BRITISH STANDARD

BS 4584-13: 1977

Specification for

Metal-clad base materials for printed circuits —

Part 13: Silicone woven glass fabric copper-clad laminated sheet Si-GC-Cu-13

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Cooperating organizations

The Electronic Components Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following Government department, scientific and industrial organizations:

British Electrical and Allied Manufacturers' Association (BEAMA)
Electricity Supply Industry in England and Wales*
Electronic Components Industry Federation*
Electronic Engineering Association*
Institution of Electronic & Radio Engineers
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British Plastics Federation
British Radio Equipment Manufacturers' Association
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Scientific Instrument Manufacturers' Association

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Contents

Foreword

This British Standard has been prepared under the direction of the Electronic Components Standards Committee. This Part of this British Standard deals with materials designated Si-GC-Cu-13, where the letters denote silicone resin, woven glass fabric, and copper respectively and 13 is a serial number.

The methods of test referred to in this specification are given in Part 1 of this standard.

BS 4584-1 substantially agrees with IEC 249-1 and 249-1A; other Parts of BS 4584[1)] are similar to, but not identical with, IEC Publication 249-2.

Certification. Attention is drawn to the certification facilities described on the inside back cover of this standard.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[1)] At present there is no similar specification to this standard in IEC Publication 249-2.

1 Scope

This Part of this British Standard specifies requirements for properties of silicone woven glass fabric copper-clad laminated sheet, general purpose grade, and covers sheet of nominal thicknesses from 0.8 mm to 3.2 mm.

The standard includes a requirement for surface finish that is to apply in special circumstances only (see **6.2**). Material complying with all the other requirements of this specification shall be deemed to comply with the standard.

2 References

The titles of the publications referred to in this standard are listed on page 4.

3 Materials and construction

The sheet consists of an insulating base with metal foil bonded to one or both sides.

3.1 Insulating base. This insulating base shall be of silicone resin bonded woven glass fabric laminate.

3.2 Metal foil. The metal foil shall be of copper, in accordance with Table 1.

Table 1 — Mass per unit area and thickness of copper foil

Mass per unit area		Thickness	
Nominal	Limits	Nominal	Limits
g/m^2	g/m^2	μm	μm
305	275–335	35	30–45
610	545–675	70	62–88

Measurements to determine that the foil complies with the above requirements before incorporation in the laminate shall be made in accordance with **2.4** of BS 4584-1:1970.

NOTE For information only:
minimum purity 99.5 %
minimum conductivity 95 % of the value equivalent to a resistivity of 1.7241×10^{-8} Ω m at 20 °C

4 Marking

The nature of this material is such that any marking within the laminate may cause unacceptable degradation of the electrical properties.

It is preferred that each sheet shall be individually wrapped and labelled with the manufacturer's identity, the number of this specification, the batch number, and the thickness of laminate and cladding.

5 Electrical properties

When the sheet is tested by the methods shown in Table 2, it shall conform to the limits therein.

Table 2 — Electrical properties

Property	Test method of BS 4584-1:1970	Requirement
	Clause	
Resistance of foil of 305 g/m^2 of 610 g/m^2	**2.1.2**	3.5 mΩ max. 1.75 mΩ max.
Surface resistance after damp heat and recovery	**2.1.3.3**[a]	50 000 MΩ min.
Volume resistivity after damp heat and recovery	**2.1.3.3**[a]	10 000 MΩ m min.
Permittivity after damp heat, steady state	**2.1.5**[a]	4.0 max.
Loss tangent after damp heat, steady state	**2.1.5**[a]	0.008 max.

[a] The recovery conditions used shall be 4 h at standard recovery conditions (BS 2011-1.1).

6 Non-electrical properties of the copper-clad sheet

6.1 Appearance of the copper-clad face. The copper-clad face shall be substantially free from blisters, wrinkles, pinholes, deep scratches, pits and resin. Any discoloration or contamination shall be readily removable with a hydrochloric acid solution of density 1 020 kg/m^3 or with industrial methylated spirit (BS 3591) or *iso*propyl alcohol (BS 1595).

