

System of quality assessment —

Capability detail specification —

Rigid double-sided printed boards with
plated-through holes

ICS 31.180

Committees responsible for this British Standard

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- Association of Contract Electronics Manufacturers
- Federation of the Electronics Industry
- GAMBICA
- Ministry of Defence
- National Supervising Inspectorate
- Printed Circuit Interconnection Federation
- Surface Mounting and Related Technologies (Smart Group) Ltd.

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Foreword

This British Standard has been prepared by Technical Committee EPL/501, Electronic assembly technology.

The BS 123000:2001 series of British Standards is based on draft proposals to revise the EN 123000 series dated 1992 and 1997. These were circulated and voted on in CENELEC, but the CENELEC Technical Board decided not to approve them for publication. Following repeated attempts by the British National Committee to get them published, the Technical Board agreed to grant derogation from standstill to the British National Committee to publish national standards on the basis of the prEN 123000 series (Technical Board decision D106/092).

These standards are published to complement the BS EN 123000 series, which remains current. They will be withdrawn only if they are replaced by revised EN standards. They have been published because they are considered to be an improvement upon the EN series, for the following reasons.

- a) Requirements for modern materials and surface finishes required by the electronics industry have been incorporated.
- b) Reference is made to ANSI/IPC A-600F for many of the inspection criteria. This has been undertaken in response to industry requests.
- c) References to obsolete CECC regulatory documents have been replaced.
- d) Tests and requirements that are no longer considered relevant have been removed.
- e) The UK electronics industry requires standards that are subject to ongoing revision, in order to take account of new European Eco-Directives.

This British Standard is a capability detail specification, based upon the sectional specification, BS 123200. It should be read in conjunction with the generic specification, BS 123000, and the sectional specification, BS 123200.

Users of printed boards procured using this capability detail specification should satisfy themselves that the sample sizes and frequencies are appropriate for the needs of their product. Alternative requirements should be included in the customer detail specification.

ACKNOWLEDGEMENT. Many of the illustrations in this British Standard have been included courtesy of IPC. Moreover, selected requirements from ANSI/IPC A-600F have been incorporated into the requirements of this British Standard. Copies of this and other IPC publications are widely available, but in case of difficulties contact:

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Annex A, Annex B, Annex C, Annex D and Annex E are normative. Annex F and Annex G are informative.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

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 to iv, pages 1 to 35 and a back cover.

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1 Scope

This British Standard specifies the capability qualifying component, its characteristics to be tested, the test methods and conditions to be applied and the requirements to be fulfilled for testing basic and additional capability, in relation to rigid double-sided printed boards with plated-through holes. It is applicable for rigid double-sided printed boards with plated-through holes made with the materials and surface finishes specified in clause 4.

This British Standard is a capability detail specification intended for use with the IECQ system of quality assessment for electronic components.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 2011-2.1Ca (IEC 60068-2-3), *Environmental testing — Part 2.1: Tests — Test Ca — Damp heat, steady state*.

BS 2011-2.1Ta (IEC 60068-2-54), *Environmental testing — Part 2.1: Tests — Test Ta — Soldering — Solderability testing by the wetting balance method*.

BS 4727-1:Group 11 (IEC 60194), *Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms — Part 1: Terms common to power, telecommunications and electronics — Group 11: Printed circuits*.

BS 6221-2:1991 (IEC 60326-2:1990), *Printed wiring boards — Part 2: Methods of test*.

BS 123000:2001, *System of quality assessment — Generic specification — Printed boards*.

BS 123200:2001, *System of quality assessment — Sectional specification — Rigid double-sided printed boards with plated-through holes*.

BS EN 60249-2-1 (IEC 60249-2-1), *Specifications — Part 2-1: Specification for phenolic cellulose paper copper-clad laminated sheet, high electrical quality*.

BS EN 60249-2-2 (IEC 60249-2-2), *Specifications — Part 2-2: Specification for phenolic cellulose paper copper-clad laminated sheet, economic quality*.

BS EN 60249-2-3 (IEC 60249-2-3), *Specifications — Part 2-3: Metal-clad base materials for printed wiring boards — Copper-clad base material — Specification for epoxide cellulose paper copper-clad laminated sheet of defined flammability (vertical burning test)*.

BS EN 60249-2-4 (IEC 60249-2-4), *Specifications — Part 2-4: Specification for epoxide woven glass fabric copper-clad laminated sheet, general purpose grade*.

