bsi.

...making excellence a habit.™

Please be aware that this PDF has been created from the original hardcopy document, which might not be in good condition and so the PDF might reflect this.

BSI Group
389 Chiswick High Road
London, W4 4AL
United Kingdom

T: +44 20 845 086 9001
F: +44 20 8996 7400
cservices@bsigroup.com
bsigroup.com

British Standards Limited
Registered in England no: 07864997
Registered address: 389 Chiswick High Road
London, W4 4AL, United Kingdom

AVA Documents
INVESTORS IN PEOPLE
Document Sharing Hub

Full document details: BS 3953:1976

BSI

BS 3953 : 1976

UDC 678.6.066 – 419 : 677.521

Specification for

Synthetic resin bonded woven glass fabric laminated sheet

Spécification des plaques stratifiées en tissus à base de verre textile liés au moyen des résines synthétiques

Spezifikation für mit Kunstharz gebundener Schichtpresstofftafeln aus Glasgewebe

British Standards Institution

A14

3065

GP7

Documents Document Sharing Hub

Contents

	Page
Foreword	1
Cooperating organizations	Back cover
Specification	
Section one General	
1. Scope	3
2. References	3
3. Definitions	3
4. Classification	3
5. Compliance	3
6. Colour	4
7. Conditioning	4
Section two. Requirements	
8. Appearance	4
9. Flatness	4
10. Preferred nominal thicknesses and permissible deviations	4
11. Machinability	4
12. Physical and electrical properties	4
Section three. British Government Services requirements for laminated sheet of types SI-4, SI-5 and MF-5	
13. Introduction	12
14. Related specifications	12
15. Type approval	12
16. Testing	12
17. Packaging	13

	Page
Appendices	
A. Conditioning of test pieces	13
B. Cross-breaking strength	13
C. Determination of water absorption	14
D. Determination of electric strength, edgewise	14
E. Determination of loss tangent and permittivity at 1 MHz	14
F. Determination of insulation resistance after immersion in water	14
G. Determination of burning time of a test piece 10 mm to 15 mm wide	14
H. Text deleted.	
J. Determination of impact strength, edgewise, Charpy method	15
K. Determination of electric strength, flatwise	15
L. Determination of resistance to tracking	16
M. Determination of bond strength	16
N. Determination of insulation resistance after heating at 180 °C and immersion in water	16
P. Proof test of electric strength after heating at 180 °C and immersion in water	16
Tables	
1. Preferred nominal thicknesses and permissible deviations	5
2. Mandatory requirements	6
3. Optional requirements	8
4. Water absorption	10
5. Electric strength, flatwise	11

ti B1

V69 3066

AVA Documents Document Sharing Hub

Full document details: BS 3953:1976

Foreword

This British Standard has been prepared under the authority of the Plastics Standards Committee and is based on data provided by the British Plastics Federation.

Since the first publication of BS 3953 in 1965, some of the types of laminated sheet of woven glass fabric bonded with synthetic resin that were covered in the standard have become obsolete, and new types of laminate have been introduced. In drafting this revision, consideration has been given to aligning it with the work of the International Organization for Standardization (ISO), in particular with International Standard ISO 1642

Special requirements of the British Government Services that were dealt with in Part 2 (published as Amendment No. 1) of BS 3953:1965 have been revised and included as section three of this standard.

The glass fabric laminated sheet materials specified are generally more heat-resistant than laminates with a paper or cotton fabric base, and have generally better mechanical properties, particularly impact strength. Most of the glass fabric laminated materials that are specified can be drilled, tapped, sawn and otherwise machined; reference should be made to the manufacturer's recommendations.

Woven glass fabric made from low-alkali glass has been specified.

During 1973–1974 several discussions took place in the Executive Board of BSI as a result of concern about potential fire hazards in the rapidly increasing use of many polymeric materials, especially for furnishing and construction purposes. Issues of great public importance were involved, relating in particular to the use of laboratory fire tests to define quality requirements, in view of the general lack of correlation between the results obtained in such small-scale tests and the fire performance of materials and products in actual conditions of use.

