

Printed wiring boards

Part 2. Methods of test

Cartes imprimées
Partie 2. Méthodes d'essai

Schaltkarten
Teil 2. Prüfverfahren

Committees responsible for this British Standard

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- British Telecommunications plc
- Electronic and Electronic Insulation Association (BEAMA Ltd.)
- Electronic Components Industry Federation
- Electronic Engineering Association
- ERA Technology Ltd.
- GAMBICA (BEAMA Ltd.)
- Institute of Circuit Technology
- Institute of Metal Finishing
- Institution of Production Engineers
- Ministry of Defence
- National Supervising Inspectorate
- Printed Circuit Association
- Telecommunication Engineering and Manufacturing Association (TEMA)

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NOTE. This amendment puts into effect the changes made by the identical Amendment No. 1 published in 1992 to IEC 326-2 : 1990.

Revised text

AMD 7515
January 1993

National foreword

In line 3, after the title of IEC 326-2, insert ' , as amended by Amendment No. 1 published in June 1992'.

AMD 7515
January 1993

Contents

After the entry for figure 11 insert the following new entry.

'12 Examples of typical test coupons'

AMD 7515
January 1993

Page 44

Add, after subclause 9.2.6.4, the following new subclause:

9.2.7 Test 19g: Thermal stress, vapour phase solder simulation

9.2.7.1 Object

To determine the resistance of printed boards to thermal stress created during vapour phase solder reflow operations.

NOTE - This test is suitable as a reference test for printed boards intended to be used for surface mounting components.

9.2.7.2 Specimen

The test specimen may be a printed board or a test coupon as agreed between manufacturer and user, and shall contain sufficient plated-through holes, conductors and surface mount land patterns to perform the evaluations shown in clause 6. Some typical examples of appropriate test coupons are shown in figure 12.

The test specimen shall be agreed between manufacturer and user and shall be mounted as specified in the relevant specification.

9.2.7.3 *General description of the test*

The level of thermal stress on the test specimen depends on the boiling temperature of the selected fluorinated chemical, dwell time in the vapour phase and the number of test cycles. The temperature of the vapour in a vapour phase soldering process is precisely known.

Either static or in-line exposure to the vapour may be used and shall be agreed between manufacturer and user.

9.2.7.3.1 *Static exposure*

The test specimen shall be suspended horizontally and lowered into the vapour of fluorinated chemical.

9.2.7.3.2 *In-line exposure*

The test specimen shall be positioned on the appropriate carrier, i.e. conveyor, tray, basket, etc., in a flat horizontal position and moved into the vapour of fluorinated chemical. Any type of automated equipment may be used.

9.2.7.4 *Preparation of the test specimen*

The test specimen shall be pre-conditioned for (60 ± 10) min according to test 18b: Pre-conditioning, at 125°C , unless otherwise specified in the relevant specification.

9.2.7.5 *Procedure*

The test specimen shall be coated with a flux or a solder paste with flux as defined in the relevant specification. The coated test specimen shall be baked for (15 ± 2) min at $(100 \pm 2)^\circ\text{C}$ or as recommended by the flux or paste manufacturer, to evaporate the flux solvent.

The test specimen shall be allowed to return to room temperature. If the test is not to be performed within 4 h, the specimen shall be kept in a desiccator.

The test specimen shall be mounted in a suitable holder for use in the static procedure and shall be lowered into the vapour phase section of the fluorinated chemical maintained at $(215 \pm 5)^\circ\text{C}$ for the time specified in the relevant specification.

Or:

The test specimen shall be positioned on the in-line carrier and moved into vapour phase section of the fluorinated chemical maintained at $(215 \pm 5)^\circ\text{C}$ for the time specified in the relevant specification.

If the relevant specification requires multiple cycling, repeat the procedure again.

9.2.7.6 *Final examination*

9.2.7.6.1 *Material defects*

Material defects shall be examined visually. Defects shall not be considered that are located within 2,5 mm of the test specimen edge.

