

Printed wiring boards —

Part 9: Specification for flexible multilayer boards with through connections

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Electronic Components Standards Policy Committee (ECL/-) to Technical Committee ECL/19 upon which the following bodies were represented:

- Association of the Electronics, Telecommunications and Business Equipment Industries (EEA)
- British Telecommunications plc
- Electrical and Electronic Insulation Association (BEAMA Ltd.)
- Electronic Components Industry Federation
- ERA Technology Ltd.
- GAMBICA (BEAMA Ltd.)
- Institute of Metal Finishing
- Ministry of Defence
- National Supervising Inspectorate
- Printed Circuit Interconnection Federation

This British Standard, having been prepared under the direction of the Electronic Components Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 30 September 1991

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The following BSI references relate to the work on this standard:
Committee reference ECL/19
Draft for comment 89/33882 DC

ISBN 0 580 19942 8

Amendments issued since publication

Amd. No.	Date	Comments

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National foreword

This Part of BS 6221 has been prepared under the direction of the Electronic Components Standards Policy Committee. It is identical with IEC Publication 326-9:1991, “*Printed boards — Part 9: Specification for flexible multilayer printed boards with through connections*”, published by the International Electrotechnical Commission (IEC).

Cross-references

International Standard	Corresponding British Standard
	BS 2011 <i>Environmental testing</i>
IEC 68-2-3:1969	Part 2.1Ca:1977 <i>Test Ca. Damp heat, steady state</i> (Identical)
IEC 68-2-20:1979	Part 2.1T:1981 <i>Test T. Soldering</i> (Identical)
IEC 68-2-38:1974	Part 2.1Z/AD:1977 <i>Test Z/AD. Composite temperature/humidity cyclic test</i> (Identical)

The Technical Committee has reviewed the provisions of IEC 194, IEC 321 and IEC 326-2, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

IEC 326-2:1990 replaces IEC 326-2:1976. BS 6221 “*Printed wiring boards*” Part 2:1991 “*Methods of test*” is identical with IEC 326-2:1990 incorporating amendments Nos. 1 and 2.

IEC 326-3:1991 replaces IEC 326-3:1980. BS 6221 “*Printed wiring boards*” Part 3:1991 “*Guide for the design and use of printed wiring boards*” is identical with IEC 326-3:1991.

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 38, 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.

Introduction

IEC Publication 326 relates to printed boards irrespective of their method of manufacture, when they are ready for mounting of the components.

It is divided into separate parts covering information for the designer, recommendations for the specification writer, test methods and requirements for the various types of printed boards, for example single and double sided, multilayer and flexible printed boards.

1 Scope

This standard relates to flexible multilayer printed boards with through connections irrespective of their method of manufacture. It is intended as a basis on which agreements between purchaser and vendor can be made. This standard defines the characteristics to be assessed, the test methods to be used, and it establishes uniform requirements for judging properties and dimensions. The term «relevant specification» used herein refers then to such agreements. This specification is not applicable to flat cables.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 68-2-3:1969, *Environmental testing — Part 2: Tests — Test CA: Damp heat, steady state.*

IEC 68-2-20:1979, *Environmental testing — Part 2: Tests — Test T: Soldering.*

IEC 68-2-38:1974, *Environmental testing — Part 2: Tests — Test Z/AD: Composite temperature/humidity cyclic test.*

IEC 194:1988, *Terms and definitions for printed circuits.*

IEC 321:1970, *Guidance for the design and use of components intended for mounting on boards with printed wiring and printed circuits.*

IEC 326-2:1976, *Printed boards — Part 2: Test methods.*

IEC 326-3:1980, *Printed boards — Part 3: Design and use of printed boards.*

3 General

The following tables contain all important characteristics and make reference to the appropriate tests to verify these characteristics.

Unless otherwise specified, all of the tests listed in Table 1 shall be carried out. Where the relevant specification specifically claims additional characteristics which require additional tests, the relevant tests shall be selected from Table 2.

Where additional details for a test shall be specified in the relevant specification, this is indicated by an asterisk in the relevant column. These details shall then be specified in accordance with IEC Publication 326-2.

The tables are not intended to prescribe a test sequence; the tests may be carried out in any sequence, unless otherwise specified.

