (or 'direction B') denotes that the principal axis of the specimen and the direction in which the mechanical stress is applied are in the across direction of the paper.*

* When the direction is not known, the lengthwise direction shall be assumed to be that in which the tensile strength of the sheet is the greater, and the crosswise direction at right angles to this. As a sheet is sometimes built up of superimposed layers having the 'grain' at right angles, it may therefore have no definite lengthwise or crosswise direction.

When so desired by the purchaser and a sheet has definite lengthwise and crosswise directions, the manufacturer shall mark one of the directions on the sheet.

PART ONE : MANDATORY CLAUSES

FINISH

4. Sheets shall be smoothly finished and shall be free from detrimental local deformation and splitting. Sheets shall be supplied with trimmed edges.

NOTE. When Type III material is intended for use in air, the user is recommended to ensure that it has been thoroughly dried, and that when cut up and/or machined, all surfaces and edges are protected by a suitable moisture-resisting insulating varnish.

FLATNESS, FOR SHEETS $\frac{3}{8}$ INCH THICK (NOMINAL) AND ABOVE

5. Any sheet $\frac{3}{8}$ in. thick (nominal) and above of any type shall be tested for flatness by being placed without restraint on a flat surface, concave side up, and a light straight edge placed on it. The departure at any point of the surface of the sheet from the straight edge in any direction on the sheet shall not exceed 0.250 in. under a 36-in. straight edge, 0.110 in. under a 24-in. straight edge, or 0.028 in. under a 12-in. straight edge.

TOLERANCE ON THICKNESS

6. (6.1) *Deviation from nominal thickness.* The permissible variation in the thickness of sheets of any type from the nominal thickness, when the thickness is determined by the method described in Appendix B, shall not exceed the appropriate value given in Table 1.

TABLE 1. TOLERANCE ON THICKNESS

Nominal thickness in.	Tolerance, mils, plus or minus	Nominal thickness in.	Tolerance, mils, plus or minus
$\frac{1}{64}$	2.5	Above $\frac{7}{32}$ up to and including $\frac{1}{4}$	12
Above $\frac{1}{64}$ up to and including $\frac{1}{32}$	3.5	Above $\frac{1}{4}$ up to and including $\frac{5}{16}$	14.5
Above $\frac{1}{32}$ up to and including $\frac{3}{64}$	4.5	Above $\frac{5}{16}$ up to and including $\frac{3}{8}$	17
Above $\frac{3}{64}$ up to and including $\frac{1}{16}$	5.5	Above $\frac{3}{8}$ up to and including $\frac{1}{2}$	19
Above $\frac{1}{16}$ up to and including $\frac{1}{8}$	7.0	Above $\frac{1}{2}$ up to and including $\frac{3}{4}$	21
Above $\frac{1}{8}$ up to and including $\frac{1}{4}$	8.0	Above $\frac{3}{4}$ up to and including 1	24
Above $\frac{1}{4}$ up to and including $\frac{1}{2}$	9.0	Above 1 up to and including $1\frac{1}{2}$	27
Above $\frac{1}{2}$ up to and including $3/4$	10	Above $3/4$ up to and including 1	30
Above $3/4$ up to and including 1	11	Above 1 up to and including $1\frac{1}{2}$	33