BS EN 60249-2-5 (IEC 60249-2-5), *Specifications — Part 2-5: Specification No. 5 — Epoxide woven glass fabric copper-clad laminated sheet of defined flammability (vertical burning test)*.

BS EN 60249-2-6 (IEC 60249-2-6), *Specifications — Part 2-6: Specification No. 6 — Phenolic cellulose paper copper-clad laminated sheet of defined flammability (horizontal burning test)*.

BS EN 60249-2-7 (IEC 60249-2-7), *Specifications — Part 2-7: Specification No. 7 — Phenolic cellulose paper copper-clad laminated sheet of defined flammability (vertical burning test)*.

BS EN 61249 (IEC 61249) (all parts), *Materials for interconnection structures*.

BS EN ISO 1463:1982, *Metallic and oxide coatings — Measurement thickness — Microscopical method*.

BS EN ISO 3543:1981, *Metallic and non-metallic coatings — Measurement thickness — Beta backscatter method*.

BS QC 221100, *Radio frequency connectors — RF coaxial connectors with inner diameter of outer conductor 4,13 mm (0,163 in) with screw coupling — Characteristic impedance 50 ohms (Type SMA)*.

ANSI/IPC A-600F, *Acceptability of printed boards*.

3 Terms and definitions

For the purposes of this British Standard the terms and definitions given in BS 4727-1:Group 11, BS 123000 and BS 123200 together with the following apply.

3.1

referee method

test method, where a choice of methods is given, to be used in the case of disputed test data arising from the two methods

4 Capability qualifying component

4.1 General

Test boards to be used as capability qualifying components for basic capability shall:

- be made from one of the copper-clad base materials specified in 4.2, with a base material thickness of (1.6 ± 0.14) mm, and 35 μm copper foil on both sides;
- bear the composite test pattern specified in BS 123200:2001, 9.3 (or equivalent composite test pattern);
- have one of the surface finishes specified by groups 11, 12, 13, 14, 15, 16, 17 or 18 in 4.3.

Test boards to be used as modified capability qualifying components for the demonstration of additional capability shall be as specified in clause 7.

4.2 Base materials

For the demonstration of basic capability, the base materials specified in Table 1 shall be used and shall conform to the performance requirements specified in Table 4, Table 5, Table 6, Table 7 and Table 8.

For the demonstration of additional capability, if base materials other than those specified in Table 1 are used, they shall be detailed in the manufacturer's capability manual. Base materials used for the demonstration of additional capability shall conform to the performance requirements specified in Table 4, Table 5, Table 6, Table 7 and Table 8 unless they have inherent electrical or physical characteristics that prevent the performance requirements from being met, in which case they shall conform to the criteria detailed in the relevant base material specification.

Table 1 — Base materials

Material group designation	Material specified in	Base material type	Grade	Base material thickness range mm	Copper thickness μm
A	BS EN 60249-2-1	Phenolic paper	High electrical	0.2 to 6.4	18, 35, 70, 105
	BS EN 60249-2-2	Phenolic paper	Economic		
	BS EN 60249-2-3	Epoxide paper	Defined flammability (vertical)		
	BS EN 60249-2-6	Phenolic paper	Defined flammability (horizontal)		
	BS EN 60249-2-7	Phenolic paper	Defined flammability (vertical)		
B	BS EN 60249-2-4	Epoxide woven glass	General purpose	0.2 to 6.4	18, 35, 70, 105
	BS EN 60249-2-5	Epoxide woven glass	Defined flammability (vertical)		

4.3 Surface finishes

4.3.1 Metallic finishes

4.3.1.1 General

Metallic finishes shall be as specified in Table 2.

Table 2 — Metallic finishes

Finish group designation	Surface finish	Abbreviation	Revalidation period ^a
11	Bare copper	Cu	1 month
12	Copper with solderable organic surface protection	Cu (osp)	6 months
13	Copper with oxide	Cu (CuO)	Not applicable
14	Tin, Tin-Lead	Sn, SnPb	12 months
15	Tin-Lead (fused)	SnPb (f)	12 months
16	Tin-Lead (dipped and levelled)	SnPb (dl)	18 months
17	Tin-Lead (roller coated)	SnPb (rt)	3 months
18	Immersion gold over electroless nickel	AuNi (smt)	3 months
19	Not assigned	—	—
20	Not assigned	—	—
21	Specimen K ^b 5 µm, gold-plated on copper; all other specimens using finish group 11 to 18 ^c	5 AuCu	—
22	Specimen K ^b 0.7 µm, gold-plated on nickel; all other specimens using finish group 11 to 18 ^c	0.7 AuNi	—
23	Specimen K ^b 2.5 µm, gold-plated on copper; all other specimens using finish group 11 to 18 ^c	2.5 AuCu	—
24	Specimen K ^b 2.5 µm, gold-plated on nickel; all other specimens using finish group 11 to 18 ^c	2.5 AuNi	—

^a See BS 123000:2001, 4.4.
^b The specimens are defined in BS 123200:2001, Figure 1 and Figure 2.
^c See clause 5.

