BRITISH STANDARD

BS 4584-5: 1972

Specification for

Metal-clad base materials for printed circuits —

Part 5: Phenolic cellulose paper copper-clad laminated sheet of medium electrical quality PF-CP-Cu-5

UDC 621.39.049.75 – 217:678.066 – 419

Co-operating organizations

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

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British Electrical and Allied Manufacturers' Association
British Radio Equipment Manufacturers' Association*
British Radio Valve Manufacturers' Association
British Railways Board
Cable and Wireless Limited
Crown Agents for Oversea Goverments and Administrations
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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
Institute of Metal Finishing
Society of Motor Manufacturers and Traders

This British Standard, having been approved by the Telecommunication Industry Standards Committee, was published under the authority of the Executive Board on 28 July 1972

The following BSI references relate to the work on this standard:
Committee references TLE/19 and TLE/19/1
Draft for comment 70/9525
Word Processing Centre reference ZZ409

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Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

Foreword

This Part of the British Standard deals with material designated PF-CP-Cu-5. The letters PF denote phenolic resin, CP denotes cellulose paper, Cu denotes copper and 5 is a serial number.

At present, International Electrotechnical Commission (IEC) Publication 249-2, "*Metal-clad base materials for printed circuits*', Part 2: "*Specifications*', does not contain a grade of base material equivalent to PF-CP-Cu-5.

The methods of test referred to by clause number in this specification are given in BS 4584:1970 "*Metal-clad base materials for printed circuits*', Part 1 "*Methods of test*'.

This British Standard replaces BS 3888:1965[1)] for material of Type PPCC.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

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)] BS 3888, "*Copper-clad synthetic resin bonded laminated sheet for use in telecommunication and allied electronic equipment*".

1 Scope

This British Standard gives requirements for properties of phenolic cellulose paper copper-clad laminated sheet, of medium electrical quality.

The standard covers sheet of nominal thicknesses from 0.8 mm to 3.2 mm.

NOTE The title of the British Standard referred to in this standard is given on the inside back cover.

2 Materials and construction

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

2.1 *Insulating base*. Phenolic resin bonded cellulose paper laminate.

2.2 *Metal foil*. Copper, as specified in 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 meets the above requirements before incorporation in the laminate shall be made in accordance with Clause **2.4** of BS 4584-1.

For information only; minimum purity 99.5 %

minimum conductivity 95 % of the value equivalent to a resistivity of 1.7241×10^{-8} Ωm at 20 °C.

3 Marking

It is preferred that each sheet should bear a manufacturer's identification mark that is:

1) black or in some other colour that cannot be confused with red, since red indicates flame retardant grades;

2) repeated at intervals so that no part of the sheet is further than 75 mm from the nearest mark;

3) printed so as to indicate the machine direction of the filler.

NOTE Attention is drawn to the certification facilities offered by BSI; see the inside back cover of this standard.

4 Electrical properties

When the sheet is tested by the methods shown in Table 2, it shall comply with the limits listed therein.

Table 2 — Electrical properties

Property	Test method of BS 4584-1, Clause	Requirement
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**	1 000 MΩ min.
Volume resistivity after damp heat and recovery	**2.1.3.3**	500 MΩ m min.
Surface resistance at 100 °C	**2.1.3.5**	100 MΩ min.
Volume resistivity at 100 °C	**2.1.3.5**	10 MΩ m min.
Permittivity after damp heat, steady state	**2.1.5**	7.0 max.
Loss tangent after damp heat, steady state	**2.1.5**	0.070 max.

5 Non-electrical properties of the copper-clad sheet

5.1 *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 a suitable organic solvent.

5.2 *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 3.

Table 3 — Nominal thicknesses and deviations of metal-clad sheet

Nominal thickness mm		Deviation ± mm
Preferred	**Non-preferred**	
0.8	—	0.09
—	1.0	0.11
—	1.2	0.12
1.6	—	0.14
—	2.0	0.15
2.4	—	0.18
3.2	—	0.20

For any other value of nominal thickness, the deviation shall be that shown in Table 3 for the next greater thickness.

5.3 *Bow*. When the sheet is tested by the method given in Clause **2.2.1** of BS 4584-1, the bow shall not exceed the value given by the formula $d\ (L/1000)^2$ mm, where L is the length of the straight-edge in millimetres and d is as given in Table 4.

Table 4 — d Values for bow

Nominal thickness mm	Copper foil on one side		Copper foil on both sides
	305 g/m^2	610 g/m^2	305 or 610 g/m^2
	d	d	d
0.8 to 1.2	91	106	35
over 1.2 to 1.6	61	76	30
over 1.6 to 1.8	50	63	30
over 1.8 to 3.2	46	53	15

The values shown in Table 4 apply only if length and width are each at least 460 mm.

5.4 *Twist*. When the sheet is tested by the method given in Clause **2.2.3** of BS 4584-1, the twist shall not exceed the value given by the formula $e\ (M/1000)^2$ mm, where M is the length in millimetres of the diagonal of the sheet and e is as given in Table 5.

Table 5 — *e* Values for twist

Nominal thickness mm	Copper foil on one side		Copper foil on both sides
	305 g/m^2	610 g/m^2	305 or 610 g/m^2
	e	*e*	*e*
0.8 to 1.2	18	22	10
over 1.2 to 1.6	13	18	10
over 1.6 to 1.8	9	14	6
over 1.8 to 3.2	7	10	5

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

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

5.6 *Solderability*. When the sheet is tested by the method given in Clause **2.2.9** of BS 4584-1, and in accordance with the times specified below, the soldered area of each specimen shall be covered with a smooth and bright solder coating with not more than traces (approximately 5 %) of scattered imperfections, e.g. small holes or unwetted or de-wetted areas.

(1) Wetting test. *a*. Plate and matt finish material: the specimen shall wet within 2 s.

(2) De-wetting test. *a*. Plate finish material: the specimen shall remain in contact with the molten solder for 5^{+1}_{-0} s.

b. Matt finish material: no test available.

5.7 *Other properties of the copper-clad sheet*. When the sheet is tested by the methods shown in Table 6 it shall comply with the limits therein.

Table 6 — Pull-off and peel strength requirements

Property	Test method of BS 4584-1, Clause	Requirement
Pull-off strength[a]	**2.2.5**	45 N min.
Peel strength after heat shock	**2.2.6.2** Solder temperature 245 ± 2 °C Time of contact 5 s	1.05 kN/m min. No delamination or blistering
Peel strength after dry heat at 100 °C	**2.2.6.3**	1.05 kN/m min. No delamination or blistering
Peel strength after exposure to solvent vapour (trichlorethylene)	**2.2.6.4**	1.05 kN/m min. No delamination or blistering
Peel strength after exposure to simulated plating conditions	**2.2.6.5**	0.6 kN/m min.

[a] This test is not applicable to sheet of nominal thickness less than 1.2 mm.

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

6.1 *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.

6.2 *Other properties of the base material after complete removal of the copper foil*. When the sheet is tested by the method shown in Table 7 it shall comply with the limits listed therein.

Table 7 — Flexural strength requirement

Not applicable to sheet of nominal thickness less than 1.6 mm.

Property	Test method of BS 4584-1, Clause	Requirement
Flexural strength	**2.3.1**	82 MN/m^2 min.

7 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

This standard makes reference to the following British Standard:
BS 4584, *Metal-clad base materials for printed circuits.*
BS 4584-1, *Methods of test.*

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