Material defect limits for acceptance shall be specified in the relevant specification.

9.2.7.6.2 *Microsection*

Microsection of plated-through holes shall be made according to test 15b: Microsection.

Plated-through holes defect limits for acceptance shall be specified in the relevant specification.

9.2.7.6.3 *Peel strength*

The peel strength of conductors shall be measured before and after vapour phase exposure using test 10: Peel strength.

Peel strength requirements after thermal stress or variation between initial and final values shall be specified in the relevant specification.

9.2.7.6.4 *Pull-off strength*

Pull-off strength shall be measured for surface mount lands before and after vapour phase exposure using test X (under consideration).

Pull-off strength values after thermal stress or variation between initial and final values shall be specified in the relevant specification.

9.2.7.7 *Details to be specified*

- a) Specimen to be tested;
- b) static or in-line procedure;
- c) specimen mounting requirements;
- d) boiling temperature if different from $(215 \pm 5) ^\circ\text{C}$;
- e) type of flux or solder paste;
- f) number of cycles;
- g) material requirements;
- h) plated-through holes requirements;
- i) peel strength requirements;
- j) pull-off strength requirements;
- k) any deviation from the standard test method.

AMD 7515
January 1993

Add, after figure 11, the following new figure 12:

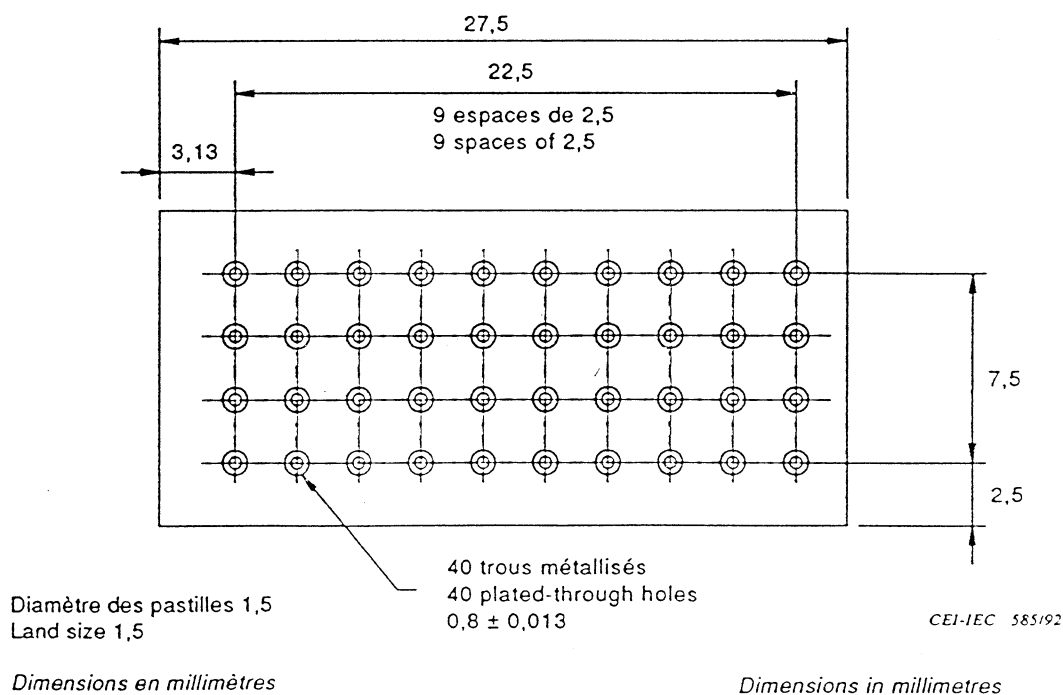
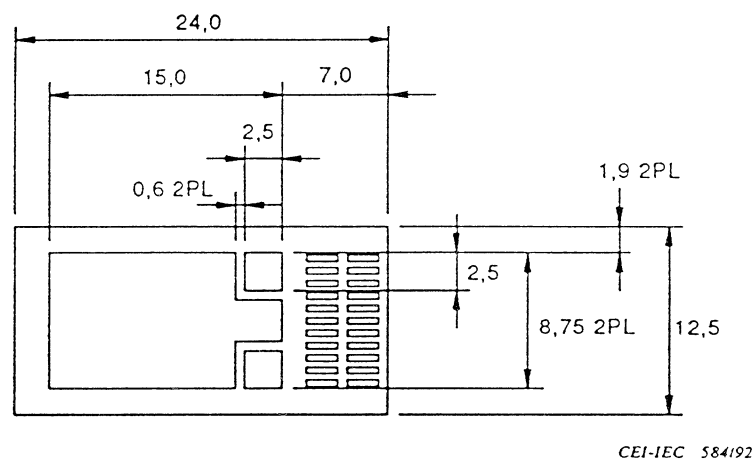
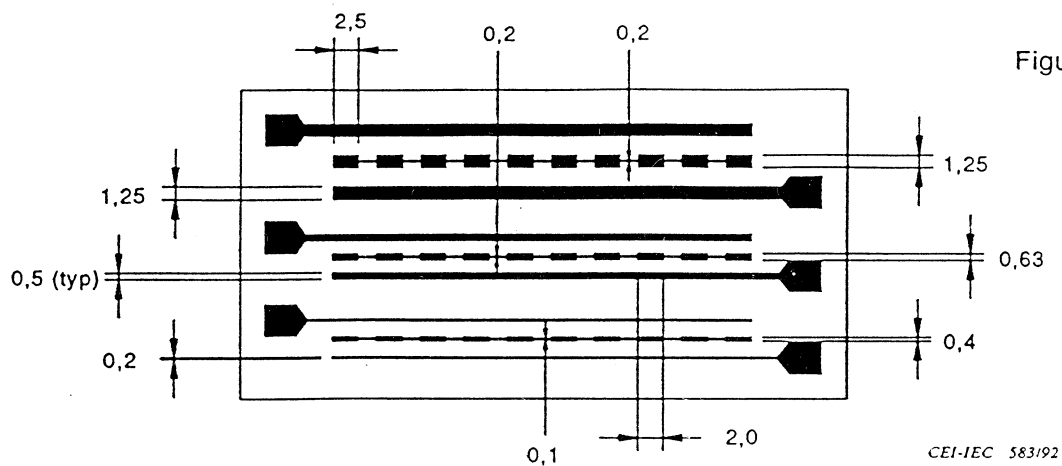


