

JIS

JAPANESE INDUSTRIAL STANDARD

**Test methods for flexible
printed wiring boards**

JIS C 5016—1994

Translated and Published

by

Japanese Standards Association

Printed in Japan

In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

1. Scope This Japanese Industrial Standard specifies test methods for single-sided and double-sided flexible printed wiring boards principally used in electronic apparatus, regardless of the manufacturing method (hereafter, referred to as "flexible printed boards").

Remarks 1. Multilayer flexible printed boards and flex-rigid printed boards are excluded from this Standard.

2. Standards cited in this Standard are given in Attached Table 1.

3. The International standards corresponding to this Standard are given below.

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

IEC 326-2 (1990) Printed boards. Part 2: Test methods

2. Definitions For the main terms used in this Standard the definitions in JIS C 0010 and JIS C 5603 apply.

3. Atmospheric conditions for testing

3.1 Standard conditions Unless otherwise specified in the detail specification, the tests shall be carried out under the standard atmospheric conditions specified in 5.3 of JIS C 0010 (temperature 15°C to 35°C, relative humidity 25 % to 75 % and air pressure 86 kPa to 106 kPa). If there is dispute on the decision based on these standard conditions or specially required, the conditions of 3.2 shall be employed.

If it is difficult to carry out the tests under the standard conditions, the tests may be carried out under atmospheric conditions other than the standard conditions unless any dispute arises on the decision.

3.2 Referee conditions The referee conditions shall be the atmospheric conditions for referee tests specified in 5.2 of JIS C 0010 (temperature 20 ± 2°C, relative humidity 60 % to 70 % and air pressure 86 kPa to 106 kPa).

4. Specimen

4.1 Preparation of specimen The specimens shall be prepared as specified in (1) or (2) below.

Care shall be taken not to make the surfaces of specimen dirty with oils, sweat, etc. during handling.

(1) Method by sampling The specimens shall be sampled from flexible printed boards for actual use. If the shape and dimensions are specified in the detail specification, the sampled ones shall be cut so that the performances are not affected.

If test coupons are provided, they may be used as the specimens.

- (2) Method by test pattern The specimens complying the test pattern of 4.2 shall be prepared from the same material and by the same manufacturing method as those of the flexible printed boards intended to be tested.

4.2 Shape and dimensions of test pattern The shape and dimensions of test pattern shall be as illustrated in Attached Figs. 1 to 8.

5. Preconditioning The specimens shall be allowed to stand under the standard conditions for 24 h, for preconditioning.

6. Tests for appearance, microsection and dimensions

6.1 Appearance In the appearance test, confirm the kind of flexible printed board, and examine the appearance, finishing, pattern, etc. by comparing with the detail specification visually or by means of a magnifier with a magnification 3 to 10.

In the case of observing the finished state of specimen used for the microsection, generally embed the specimen into epoxy or polyester resin, set the resin, cut the part of specimen to be observed, grind the cut surface, and then examine the ground surface by using a microscope with a magnification of approximately 250.

6.2 Microsection In the microsection test, examine the plated-through hole, conductor, internal conditions, appearance, dimensions, etc. in accordance with the detail specification.

- (1) Equipment A grinder and a microscope with a specified magnification of a range from 100 to about 1000 shall be used as the equipment.

The microscope shall be capable of measuring the thickness of plating, with an accuracy of 0.001 mm or better, or a thickness measuring apparatus at least equivalent in accuracy.

- (2) Materials The material shall be mold release agents, patting resins, abrasive cloth (#180, #400, #1000, etc.), abrasive paper (#180, #400, #1000, etc.) and abrasives (almina, chromium oxide, etc.).

- (3) Preparation of specimen The sample shall be carefully cut in an adequate size not to give damage on the observing portion and patted using a suitable patting resin. Coarse grinding of specimen shall be carried out by using the abrasive cloth or paper starting from coarse grain size then moving to finer ones. Then fine grinding shall be carried out on the felt of rotary grinding machine with the abrasive poured. The polished surface shall fall within 85° to 95° to the layer.