The sample quantity shall also be specified by the relevant specification.

4 Test specimens

The tests shall preferably be carried out on production boards. Where the use of test coupons is agreed upon, they shall be prepared in accordance with IEC Publication 326-2, Sub-clause 4.2. A suitable composite test pattern is shown in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f and Figure 1g.

5 Relevant specification

The relevant specification shall contain all information necessary to define the printed board clearly and completely. The recommendations given in IEC Publication 326-3 shall be followed.

Care should be taken to avoid unnecessary prescriptions. Permissible deviations shall be stated where necessary. Nominal values without tolerance or simple maxima or minima shall be given where sufficient. Where precise specifications are necessary for certain areas or parts of the printed board only, they shall be applied and restricted to those areas or parts.

If there are several possibilities of presentation or of tolerance classes, etc., the selections given in IEC Publication 326-3 shall be applied.

6 Characteristics of printed boards

(See Table 1 and Table 2.)

Table 1 — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC Publication 326-2	Additional test details to be specified in the relevant specification	Specimen of composite test pattern	Requirements	Remarks
6.1 General examination					
6.1.1 Visual examination					
6.1.1.1 Conformity and identification	1	^a	Complete printed board or composite test pattern	Pattern, marking, identification, material and finishes shall comply with the relevant specification. There shall be no apparent defects	
6.1.1.2 Appearance and workmanship	1a		Complete printed board or composite test pattern	The boards shall appear to have been processed in a careful and workmanlike manner, in accordance with good current practice	
6.1.1.3 Plated-through holes			Complete printed board or composite test pattern	Plated-through holes shall be clean and free from inclusions of any sort that could affect component insertion and solderability Total area of the voids shall not exceed 10 % of the total wall area. The largest dimension shall not exceed 25 % of the hole circumference in the horizontal plane and 25 % of the thickness of the board in the vertical plane Plated-through holes shall have no plating voids at the interface of the hole wall and the conductive pattern or internal layer ring The interface shall be considered to extend into the hole below the surface of the board at a distance of one and a half times the total copper thickness on the surface or to be two times the inner layer copper thickness at level of contact ring	

^a See the third paragraph of Clause 3.

Table 1 — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC Publication 326-2	Additional test details to be specified in the relevant specification	Specimen of composite test pattern	Requirements	Remarks
6.1.1.4 <i>Board edges</i> 6.1.1.5 <i>Eyelets</i> 6.1.1.6 <i>Bonding conductor to substrate</i>	1c			Resin smear at the edge of the clad-copper and the continuous plated copper is permitted provided the smear does not interrupt electrical continuity	
	1a		Complete printed board or composite test pattern	There shall be no circumferential cracks of the copper, or circumferential separation of the copper from the wall in the plated-through hole Holes with plating voids shall not exceed 5 % of the total number of plated-through holes The edges of the board and internal cut-outs shall be clean cut without tears or nicks	
	1a		Complete printed board	Eyelets shall be firmly secured. Plated eyelets shall not have exposed base metal. Eyelets shall not have cracked flanges. There shall be no damage to conductors or substrate around the eyelet There shall be no separation of the conductors from the substrate by apparent blister or wrinkles other than those permitted in the material specification	

Table 1 — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC Publication 326-2	Additional test details to be specified in the relevant specification	Specimen of composite test pattern	Requirements	Remarks
6.1.1.7 <i>Bonding cover layer to substrate and pattern</i>	1 1a		Complete printed board	The bonding shall appear to be complete and uniform. Minor delaminations are permitted in the following positions: a) at random locations away from the conductors. Such delaminations shall have an area not exceeding 5 mm ² each, and shall be more than 0,5 mm from the edges; b) along conductor edges. Such delaminations shall not infringe upon the design spacing between the conductors by more than 20 % of the design width by visual estimation. (See Figure 2.) There shall be a minimum of continuous bonding width of 0,5 mm between adjacent conductors. There shall be no delamination with conductor spacings less than 0,5 mm	
6.1.1.8 <i>Conductor defects</i>	1b		Complete printed board or composite test pattern	There shall be no cracks or breaks. Imperfections such as voids or edge defects are permissible, provided that the conductor width or leakage path between conductors is not reduced by more than specified in the relevant specification, for example 20 % or 35 %. (See Figure 3.)	Where necessary this shall be verified by dimensional examination using test 2a
6.1.1.9 <i>Particles between conductors</i>	1b or 1c		Complete printed board or composite test pattern	Residual metallic particles are permissible provided that the leakage path is not reduced by more than 20 % or to less than the distance required for the circuit voltage	Where necessary this shall be verified by dimensional examination using test 2a