The Executive Board decided that a detailed review of all the issues involved should be carried out as a matter of urgency, and that this should be comprehensive in scope rather than limited to polymeric materials. For this purpose an authoritative co-ordinating committee on fire tests was established. In the meantime certain general principles were laid down regarding the terminology and approach to be adopted in immediate revisions and amendments of the British Standards involving small-scale fire tests.

When this revision was published in 1976, provision was made for two methods of test for the determination of impact strength; it was stated that the use of the Izod method would be discontinued as soon as sufficient data had been accumulated to specify limits for the impact strength determined by the Charpy method. This data having become available, the limits were introduced into the standard by Amendment No. 1 and the optional requirement for the use of the Izod method was deleted.

In keeping with this policy, type designations and descriptions in this standard have been drafted to avoid reference to terms that might be misinterpreted as applying to situations other than those of the specified test conditions. Further changes may be made later as a result of the general review undertaken by the coordinating committee mentioned above.

International Standard ISO 1210, on which appendix G of this standard is based, is currently under review and the method given in appendix B for determining flammability of plastics in the form of bars may therefore have to be amended when the review has been completed.

The types of laminated sheet of woven glass fabric bonded with synthetic resin that are specified in this standard correspond to those specified in BS 3953:1965 and in ISO/DIS*.... as indicated in the table below. This is only a general guide to the relationship between the types of laminated sheets covered by the three standards. In view of the differences in limiting values, in test methods, and in the ranges of properties covered, it should not be assumed that corresponding types are exact equivalents. Types given in brackets show particularly wide variations.

Types in this standard	Types in BS 3953:1965 (withdrawn)	Types in ISO/DIS*....
–	EP1	–
EP-3	(EP2)	EP GC-1
EP-4	–	EP GC-2
EP-5	–	EP GC-3
EP-6	–	EP GC-4
EP-7	–	–
MF-3	(MF1)	–
MF-4	(MF2)	MF GC-1
MF-5	–	–
PF-2	PF1	PF GC-1
SI-4	SIL1	SI GC-1
SI-5	SIL2	SI CG-2
–	SIL3	–
UP-4	PR1	–
UP-5	PR2	–
UP-6	PR3	–

*Subsequently replaced by ISO 1642-1979

PAGE 2 IS BLANK

AVA Documents Document Sharing Hub
V69 3067
Full document details: BS 3953:1976

British Standard Specification for

Synthetic resin bonded woven glass fabric laminated sheet

1. Scope

This British Standard specifies requirements and preferred nominal thicknesses for 14 types of laminated sheet of woven glass fabric bonded with synthetic resin. It does not cover laminated sheets prepared by bonding together previously prepared thinner laminated sheets.

The ranges of thicknesses covered are as follows:

- 0.4 mm to 50 mm for types EP-3, EP-4, EP-5, EP-6, EP-7, MF-3, MF-4 and MF-5;
- 0.4 mm to 6 mm for type PF-2;
- 0.4 mm to 25 mm for types SI-4 and SI-5;
- 0.4 mm to 12 mm for types UP-4, UP-5 and UP-6.

The nominal density of the classes of material covered by this standard may be taken as 1.6 g/cm^3 to 2.1 g/cm^3.

2. References

The standards publications referred to in this standard are listed on the inside back cover.

3. Definitions

For the purposes of this British Standard the following definitions apply.

3.1 laminated sheet of woven glass fabric bonded with synthetic resin. Sheet or board made from layers of woven glass fabric treated with epoxide, melamine, phenolic, silicone or polyester thermosetting resin and bonded together usually under heat and pressure.

3.2 woven glass fabric. A suitably treated or finished fabric woven from glass-fibre yarn consisting of strands put together by twisting, the glass containing not more than 1 % of alkali metal oxide expressed as Na_2O.