Figure 12 – Exemples des éprouvettes typiques
Examples of typical test coupons

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National foreword

This Part of BS 6221, prepared under the direction of the Electronic Components Standards Policy Committee, is identical with IEC publication 326-2 : 1990, 'Printed boards, Part 2 : Test methods', published by the International Electrotechnical Commission (IEC). It supersedes BS 6221 : Part 2 : 1982, which is withdrawn. IEC publication 326-2 : 1990 supersedes IEC 326-2A : 1980 and IEC 326-2B : 1982.

Cross-references

International standard	Corresponding British Standard
IEC 68-2-3 : 1969	BS 2011 Environmental testing Part 2.1 Ca : 1977 Test Ca. Damp heat, steady state (Identical)
IEC 68-2-20 : 1979	Part 2.1T : 1981 Test T : Soldering (Identical)
IEC 68-2-30 : 1980	Part 2.1Db : 1981 Test Db and guidance : Damp heat, cyclic (12 + 12 hour cycle) (Identical)
IEC 97 : 1970	BS 5830 : 1979 Specification for grid system for printed circuits (Identical)
IEC 326-4 : 1980	BS 6221 Printed wiring boards Part 4 : 1982 Method for specifying single and double sided printed wiring boards with plain holes (Identical)
IEC 326-5 : 1980	Part 5 : 1982 Method for specifying single and double sided printed wiring boards with plated through holes (Identical)
IEC 326-6 : 1980	Part 6 : 1982 Method for specifying multilayer printed wiring boards (Identical)
IEC 695-2-1 : 1980	BS 6458 Fire hazard testing for electrotechnical products Section 2.1 : 1984 Glow-wire test (Identical)
IEC 695-2-2 : 1980	Section 2.2 : 1984 Needle-flame test (Identical)
ISO 1463 : 1982	BS 5411 Methods of test for metallic and related coatings Part 5 : 1984 Measurement of local thickness of metal and oxide coatings by the microscopical examination of cross-sections (Identical)
ISO 3448 : 1975	BS 4231 : 1982 Classification for viscosity grades of industrial liquid lubricants (Identical)
ISO 6743-0 : 1981	BS 6413 Lubricants, industrial oils and related products (class L) Part 0 : 1983 Classification (general) (Identical)