Table 1 — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC Publication 326-2	Additional test details to be specified in the relevant specification	Specimen of composite test pattern	Requirements	Remarks
6.1.2 Dimensional examination					
6.1.2.1 Board dimensions	2		Complete printed board or composite test pattern	Dimensions and tolerances shall comply with the relevant specification. The nominal board thickness shall comply with the relevant specification	
6.1.2.2 Board thickness in the zone of edge board contacts	2		K	The total board thickness and the tolerances shall comply with the relevant specification	Total board thickness and tolerances shall be specified in accordance with IEC Publication 321
6.1.2.3 Holes	2		Complete printed board or composite test pattern	Nominal diameters and tolerances of mounting holes and of component holes shall comply with the relevant specification The nominal diameter of plated through holes used for through connections only shall comply with the relevant specification	A recommended range of hole sizes and tolerances is given in IEC Publication 326-3 Accurate measurement is not necessary since deviations are not important
6.1.2.4 Access holes	2		Complete printed board or composite test pattern	Registration of an access hole including influence of adhesive flow in the coverlayer with relation to the relevant land on the base material shall be such that any overlapping will not reduce The effective land dimensions to less than the minimum stated in the relevant specification. (See Figure 4.)	Recommended minimum effective land at any point around the hole: — plain hole 0,15 mm. — plated-through hole 0,10 mm
6.1.2.5 Slots, notches	2		Complete printed board or composite test pattern	The dimensions shall comply with the relevant specification	

Table 1 — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC Publication 326-2	Additional test details to be specified in the relevant specification	Specimen of composite test pattern	Requirements	Remarks
6.1.2.6 <i>Conductor width</i>	2 2a		Complete printed board or composite test pattern	The width shall comply with any specific dimensions given in the relevant specification Imperfections such as voids or edge defects are permissible, provided the conductor width is not reduced by more than specified in the relevant specification, for example 20 % or 35 %. The length L of a defect shall not be greater than the conductor width S or 5 mm (0,2 in), whichever is the smaller. (See Figure 3.)	If no tolerances are stated, the coarse deviation given in IEC Publication 326-3 shall apply
6.1.2.7 <i>Spacing between conductors</i>	2		Complete printed board or composite test pattern	The spacing shall comply with any specific dimensions given in the relevant specification	
6.1.2.8 <i>Misalignment of hole and land</i>	1a 2a		Complete printed board or composite test pattern	There shall be no interruption of the land. There shall be no breakout at the junction of the land and the conductor	
6.1.2.9 <i>Positional tolerance of hole centers</i>			Complete printed board or composite test pattern	The hole centers shall be within any deviation specified in the relevant specification	
6.2 Electrical tests					
6.2.1 Resistance					
6.2.1.1 <i>Change in resistance of plated-through holes, thermal cycling</i>	3c		D	The requirements of the relevant specification shall be met	Not applicable to polyester materials

Table 1 — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC Publication 326-2	Additional test details to be specified in the relevant specification	Specimen of composite test pattern	Requirements	Remarks
6.2.1.2 <i>Eyelets</i>				Under consideration	
6.2.1.3 <i>Short circuit</i>	4a	a	Complete printed board or composite test pattern		
6.2.2 <i>Insulation resistance</i>	6	a		The insulation resistance shall comply with the relevant specification	Insulation resistance shall be measured before and after environmental conditioning and at elevated temperature as specified in the relevant specification
6.2.2.1 <i>Preconditioning</i>	18a	a			
6.2.2.2 <i>Measurement at standard atmospheric conditions</i>					
6.2.2.2.1 <i>External layers</i>	6a	a	E or J		
6.2.2.2.2 <i>Internal layers</i>	6b	a	E or J		
6.2.2.2.3 <i>Between layers</i>	6c	a	M		
6.2.2.3 <i>Conditioning IEC Publication 68-2-3 or Publication 68-2-38</i>					Applicable conditioning to be specified in the relevant specification
6.2.2.4 <i>Measurement at elevated temperature</i>					Not applicable to polyester materials
6.2.2.4.1 <i>Surface layers</i>	6a	a	E or J		
6.2.2.4.2 <i>Internal layers</i>	6b	a	E or J		
6.2.2.4.3 <i>Between layers</i>	6c	a	M		
^a See the third paragraph of Clause 3.					