When the thickness of plating on a through hole is measured, the diameter of hole appearing on the microsection shall be not less than 90 % of the diameter of hole previously measured.

If it is necessary to make the boundary of plating clear, etching shall be carried out after the grinding.

- (4) Test In the test, examine the specified items in the detail specification with a microscope of a specified magnification.

6.3 Dimension test

6.3.1 Outline

- (1) Equipment The equipment shall be the toolmaker's microscope specified in JIS B 7153 or an equipment at least equivalent in accuracy.
- (2) Measurement Measure the length and width to the nearest 0.05 mm.

6.3.2 Thickness

- (1) Equipment The equipment shall be the dial gauge reading in 0.001 mm specified in JIS B 7503 or an equipment at least equivalent in accuracy.
- (2) Measurement Measure the thickness or total thickness of specimen to the nearest 0.001 mm.

6.3.3 Diameter of hole

- (1) Equipment The equipment shall be a magnifier equipped with reading scale with an accuracy of 0.01 mm or better, or an equipment at least equivalent in accuracy.
- (2) Measurement Measure the diameters of specified holes.

6.3.4 Position of hole

- (1) Equipment The equipment shall be a coordinate measuring apparatus or a toolmaker's microscope with an accuracy of 0.01 mm or better, or an equipment at least equivalent in accuracy.
- (2) Measurement
- (a) In the case of measuring relative position of a hole to the lattice, hold the flexible printed board by means of a suitable method for the purpose, and measure the distance from the reference hole or reference point on the lattice of flexible printed board to the hole to be measured along the X axis and Y axis.
 - (b) In the case of measuring the position of a hole from an optional hole, hold the flexible printed board by means of a suitable method for the purpose, and measure the distance from the said optional hole to the hole to be measured.

6.3.5 Conductor width and minimum spacing between conductors

- (1) Equipment The equipment shall be a reading micrometer with an accuracy of 0.01 mm or better, or an equipment at least equivalent in accuracy.
- (2) Measurement Hold the flexible printed board by means of a suitable method, and measure projected dimensions of the conductor width and the minimum spacing between conductors.

6.3.6 Conductor void and residual conductor

- (1) Equipment The equipment shall be as specified in 6.3.3 (1).
- (2) Measurement Measure the dimensions of conductor void in the conductor part and those of residual conductor in the insulation part along the longitudinal direction and lateral direction of conductor.

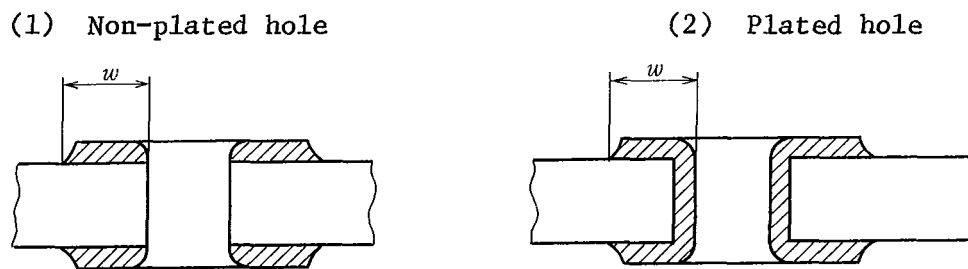
6.3.7 Land dimensions

- (1) Equipment The equipment shall be as specified in 6.3.4 (1).
- (2) Measurement Measure the projected dimensions.

6.3.8 Land width

- (1) Equipment The equipment shall be as specified in 6.3.4 (1).
- (2) Measurement Measure the projected dimension (w) between the inside wall of hole and the edge of land shown in Fig. 1.

Fig. 1. Land width



6.3.9 Thickness of plating of plated-through hole Carry out the measurement on the microsection prepared in accordance with 6.2 using the material specified in 4.