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

PRINTED BOARDS

Part 2: Test Methods

1. Introduction

IEC Publication 326 relates to printed boards, irrespective of their method of manufacture, when they are ready for mounting 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, e.g. single- and double-sided, multilayer and flexible printed boards.

1.1 *Purpose of Part 2*

IEC Publication 326-2 contains fundamental information on test methods and procedures including environmental conditioning for printed boards.

It is intended to be used in those cases where a detail specification has to be prepared, so as to achieve uniformity and reproducibility in the test methods and procedures for the testing of printed boards.

The requirements for the dimensions, properties and performance of printed boards are not covered by this Part 2 of the publication. The detail specification for the board under consideration specifies the tests to be applied and the permissible performance limits.

1.2 *Contents of Part 2*

The tests are grouped and numbered accordingly.

To facilitate reference to the tests, to retain consistency of presentation and to provide for future expansion, each test is identified by a number and a lower-case letter.

Note.- The test numbers have no significance with respect to an eventual test sequence. They are intended only to identify a test for reference purposes.

A list of all test methods included in this publication is given in Annex A. This annex will be reissued whenever new tests are introduced.

1.3 *Associated IEC publications*

This standard shall be used in conjunction with the following IEC publications:

68: Environmental testing - (Previously: Basic environmental testing procedures).

68-2-3 (1969): Part 2: Tests - Test Ca: Damp heat, steady state.

68-2-20 (1979): Test T: Soldering.

68-2-30 (1980): Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle).

97 (1970): Grid system for printed circuits.

194 (1975): Terms and definitions for printed circuits.

249-1 (1982): Base materials for printed circuits, Part 1: Test methods.

326-1 (1984): Printed boards, Part 1: General information for the specification writer.

326-3 (1980): Part 3: Design and use of printed boards.

326-4 (1980): Part 4: Specification for single and double sided printed boards with plain holes.

326-5 (1980): Part 5: Specification for single and double sided printed boards with plated-through holes.

326-6 (1980): Part 6: Specification for multilayer printed boards.

454: Specifications for pressure-sensitive adhesive tapes for electrical purposes.

454-3-1 (1976): Part 3: Specifications for individual materials. Sheet 1: Requirements for plasticized polyvinyl chloride with non-thermosetting adhesive.

695-2-1 (1980): Fire hazard testing, Part 2: Test methods. Glow-wire test and guidance.

695-2-2 (1980): Needle-flame test.

Other publications quoted:

ISO Standard 1463 (1982): Metallic and oxide coatings - Measurement of coating thickness - Microscopical method.

3448 (1975): Industrial liquid lubricants - ISO viscosity classification.

6743: Lubricants, industrial oils and related products (class L) - Classification.

2. Scope

This standard is a catalogue of test methods. It relates to test methods and procedures for printed boards irrespective of their method of manufacture, when they are ready for the mounting of the components.

3. Object

To describe standard test methods for assessing the properties, dimensions and performance of printed boards.

4. General

4.1 *Standard atmospheric conditions for testing*

Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions, as specified in IEC Publication 68.