Table 1 — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC Publication 326-2	Additional test details to be specified in the relevant specification	Specimen of composite test pattern	Requirements	Remarks
6.3 Mechanical tests					
6.3.1 Peel strength					
6.3.1.1 Conductor to base material			G	The peel strength shall comply with the relevant specification	Conductors without cover layer
6.3.1.2 Measurement at standard atmospheric conditions	10a	a			
6.3.1.3 Measurement at elevated temperature	10b	a			Not applicable to polyester materials
6.3.2 Pull-strength					
6.3.2.1 Pull-off strength, lands with plain holes	11a	a	C	The land shall not become detached during soldering operation. The pull-off strength shall not be less than the value specified in the relevant specification	A flexible specimen needs to be supported by a rigid board
6.3.3 Pull-out strength					
6.3.3.1 Landless plated-through holes	11b	a	B	The pull-out strength shall be not less than the value specified in the relevant specification	
6.4 Miscellaneous tests					
6.4.1 Plating finishes					
^a See the third paragraph of Clause 3.					

Table 1 — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC Publication 326-2	Additional test details to be specified in the relevant specification	Specimen of composite test pattern	Requirements	Remarks
6.4.1.1 <i>Adhesion of plating, tape method</i>	13a		K	There shall be no evidence of plating adhering to the tape after removal from the conductor, other than resulting from overhang	
6.4.1.2 <i>Thickness of plating, contact areas</i>	13f	^a	K or printed board	The thickness shall comply with the relevant specification	
6.4.2 <i>Solderability</i>	14a	^a	H	The conductors shall be covered with a smooth and bright solder coating with not more than traces (approximately 5 %) of scattered imperfections such as pinholes, unwetted or dewetted areas. The imperfections shall not be concentrated on one area of the surface	Not applicable to polyester materials. For polyimide materials, appropriate drying to protect the soldering may be necessary
A) When the use of a nonactivated flux is agreed between purchaser and vendor					Testing shall be carried out in the as received conditions or after accelerated ageing as agreed upon between purchaser and vendor
6.4.2.1 <i>As received condition</i>				Wetting: The specimen shall wet within 3 s. When temporarily protective coating intended to preserve the wettability is used the specimen shall wet within 4 s Dewetting: The specimen shall remain in contact with the molten solder for 5 s minimum and 6 s maximum and shall not have dewetted	Non activated flux as specified in IEC Publication 68-2-20

^a See the third paragraph of Clause 3.

Table 1 — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC Publication 326-2	Additional test details to be specified in the relevant specification	Specimen of composite test pattern	Requirements	Remarks
6.4.2.2 <i>After accelerated ageing</i> B) When the use of an activated flux is agreed between purchaser and vendor 6.4.2.3 <i>As received condition and after accelerated aging</i>				Wetting: The specimen shall wet within 4 s. Dewetting: The specimen shall remain in contact with the molten solder for 5 s minimum and 6 s maximum and shall not have dewetted For both, wetting and dewetting (if applicable), the holes shall comply with the well soldered holes of Figure 5 as far as possible with the thin material used for flexible printed boards For boards with or without solderable temporarily protective coating: Wetting: The specimen shall wet within 3 s Dewetting: The specimen shall remain in contact with the molten solder for 5 s minimum and 6 s maximum and shall not have dewetted For both, wetting and dewetting (if applicable) the holes shall comply with the well soldered holes of Figure 5, as far as possible with the thin material used for flexible printed boards	Activated flux (0,2 %) as specified in IEC Publication 68-2-20