6.3.10 Cover lay

- (1) Equipment The magnifier specified in 6.1 shall be used as the equipment.
- (2) Specimen The specimen shall be a portion of flexible printed board where the cover lay is applied.
- (3) Test Examine the misalignment of the cover lay and the exposed conductor such as land, and existence or nonexistence of the air gap or foreign matter remaining in the gap between the cover lay and the conductor or the base film and extrusion of cover lay, in accordance with the provisions of the detail specification, throughout the specimen by using a magnifier.

7. Electrical performance test

7.1 Resistance of conductors

7.1.1 Equipment The equipment shall be the one employing voltage drop method (four-terminal method) as illustrated in Fig. 2 or at least the equivalent. The current shall be d.c. current.

7.1.2 Specimen The specimen shall be a conductor as long and narrow as possible and shall comply with the detail specification.

7.1.3 Preconditioning The preconditioning shall be as specified in 5.

7.1.4 Test Take care to avoid the influences due to contacting method of probe and due to heat generation by measuring current, and measure the resistance value within an accuracy of $\pm 5\%$, by means of the method shown in Fig. 3.

Fig. 2. Measuring equipment of conductor resistance

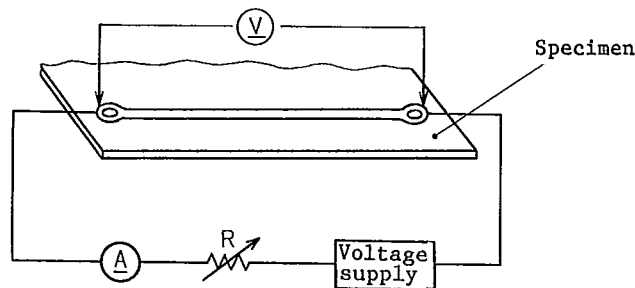
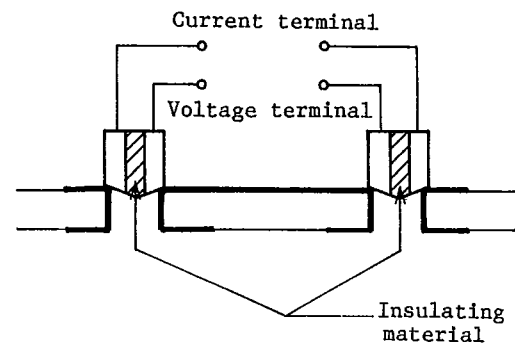


Fig. 3. Measuring method of conductor resistance



Ⓐ : ammeter specified in JIS C 1102.

Ⓥ : voltmeter having sufficiently high internal resistance compared with the resistance of test circuit.

7.2 Resistance of plated-through hole

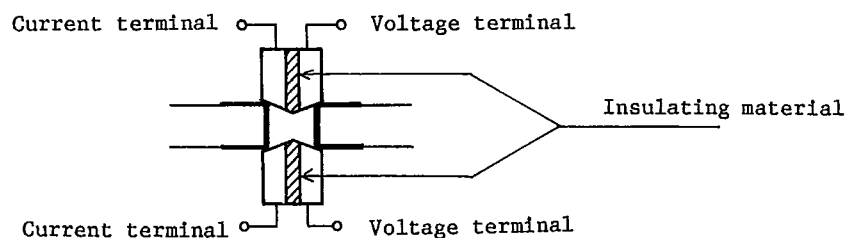
7.2.1 Equipment The equipment shall be as specified in 7.1.1.

7.2.2 Specimen The specimen shall be the specified parts of flexible printed board, test coupon or the test pattern of Attached Fig. 5.

7.2.3 Preconditioning The preconditioning shall be as specified in 5.

7.2.4 Test Take care to avoid the influences due to contacting method of probe and due to heat generation by measuring current, and measure the resistance value within an accuracy of $\pm 5\%$ by the method shown in Fig. 4.

Fig. 4. Method for measurement of plated-through hole resistance



7.3 Current proof of conductor

7.3.1 Equipment The equipment shall be a d.c. or a.c. power supply which can pass the test current of 7.3.4, an ammeter and a temperature measuring device.