The ambient temperature and the relative humidity at which the measurements are made shall be stated in the report.

In case of dispute between purchaser and vendor about test results, the tests shall be carried out at one of the "referee conditions" of IEC Publication 68.

4.2 *Test specimen*

If possible and unless otherwise specified, the test shall be carried out on production boards.

Test coupons may be necessary or desirable for certain tests.

Test coupons may be included on the panel with the production boards or may be produced as separate composite test coupons in conjunction with the production boards with the same materials and processes so as to be representative of the production boards. If separate composite test coupons are manufactured, they shall be spaced out evenly in production in such a quantity that a good average assessment can be made.

5. General examination

5.1 *Test 1: Visual examination*

The visual examination checks identification, appearance, workmanship, finish, pattern, etc., of a printed board against the relevant specification by viewing with or without use of magnification.

5.1.1 *Test 1a: x 3 magnification method*

The visual examination shall be carried out using optical equipment with approximately x 3 linear magnification and where possible transmitted light.

5.1.2 *Test 1b: x 10 magnification method*

When specified, the visual examination shall be carried out using optical equipment with approximately x 10 linear magnification and where possible transmitted light.

5.1.3 *Test 1c: x 250 magnification method*

When specified, the visual examination shall be carried out using optical equipment with approximately x 250 linear magnification. This is usually required for microsection.

5.2 *Test 2: Dimensional examination*

The dimensional examination is the measurement of actual dimensions with the aid of measuring tools and measuring equipment against the relevant specification.

5.2.1 The measuring tools and equipment shall have an accuracy and readability suitable for the dimension and tolerance to be measured.

5.2.2 *Test 2a: Optical method*

When specified, particular measurements, for instance, on dimensions of holes and edge defects in conductors, shall be measured with an optical instrument having a measuring reticule and a readability of 0,025 mm.

5.2.3 When specified, particular measurements, for instance, flatness of printed boards, shall be carried out using gauges as specified under the test method and/or the detail specification.

6. **Electrical tests**

6.1 *Test 3: Resistance*

6.1.1 *Test 3a: Resistance of conductors*

6.1.1.1 *Object*

To determine the resistance of conductors.

6.1.1.2 *Specimen*

The measurement shall be carried out on specified conductors. These conductors shall be as long and narrow as possible.

6.1.1.3 *Method*

The resistance shall be measured using a suitable method on two conductors at two places. The measuring error shall not be greater than 5%. The current shall be kept small enough to avoid heating the specimen appreciably.

In case of dispute, a four-terminal method shall be used.

6.1.1.4 *Details to be specified*

- a) conductors to be measured;
- b) value of the resistance;
- c) any deviation from the standard test method.

6.1.2 *Test 3b: Resistance of interconnections*

6.1.2.1 *Object*

To determine the resistance of interconnections on a printed board.

6.1.2.2 *Specimen*

The measurement shall be carried out on specified parts of a production board, of a test coupon or of a composite test coupon.

6.1.2.3 *Method*

The resistance shall be measured with a four-terminal method or equivalent method between two specified holes.

The measuring current shall not exceed 0,1 A. The total measuring error shall be less than 5%.

Two typical connection methods are shown in Figures 1 and 2.

Connection method A

Leads are soldered into the specified holes according to Figure 1.

Connection method B

The connections are made using two pairs of contact pins according to Figure 2.

Note.— Test probes as described in Test 5a are suitable (see Figure 3).

6.1.2.4 *Details to be specified*

- a) holes and interconnections to be measured;
- b) connection method;
- c) maximum value of the resistance;
- d) any deviation from the standard test method.

6.1.3 *Test 3c: Change in resistance of plated-through holes, thermal cycling*

6.1.3.1 *Object*

To determine the increase in resistance of plated-through holes that may occur when the holes are subjected to thermal cycling, by monitoring the resistance continuously during the test.

The increase gives an indication of the quality of the plating.

6.1.3.2 Specimen

The test shall be carried out on a suitable printed board having a number of plated-through holes connected in series.