NOTE. Type E glass is commonly used.

3.3 flatwise. Perpendicular to the plane of lamination.

3.4 edgewise. Parallel to the plane of lamination.

3.5 directions A and B. Two directions in the plane of a sheet that are mutually at right angles. They are related to the surface layer of fabric, one of the directions being parallel to either the warp threads or the weft threads of the fabric in a surface layer.

4. Classification

The classification of the laminated sheets specified in this British Standard is as follows:

Class EP (bonded with epoxide resin)

Type EP-3 A general-purpose type

Type EP-4 Similar to type EP-3, but satisfying a specified requirement for burning behaviour of a test piece 10 mm to 15 mm wide (see table 2 and appendix G)

Type EP-5 Similar to type EP-3, but offering greater retention of mechanical strength at elevated temperature

Type EP-6 Similar to type EP-5, but satisfying a specified requirement for burning behaviour of a test piece 10 mm to 15 mm wide (see table 2 and appendix G)

Type EP-7 Similar to type EP-5, but offering even greater retention of mechanical strength at elevated temperature, after prolonged exposure to elevated temperature

Class MF (bonded with melamine resin)

Type MF-3 Having better electrical properties than type MF-4

Type MF-4 A general-purpose type

Type MF-5 A special type, having higher resistance to humidity and elevated temperature than types MF-3 and MF-4, introduced to cover certain special requirements of British Government Services

Class PF (bonded with phenolic resin)

Type PF-2 A general-purpose type

Class SI (bonded with silicone resin)

Type SI-4 Having good electrical properties

Type SI-5 Having good mechanical properties

Class UP (bonded with polyester resin)

Type UP-4 Having better electrical properties than type UP-5

Type UP-5 A general-purpose type

Type UP-6 Satisfying a specified requirement for burning behaviour of a test piece 10 mm to 15 mm wide (see table 2 and appendix G)

NOTE. Certain types in this revised specification are different from those previously specified in BS 3951:1965. Consequently, to avoid confusion, the types specified herein have been allocated type numbers following on consecutively from those used in the 1965 edition.

The abbreviations for polyester and silicone have been changed from PR and SIL to UP and SI, respectively, to align with ISO/DIS ...*

*Subsequently replaced by ISO 1642-1979

5. Compliance

All materials purporting to be in accordance with this British Standard shall comply with the requirements of clauses 6 to 11 and tables 1 and 2. Such materials will normally also comply with the optional requirements given in table 3 but if assurance is necessary for one or more of these requirements this should be stated in the enquiry or order.

BEST COPY AVAILABLE

ti B3

AVA Documents Document Sharing Hub

VGB 3068

Full document details: BS 3953:1976

6. Colour

Unless otherwise specified, the material shall be of natural colour, but colouring matter may be incorporated by agreement between purchaser and supplier, provided that the sheet meets the requirements of this British Standard.

It is recommended that the possible variations in natural colour and the possible effects of added colouring matter should be discussed and agreed by supplier and purchaser.

7. Conditioning

Where conditioning of test pieces is specified in the method of test, this shall be carried out in accordance with appendix A.

Section two. Requirements

8. Appearance

Sheets shall be of generally uniform appearance and shall be free from wrinkles, blisters and cracks. They shall be substantially free from other small defects, for example scratches, dents, inclusions and discolouration. They shall be supplied with trimmed edges.

9. Flatness

When any sheet of nominal thickness 3 mm or more is placed without restraint, concave side up, on a flat, horizontal surface, the departure at any part of the upper surface of the sheet from a light straightedge laid in any direction upon it shall not exceed either of the appropriate values that follow.

Type	Thickness	Departure from straightedge	
		1 m straightedge	0.5 m straightedge
	mm	mm	mm
SI-4 and SI5	3 to 6 inclusive	15	4
	over 6 to 8 inclusive	12	3
	over 8	10	2.5
All other types	3 to 8 inclusive	8	2
	over 8	6	1.5

No limits are specified for materials of nominal thickness below 3 mm.