7.3.2 Specimen The specimen shall be the specified part of conductor in flexible printed board, test pattern, etc.

7.3.3 Preconditioning The preconditioning shall be as specified in 5.

7.3.4 Test Pass the a.c. or d.c. current specified in the detail specification for the specified duration through the specified conductor and then measure the temperature rise.

7.4 Current proof of plated-through hole

7.4.1 Equipment The equipment shall be a d.c. or a.c. power supply which can pass the test current of 7.4.4 and an ammeter.

7.4.2 Specimen The specimen shall be the plated-through holes of flexible printed board, test coupon or the test pattern of Attached Fig. 5.

7.4.3 Preconditioning The preconditioning shall be as specified in 5.

7.4.4 Test Pass the test current specified in the detail specification through the plated-through holes of specimen continuously for 30 s, and examine existence or nonexistence of any abnormality during that period.

An example of the test current versus the diameter of hole is shown in Table 1.

Table 1. Example of test current versus hole diameter

Diameter of hole	mm	0.6	0.8	1.0	1.3	1.6	2.0
Test current	A	8	9	11	14	16	20

7.5 Voltage proof of surface layers

7.5.1 Equipment The equipment shall be the circuit breaker specified in 6.2 (Circuit breaker) of JIS C 2110, or at least the equivalent.

7.5.2 Specimen The specimen shall be the flexible printed board, or the test pattern of Attached Fig. 1.

For double-sided flexible printed board, two kinds of specimens, i.e. one in which the conductor pattern is formed on the front surface and the other having the pattern on the rear surface, shall be prepared.

The specimen which causes mechanical damage, flash over, spark over or dielectric breakdown in this test shall not be used for other tests.

7.5.3 Preconditioning The preconditioning shall be as specified in 5.

7.5.4 Test Apply the voltage specified in the detail specification as a d.c. voltage or a peak sinusoidal a.c. voltage at a frequency 50 Hz or 60 Hz, to the specified part of printed board. Raise the applied voltage gradually to the specified voltage in about 5 s, maintain the voltage for 1 min, and then examine existence or nonexistence of such abnormalities as mechanical damage, flash over, spark over and dielectric breakdown.

7.6 Insulation resistance of surface layers

7.6.1 Equipment The equipment shall be the high insulation resistance meter specified in JIS C 1303, or a standard resistance, a universal shunt and a galvanometer calibrated to an accuracy of $\pm 10\%$.

7.6.2 Specimen The specimen shall be the flexible printed board, test coupon, or the test pattern of Attached Fig. 1 which has no cover lay or cover coat.

For double-sided flexible printed board, two kinds of specimens, i.e. one in which the conductor pattern is formed on the front surface and the other having the pattern on the rear surface, shall be prepared.

7.6.3 Preconditioning The preconditioning shall be as specified in 5.

7.6.4 Test Apply a d.c. voltage 500 ± 5 V, maintain the voltage for 1 min and then measure the insulation resistance with the said voltage applied.

7.7 Electrical integrity

7.7.1 Test for circuit isolation

(1) Equipment The equipment shall consist of a voltage supply which can apply the test voltage, resistance measuring apparatus and probes to have electrical connection with the specified positions on the conductor pattern.

The voltage supply shall allow current observation and shall have a function to limit the current within the current capacity of the test circuit, to avoid the heating.

(2) Specimen The specimen shall be the specified part of the flexible printed board.

(3) Preconditioning The preconditioning shall be as specified in 5.

(4) Test Verify the absence of conductive connection between specified parts of a conductive pattern of a flexible printed board that were intended to be unconnected, in accordance with the relevant specification (i.e., artwork, test data, detail specification, etc.).

Apply the test voltage specified in the detail specification across the specified positions of the conductor pattern to be tested and obtain the resistance from the current passing through the conductors. If the measured resistance is not less than the minimum specified value, consider that isolation of the circuit is maintained.

The test voltage, duration of voltage application and permissible minimum resistance value shall be as specified in the detail specification.