Trichlorotrifluoroethane (BS 4849) is suitable provided that the silicone/glass base laminate is exposed to the action of the solvent for a limited time only. Corrugations may occur in the copper surface, due to the threads of the material. Laminated sheet of this type shall not show any corrugations greater in depth than 0.005 min.

6.2 High quality surface finish (optional). If a surface finish of high quality is essential, e.g. for precious metal plating or fine line etching, the following requirements shall apply when agreed upon by the supplier and the purchaser (for test method, see **2.2.8** of BS 4584-1:1970).

The surface finish of the copper-clad face shall be such as not to conceal imperfections.

Table 3 — Types, sizes and permitted number of imperfections

Types	Size (length unless otherwise indicated)		Number of imperfections permitted	
	Above	Not above	In any sheet of area about 1 m^2	In any area of 300 × 300 mm
	mm	mm		
Inclusions	— 0.1 0.25	0.1 0.25 —	Any number 30 0	Any number 4 0
Indentations	— 0.25 1.25 3.0 (or width 1.0)	0.25 1.25 3.0 (or width 1.0) —	Any number 13[a] 3[a] 0	Any number 3[b] 1[b] 0
Bumps	— 0.1 4.0 (or height 0.1)	0.1 4.0 (or height 0.1) —	Any number 10 0	Any number 2 0
Wrinkles Blisters	Of any size		0	0

[a] Maximum number of indentations (both sizes combined) is 13.
[b] Maximum number of indentations (both sizes combined) is 3.

The surface of the copper foil shall be free from scratches of depth greater than 0.01 mm. The total length of scratches of depth greater than 0.005 mm but not greater than 0.01 mm shall not exceed 1 m/m^2 of the total area of the sheet under test.

The total area of any one or number of pinholes in an area of 0.5 m^2 shall not exceed the area of a circle of diameter 0.125 mm.

No sheet shall have more imperfections of the types listed than those permitted in Table 3.

For sheets of 1 m^2 or greater, the values of column 4 of Table 3 apply within any area of 1 m^2; for the same sheets in any area of 300 mm × 300 mm, the values in column 5 apply. For sheets smaller than 1 m^2, the values in column 5 apply for any area of 300 mm × 300 mm.

For cut panels smaller than 300 mm × 300 mm, the numbers and maximum sizes of imperfections shall be as agreed between the supplier and the purchaser.

6.3 Thickness. The thickness of a sheet, including the metal foil, shall not depart at any point from the nominal thickness by more than the appropriate value shown in Table 4. The coarse deviations shall apply unless the close deviations are ordered. The coarse deviations are not applicable to laminated sheets to be used for plug-in connectors.

For any other value of nominal thickness, the deviations shall be those shown in Table 4 for the next greater thickness.

Table 4 — Nominal thicknesses and deviations of metal-clad sheet

Nominal thickness		Deviation	
Preferred	Non-preferred	Coarse	Close
mm	mm	mm	mm
0.8	—	0.15	0.10
—	1.0	0.17	0.11
—	1.2	0.18	0.12
1.6	—	0.20	0.14
—	2.0	0.23	0.15
2.4	—	0.25	0.18
3.2	—	0.30	0.20

6.4 Bow. When the sheet is tested by the method given in **2.2.1** of BS 4584-1:1970, the bow shall not exceed the value given by the formula $d(L/1\,000)^2$ mm, where L is the length of the straightedge in millimetres and d is as given in Table 5.

Table 5 — d values for bow

Nominal thickness	Copper foil on one side		Copper foil on both sides
	305 g/m^2	610 g/m^2	305 g/m^2 or 610 g/m^2
	d	d	d
mm			
0.8 to 1.2	34	46	15
Over 1.2 to 1.6	23	38	15
Over 1.6 to 1.8	23	38	15
Over 1.8 to 3.2	11	19	8

The values shown in Table 5 apply only if length and width are each at least 460 mm.