Where the use of test coupons as specified in Publications 326-5 or 326-6 is agreed, the test shall be carried out on "Specimen D".

The test board shall preferably not be tin-lead plated. If it is, the plating shall be chemically removed prior to testing but care shall be taken to avoid any detrimental effect to the copper.

Note.- A suitable remover consists of:

- 330 ml nitric acid 60% (density, 1,36 g/cm³ at 20 °C);
- 3 ml fluoroboric acid 40% (density 1,32 g/cm³ at 20 °C);
- 670 ml deionized water.

Caution: when using removers, the necessary precautions shall be taken to avoid any injury to health.

6.1.3.3 Method

The resistance (or the corresponding voltage drop) of the holes connected in series shall be measured at a constant measuring current of 100 ± 5 mA using the four-terminal method. The resistance shall be monitored continuously during the test. The specimen shall be connected to the recording device by, for example, a suitable edge-board connector.

The thermal cycling shall be carried out by using two separate fluid baths alternately:

- An ambient temperature bath, as specified in Sub-clause 9.2.1, Test 19a, but kept at the temperature of 25 ± 2 °C; it is essential for efficient cooling that the bath at 25 °C should contain a low viscosity fluid.
- A hot bath, as specified in Sub-clause 9.2.1, Test 19a, kept at the temperature of 260^{+5}_0 °C.

The specimen shall be immersed in the fluid vertically to a depth which leaves the area of connection, for example the edge board connector, approximately 30 mm above the surface of the fluid. To improve the heat transfer during the immersion in the hot fluid, the specimen should be slightly moved (in a horizontal direction parallel to its surface). After immersion and withdrawal from the 25 °C bath, the fluid remaining on the test panel shall be removed before the next immersion.

The specimen shall be immersed alternately in the 25 °C bath and in the 260 °C bath. The cycling begins and ends with an immersion in the 25 °C bath. The specimen must be transferred from the 260 °C bath into the 25 °C bath without time delay.

The total number of immersions shall be as specified. The specimen shall remain in the 25 °C bath until a stable reading of the resistance is obtained. The specimen shall remain in the 260 °C bath for a period of 20 ± 1 s. If the characteristics of the base material used require it, slightly different immersion times may be specified in the relevant specification or agreed upon between purchaser and vendor.

The resistance value (or the corresponding voltage drop) is plotted on a time scale against the number of immersions. The diagram resulting, for example from a chart recorder, has an aspect similar to that shown in Figure 4.

6.1.3.4 *Details to be specified*

- a) specimen to be tested;
- b) number of 260 °C immersions;
- c) maximum permissible increase in per cent of resistance between the first and the last 25 °C immersion;
- d) maximum permissible increase in per cent of resistance between the first and the last 260 °C immersion;
- e) maximum permissible increase in per cent of resistance during any one 260 °C immersion;
- f) any deviation from the standard test method.

6.2 *Test 4: Electrical integrity*

Electrical integrity shall be established by two (2) test procedures: Test 4a: Circuit isolation; and Test 4b: Circuit continuity. These tests may be combined in order to be carried out one after the other on the same specimen. Usually circuit continuity (Test 4b) is done first.

The application of a common value of current as a limiting condition (i.e., as a border-line between circuit isolation conditions and circuit continuity conditions) as well as the use of automatic test equipment may facilitate the combination.

These tests are not intended to replace visual inspection (Test 1a).

6.2.1 *Test 4a: Circuit isolation*

6.2.1.1 *Object*

To verify the absence of conductive connection between specified parts of a conductive pattern of a printed board that were intended to be unconnected, in accordance with the relevant specification (i.e., artwork, customer requirements, computer aided data, etc.).

6.2.1.2 *Specimen*

The test shall be carried out on all or on specified portions of conductive patterns on or between any layers of the production board.