7.7.2 Test for circuit continuity

- (1) Equipment The equipment shall consist of a current supply which can supply the test current, resistance measuring apparatus, and probes to have electrical connection with the specified positions on the conductor pattern.
- (2) Specimen The specimen shall be the specified part of the flexible printed board.
- (3) Preconditioning The preconditioning shall be as specified in 5.
- (4) Test Verify the establishment of electrical continuity through the specified joints of a conductive pattern, in accordance with the relevant specification (i.e. artwork, test data, detail specification, etc.).

Pass the test current specified in the detail specification through the specified positions on the conductive pattern to be tested and obtain the resistance from the potential difference between the said two points. If the measured resistance does not exceed the maximum specified value, consider that continuity of the circuit is maintained.

The test current, duration of current and permissible maximum resistance value shall be as specified in the detail specification.

8. Mechanical performance test

8.1 Peel strength of conductor

8.1.1 Classification of test methods The test methods for peel strength of conductor are classified into the following two methods:

- (1) Method A In this method, the copper foil is peeled in the direction 90° to the surface from which the copper foil is removed. Unless otherwise specified, the test shall be carried out in accordance with this method.
- (2) Method B In this method, the copper foil is peeled in the direction 180° to the surface from which the copper foil is removed. This method may be used subject to agreement between the parties concerned with acceptance in such cases, that the base material is thin i.e. the thickness is less than 0.025 mm and it is difficult to fix the specimen to the support so that it will not cause tenting or break due to the peeling load, or that it is desired to obtain the approximate measured values quickly.

8.1.2 Equipment

- (1) The equipment shall consist of such a tensile tester that the error is within $\pm 1\%$ of the indication, the peeling load falls 15 % to 85 % of the capacity of the tester and the cross head speed can be maintained approximately 50 mm per min, and a recorder which can continuously record the peeling force.
- (2) A support exemplified in Figs. 5 and 6 to keep the angle of copper foil peeling direction to the specimen surface from which the copper foil is removed $90 \pm 5^\circ$, for application of method A, or a support having the equivalent function.

Fig. 5. Sliding support for measurement of peel strength by method A (peeling in a direction 90°)

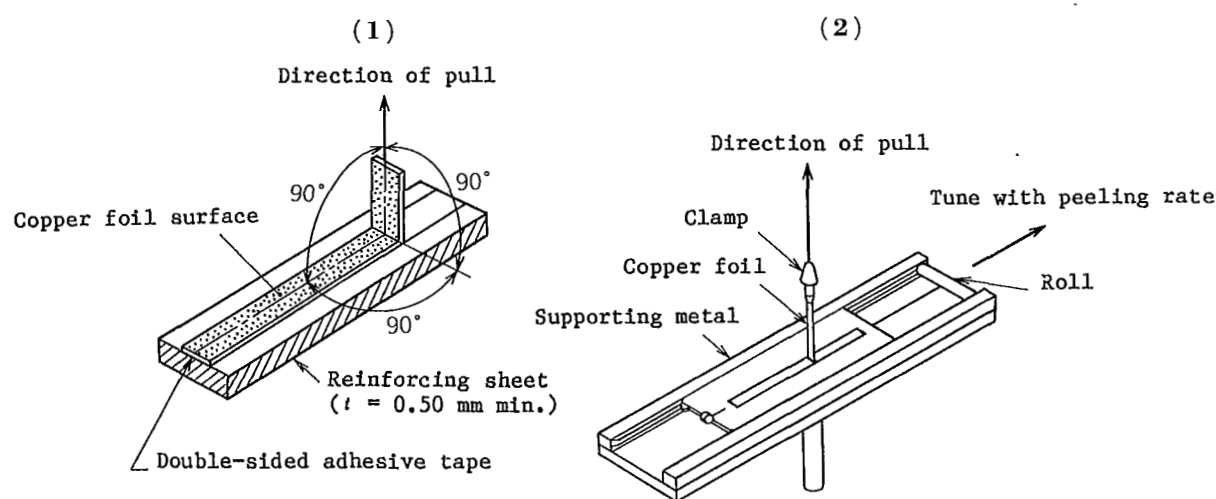


Fig. 6. Rotary drum type support for measurement of peel strength by method A (peeling in a direction 90°)