The demonstration of metallic group finishes 21, 22, 23 or 24 shall be combined with a finish from groups 11, 12, 13, 14, 15, 16, 17 or 18. Each claimed combination of metallic finishes shall be tested separately. Selective and non-selective finishes of the same material, where claimed, shall be demonstrated separately.

4.3.1.2 Accelerated ageing

The ability of finish groups 11, 12, 13, 14, 15, 16, 17 or 18 to solder after extended or adverse storage conditions shall be demonstrated using accelerated ageing. This test shall be carried out on those finishes where accelerated ageing is claimed.

NOTE Each finish that conforms to the requirements of the ageing test is highlighted by the inclusion of an asterisk (*) adjacent to that finish in the manufacturer's abstract of capability as published in the qualified product list.

4.3.2 Organic finishes

Organic finishes, where claimed, shall be as specified in Table 3.

Table 3 — Organic finishes

Finish group designation	Organic finish	Abbreviation
a	Dry film solder mask	DSM
b	Wet resist solder mask	WSM
c	Liquid photopolymer solder mask	LSM
d	Marking ink	MI
e	Conductive ink	CI

The demonstration of organic finish groups a, b, c or d shall be over a finish from groups 11, 12, 13, 14, 15, 16, 17 or 18. All claimed types of solder resist shall be tested separately.

5 Range of capability approval

Capability approval granted on the testing of one variant shall be deemed to be valid within the limits specified in BS 123000:2001, **5.5** for:

- a) metal-clad base materials within one group designation;
- b) all base material thicknesses and all foil thicknesses of the material in accordance with **4.2**.

NOTE In some cases, a demonstration of one metallic surface finish may also be taken as being representative of others, as listed below:

- 1) finish group 11 covers finish group 11 only;
- 2) finish group 12 covers finish group 11 and 12;
- 3) finish group 13 covers finish group 11 and 13;
- 4) finish group 14 covers finish group 11 and 14;
- 5) finish group 15 covers finish group 11 and 15;
- 6) finish group 16 covers finish group 11 and 16;
- 7) finish group 17 covers finish group 17 only;
- 8) finish group 18 covers finish group 18 only;
- 9) finish group 21 covers finish group 21 only;
- 10) finish group 22 covers finish group 22 and 24;
- 11) finish group 23 covers finish group 21 and 23;
- 12) finish group 24 covers finish group 24 only.

6 Capability test programme

6.1 General

Capability shall be demonstrated using nine composite test patterns of one variant from each material group claimed. The test schedule and performance shall be in accordance with Table 4. Each separate process shall be assessed within the test programme.

In all cases there shall be no failures.

6.2 Other metallic surface finishes

If claimed, metallic surface finishes, other than those defined in **4.3.1**, shall be demonstrated by the manufacture and testing of three composite test patterns, plus sufficient extra A and H specimens to meet the requirements of Table 5 and Table 6. The maximum active board size for the finish shall be demonstrated. The test schedule and performance shall be in accordance with Table 5 and Table 6.

NOTE See also clause 7.

6.3 Organic surface finishes

Each claimed organic surface finish, as designated in **4.3.2**, shall be demonstrated by the manufacture and testing of three composite test patterns using the pattern specified in Annex A for marking inks or Annex B for solder masks. The test schedule and performance shall be in accordance with Table 7.

6.4 External bonded heatsinks

Where claimed, each bonded heatsink and adhesive system shall be demonstrated by the manufacture of three composite test patterns using the pattern specified in Annex C. The test schedule and performance shall be in accordance with Table 8.

6.5 Demonstration of impedance control

Special capability qualifying components shall be constructed in accordance with Figure E.1, configured as either a “stripline” or a “microstrip”. Demonstrations shall be made for the following variants, as required and defined by the approved manufacturer:

- a) each base material type (e.g. woven glass epoxide);
- b) each impedance geometry (microstrip, stripline);
- c) each impedance extreme, and a 50 Ω demonstration;
- d) conductor width and lateral separation minimum values;
- e) each metallic surface finish.