6.2.1.3 *Method*

The specified points of each separately accessible circuit of the conductive pattern shall be connected to the test source by suitable means, for example, by test probes contacting the specified conductors or lands. The remaining circuits, not under test, may be connected together, connected in turn as groups, or tested in turn individually.

Where appropriate, multiple arrangements of test probes may be used (for example, beds of nails, integrated or hybrid circuit pattern probes, etc.). Where a printed board contains edge board contacts, these may also be used together with a suitable edge socket connector or test probes.

A specified test voltage shall be applied to parts of the conductive pattern under test, so that a current flows if a short circuit is present. The source of the test voltage shall be associated with the means for monitoring delivered current and limiting the current to a value within the current carrying capacity of the circuit under test in order to avoid overheating.

A quick evaluation for short circuits may be made using a simple indicator, such as an indicator lamp or measuring instrument or by an electrical circuit transforming the current into a signal which may be evaluated by automatic test equipment.

For sophisticated evaluation of short circuits, the current shall be monitored in such a fashion as to enable the value of ohmic resistance existing between separate conductive patterns to be determinable within a measurement uncertainty not exceeding 100% at the minimum value of resistance given as the limiting requirement for circuit isolation.

There shall be no short circuits between specified points. When evaluating specific requirements, circuit isolation is deemed to be maintained when the value of resistance represented by any current flowing between separate conductors under test is greater than 1 M Ω , or as otherwise specified in the customer's detail specification.

6.2.1.4 *Details to be specified*

- a) test voltage;
- b) minimum allowable resistance if other than 1 M Ω ;
- c) part(s) of conductive pattern to be tested;
- d) maximum allowable current;
- e) any deviation from the standard test method.

6.2.2 *Test 4b: Circuit continuity*

6.2.2.1 *Object*

To verify the establishment of electrical continuity through the specified connected points of a conductive pattern of a printed board in accordance with the relevant specification (i.e., artwork, customer requirements, computer aided data, etc.).

6.2.2.2 *Specimen*

The test shall be carried out on all or on specified portions of the conductive patterns on or between any layers of the production board.

6.2.2.3 *Method*

The specified points of the conductive patterns shall be connected to the test circuit by any suitable means, for example, by test probes contacting specified conductors or lands. Where appropriate, multiple arrangements of test probes may be used. Where a printed board contains edge board contacts, these may also be used together with a suitable edge socket connector or test probes.

A specified voltage shall be applied to, or a specified current shall be passed through, each separately connected conductive path in turn, across any externally accessible circuit connection point (for example, land, edge connector, contact) and sequentially to each other external connecting point to which it is intended to be connected.

A quick evaluation of circuit continuity may be made by using a simple indicator, such as an indicator lamp or measuring instrument or by an electrical circuit transforming the current into a signal which may be evaluated by automatic test equipment.

For sophisticated evaluation of circuit continuity, the resultant current flow in each path shall be monitored in such a fashion as to enable the value of ohmic resistance existing between any points within the circuit to be determinable within a measurement uncertainty not to exceed 100% at the maximum value of resistance given as the limit requirement for circuit continuity.

Arrangements shall be made to limit the maximum current to be within the current carrying capacity of the circuits under test.

There shall be electrical continuity between all specified points of each circuit. For sophisticated equipment, the circuit continuity is deemed to have been established when the value of resistance represented by the current flowing between any points in the circuit is less than 5 Ω , or whichever single value is specified in the customer detail specification.

6.2.2.4 *Details to be specified*

- a) test voltage;
- b) maximum allowable resistance if other than 5 Ω ;
- c) part(s) of conductive pattern to be tested;
- d) maximum allowable current;
- e) any deviation from the standard test method.

6.3 Test 5: Current proof

6.3.1 Test 5a: Current proof, plated-through holes

6.3.1.1 Object

To assess the ability of the plating in plated-through holes to withstand a specified test current

6.3.1.2 Specimen

The test shall be carried out on plated-through holes of a production board. The test may be applied to holes that appear suspect when visually examined.