6.5 Twist. When the sheet is tested by the method given in **2.2.3** of BS 4584-1:1970, the twist shall not exceed the value given by the formula $e(M/1\,000)^2$ mm, where M is the length in millimetres of the diagonal of the sheet and e is as given in Table 6.

Table 6 — e values for twist

Nominal thickness	Copper foil on one side		Copper foil on both sides
	305 g/m^2	610 g/m^2	305 g/m^2 or 610 g/m^2
	e	e	e
mm			
0.8 to 1.2	25	30	14
Over 1.2 to 1.6	18	25	14
Over 1.6 to 1.8	12	16	8
Over 1.8 to 3.2	12	16	8

The values shown in the table apply only if length and width are each at least 460 mm.

6.6 Punching. The sheet shall be capable of being punched in accordance with the recommendations of the manufacturer of the sheet.

6.7 Solderability

6.7.1 *General.* When the sheet is tested by the method given in **2.2.9** of BS 4584-1:1970, and in accordance with the times specified in **6.7.2** and **6.7.3**, the soldered area of each specimen shall be covered with a smooth and bright solder coating. Any imperfections, e.g scattered small holes or unwetted or de-wetted areas, should cover not more than approximately 5 % of the total soldered area.

6.7.2 *Wetting test.* For plate and matt finish material, the specimen shall wet within 2 s.

6.7.3 ***De-wetting test***

a) For plate finish material, the specimen shall remain in contact with the molten solder for 5 + 1, – 0 s.

b) For matt finish material, no test is available.

6.8 Other properties of the copper-clad sheet. When the sheet is tested by the methods shown in Table 7, it shall conform to the limits therein.

Table 7 — Pull-off and peel strength requirements

Property	Test method of BS 4584-1:1970	Requirement
	Clause	
Pull-off strength[a]	**2.2.5**	63 N min.
Peel strength after heat shock	**2.2.6.2** Solder temperature 260 ± 2 °C Time of contact 10 s	0.7 kN/m min. No delamination or blistering
Peel strength after exposure to simulated plating conditions	**2.2.6.5**[b]	0.7 kN/m min.

[a] Not applicable to sheet of nominal thickness less than 1.2 mm.
[b] Trichloroethylene should not be used on these materials. See **6.1** for suitable solvents.

7 Non-electrical properties of the base material after complete removal of the copper foil

7.1 Appearance of base material. The base material shall be substantially free from pits, holes, scratches, surface porosity, foreign matter, conductive particles and resin inclusions and shall be substantially uniform in colour. A small amount of irregular variation of colour is permissible.

7.2 Other properties of the base material after complete removal of the copper foil. When the sheet is tested by the method shown in Table 8 it shall conform to the limits therein.

Table 8 — Flexural strength requirement

Not applicable to sheet less than 1.0 mm nominal thickness.

Property	Test method of BS 4584-1:1970	Requirement
	Clause	
Flexural strength	**2.3.1**	100 MN/m^2 min.

8 Packaging

The sheets shall be adequately packed and protected in cases or crates to avoid damage and contamination in transit and during storage.

Publications referred to

BS 1595, *isoPropyl alcohol.*
BS 2011, *Methods for the environmental testing of electronic components and electronic equipment.*
BS 2011-1, *General.*
BS 3591, *Industrial methylated spirits.*
BS 4584, *Metal-clad base materials for printed circuits.*
BS 4584-1, *Methods of test.*
BS 4849, *1,1,2-trichlorotrifluoroethane (R113).*
IEC 249, *Metal-clad base materials for printed circuits.*
IEC 249-1, *Test methods.*
IEC 249-1A, *First supplement to IEC 249-1.*
IEC 249-2, *Specifications.*

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BSI
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London
W4 4AL