Tolerances at 50 Ω and each impedance extreme shall be claimed prior to demonstration, and shall be achieved.

For each solder resist type and thickness claimed, impedance value derating factors shall be declared.

NOTE Impedance control is shown on the Capability Approval certificate as a separate annex.

7 Additional capability

7.1 Maximum active board size

See BS 123000:2001, 5.3.3.

7.2 Plated-through hole diameters

Specimen C (microsection coupon) of the composite test pattern shall be employed:

- a) minimum drilled hole diameter, use 2.0 mm pads;
- b) minimum clearance diameter, use 2.5 mm pads.

7.3 Maximum aspect ratio

The maximum aspect ratio shall be the nominal base material thickness for the maximum number of layers divided by the minimum drilled hole diameter.

7.4 Minimum conductor width and spacing

Specimen F of the composite test pattern shall be modified to provide an additional five conductors and four spacings, each of the claimed minimum value. If an initial foil thickness of less than 35 μm is used for this demonstration, the thickness used shall be declared.

7.5 Metallic conductor finishes

NOTE Manufacturers are permitted to demonstrate conductor finishes other than those detailed in 4.3.1.

The finish shall be demonstrated in accordance with Table 6 and shall be detailed in the manufacturer’s capability manual.

8 Traceability

Traceability of all specimens to the original product shall be maintained. The method used to identify individual test specimens shall not prejudice the test result.

Table 4 — Capability approval test schedule and performance requirements — General

Test	Test no. ^a	Specimen of CTP ^b	Test conditions	Requirements	Notes
General examination					
<i>Visual examination</i>					
Conformity and identification	1	All CQCs		In accordance with ANSI/IPC A-600F (see Annex D).	
Appearance and workmanship	1a	All CQCs		In accordance with ANSI/IPC A-600F (see Annex D).	
Plated-through holes	1a	All CQCs		In accordance with ANSI/IPC A-600F (see Annex D).	
Conductor defects	1b	All CQCs	Where necessary, this shall be verified by dimensional examination using BS 6221-2:1991, test 2a.	In accordance with ANSI/IPC A-600F (see Annex D). (Indentations in conductors, other than those in edge board contacts, shall not be a reason for rejection.)	
Particles between conductors	1b or 1c	All CQCs	Where necessary, this shall be verified by dimensional examination using BS 6221-2:1991, test 2a.	In accordance with ANSI/IPC A-600F (see Annex D).	
Edge connector defects	2a	All specimens K		In accordance with ANSI/IPC A-600F (see Annex D).	

Table 4 — Capability approval test schedule and performance requirements — General (*continued*)

Test	Test no. ^a	Specimen of CTP ^b	Test conditions	Requirements	Notes
General examination (<i>continued</i>)					
<i>Dimensional examination</i>					
Board dimensions	2	All CQCs	The thickness measurement of the printed board shall exclude the surface finishes.	Dimensions and tolerances shall conform to the capability qualifying component outline dimensions.	
Flatness	12a	All CQCs		In accordance with ANSI/IPC A-600F (see Annex D).	
Board thickness in the zone of edge board contacts	2	All specimens K		The board thickness in the zone of edge board contacts shall be (1.6 ± 0.2) mm.	
Holes	2	All CQCs		The hole diameter shall conform to BS 123200:2001, 9.3 , or shall be as claimed, with a tolerance of ± 0.1 mm.	
Misalignment of hole and land	1a, 2a	All CQCs	Conductor defects and particles between conductors shall be disregarded when evaluating conductor width and spacing — see “visual examination”.	In accordance with ANSI/IPC A-600F (see Annex D).	
Conductor width	2	All specimens F		Conductor widths greater than or equal to 0.25 mm shall not deviate from nominal values by more than +0.08 mm or –0.05 mm. If the nominal conductor width is less than 0.25 mm, the actual conductor width shall be within the manufacturer’s claimed tolerance.	
Spacing between conductors	2	All specimens F		If the nominal conductor spacing is 0.5 mm, the actual conductor spacing shall be not less than 0.42 mm. If the nominal conductor spacing is 0.25 mm, the actual conductor spacing shall be not less than 0.17 mm. If the nominal conductor spacing is less than 0.25 mm, the actual conductor spacing shall be within the manufacturer’s claimed tolerance.	
					Artwork for composite test patterns may need etch factor allowance adjustments in order to meet these requirements.