10. Preferred nominal thicknesses and permissible deviations

The preferred nominal thicknesses are given in table 1. The thickness of a sheet at any point shall not deviate from the nominal thickness by more than the appropriate value shown in table 1. If the nominal thickness is not one of the preferred values, the tolerance for the next higher preferred nominal thickness shall apply.

NOTE. The permitted deviations from nominal thickness listed in table 1 define upper and lower limits of thickness that are symmetrically disposed about the nominal thickness. By agreement between purchaser and supplier, limits disposed asymmetrically about the nominal thickness may be applied. In such cases, the overall tolerance in thickness (i.e. the difference between the agreed upper and lower limiting values) should equal twice the appropriate numerical value given in table 1.

11. Machinability

When sawn, drilled, turned, routed, milled or punched in accordance with the recommendations of the manufacturer, sheets of any type other than types SI-4 and SI-5 shall not show undue chipping or any sign of splitting, cracking or delamination.

In view of the comparatively poor interlaminar adhesion of types SI-4 and SI-5, the machining capabilities and characteristics of the material should be a subject for agreement between purchaser and supplier.

12. Physical and electrical properties

12.1 Basic requirements. All the properties indicated in table 2 are mandatory requirements of this specification.

When the sheet is tested by the methods indicated in table 2, no test result for any single sheet shall be worse than the applicable maximum or minimum limiting value shown in tables 2 or 4.

12.2 Optional requirements. The tests indicated in table 3 are optional requirements, any of which may be specified by the purchaser (see clause 5).

When the sheet is tested by any of the methods indicated in table 3 that are specified by the purchaser, no test result for any single sheet shall be worse than the applicable maximum or minimum limiting value shown in tables 3 or 5.

ti B4
AVA Documents Document Sharing Hub
Full document details: BS 3953:1976

Table 1. Preferred nominal thicknesses and permissible deviations

Preferred* nominal thickness	Permissible deviations from nominal thickness plus or minus					
	PF-2	UP-4 UP-5 UP-6	SI-4	SI-5	EP-3 EP-4 EP-5 EP-6 EP-7 MF-3 MF-4	MF-5
mm	mm	mm	mm	mm	mm	mm
0.4	0.19	0.19	0.10	0.19	0.19	0.15
0.5	0.20	0.20	0.12	0.20	0.20	0.16
0.6	0.21	0.21	0.13	0.21	0.21	0.17
0.8	0.22	0.22	0.16	0.22	0.22	0.18
1	0.23	0.23	0.18	0.23	0.23	0.20
1.2	0.24	0.26	0.20	0.24	0.24	0.22
1.6	0.27	0.28	0.24	0.27	0.27	0.24
2	0.29	0.31	0.27	0.29	0.29	0.26
2.5	0.32	0.35	0.31	0.32	0.32	0.28
3	0.36	0.39	0.35	0.36	0.36	0.30
4	0.42	0.49	0.44	0.42	0.42	0.35
5	0.52	0.63	0.52	0.52	0.52	0.40
6	0.60	0.76	0.60	0.60	0.60	0.45
8	—	0.90	0.72	0.72	0.72	0.55
10	—	1.03	0.82	0.82	0.82	0.65
12	—	1.17	0.94	0.94	0.94	0.75
14	—	—	1.02	1.02	1.02	0.85
16	—	—	1.12	1.12	1.12	0.95
20	—	—	1.30	1.30	1.30	1.15
25	—	—	1.50	1.50	1.50	1.25
30	—	—	—	—	1.70	1.35
35	—	—	—	—	1.95	1.45
40	—	—	—	—	2.10	1.55
45	—	—	—	—	2.30	1.65
50	—	—	—	—	2.45	1.75

*See clause **10** regarding other nominal thicknesses.

ti B5

AVA Documents Document Sharing Hub
VBB 3070
Full document details: BS 3953:1976