6.3.1.3 Method

A current in accordance with Table I shall be passed for a period of 30 s through the plating within a plated-through hole, and shall be continuously monitored.

TABLE I

Hole diameter mm	Test current A
0,6	8
0,8	9
1,0	11
1,3	14
1,6	16
2,0	20

The current shall be constant and shall be produced by a suitable a.c. or d.c. power supply.

The current shall be applied by test probes. Suitable probes are shown in Figure 3. Sufficient pressure shall be exerted to ensure good electrical contact. A force of about 1 N may be suitable.

6.3.1.4 Details to be specified

- a) holes to be tested;
- b) final measurements and requirements;
- c) any deviation from the standard test method.

6.3.2 Test 5b: Current proof, conductors

6.3.2.1 Object

To assess the ability of conductors and of connections between conductors and plating in plated-through holes to withstand a specified current.

6.3.2.2 *Specimen*

The test shall be carried out on specified parts of a pattern of a production board, or of a test coupon or of a composite test coupon.

6.3.2.3 *Method*

A specified a.c. or d.c. current shall be passed through the conductor under test for a specified period. The current shall be continuously monitored.

The current shall be chosen in accordance with the information given in IEC Publication 326-3.

Care shall be taken to ensure good electrical contact to the conductor under test.

6.3.2.4 *Details to be specified*

- a) conductor(s) to be tested, including connection points;
- b) current, value and duration;
- c) final measurements and requirements;
- d) any deviation from the standard test method.

6.4 *Test 6: Insulation resistance*

6.4.1 *Test 6a: Insulation resistance, surface layers*

6.4.1.1 *Object*

To determine the insulation resistance between specified parts of a conductive pattern on the surface of a printed board or of a layer of a multilayer printed board before lamination.

The insulation resistance gives an indication of the quality of the material as well as the quality of the processes used in the production.

The relation between the insulation resistance specified in IEC Publication 249 for the metal-clad base material and the insulation resistance to be specified for this test is explained in IEC Publication 326-3.

6.4.1.2 *Specimen*

The insulation resistance shall be measured between any two specified points of a conductive pattern of a production board or of a layer of a multilayer printed board before lamination.

The specimen shall be handled carefully in order to avoid any contamination, for example fingerprints, dust, etc.

6.4.1.3 *Method*

The specimen shall be preconditioned using Test 18a.

The insulation resistance shall be measured with suitable measuring equipment. The test voltage, i.e. the voltage across the insulation resistance to be measured, shall be:

$$\begin{aligned} &10 \pm 1 \text{ V, or} \\ &100 \pm 15 \text{ V, or} \\ &500 \pm 50 \text{ V,} \end{aligned}$$

as specified in the relevant specification. The test voltage shall be applied for 1 min before measurement. If a stable reading is obtained earlier, the measurement may be made earlier. If stable reading is not obtained within 1 min, this shall be recorded in the test report.

The relevant specification may also call for measurement of the insulation resistance at elevated temperatures, e.g. during a dry heat or a humidity test while the specimen is still in the test chamber. Then, the same method shall be applied.

Where the test wires enter into the chamber, precautions must be taken to minimize any influence on the insulation resistance readings.

6.4.1.4 *Details to be specified*

- a) parts of the pattern to be measured;
- b) test voltage;
- c) temperature and/or humidity if different from standard conditions;
- d) minimum value of insulation resistance;
- e) any deviation from the standard test method.

6.4.2 *Test 6b: Insulation resistance, internal layers*

6.4.2.1 *Object*

To determine the insulation resistance between specified parts of a conductive pattern on an internal layer of a multilayer printed board.

The insulation resistance gives an indication of the quality of the material as well as the quality of the process used in the production.

Since this insulation resistance is a combination of surface resistance and volume resistance, no correlation with the value specified in IEC Publication 249 for the metal-clad base material can be given.

6.4.2.2 *Specimen*

The insulation resistance shall be measured between any two specified points of a conductive pattern on an internal layer of a production board or a test coupon.