

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD



**Test methods for electrical materials, printed boards and other interconnection structures and assemblies –
Part 3-913: Test methods for interconnection structures (printed boards) –
Electronic circuit board for high-brightness LEDs**

[IEC PAS 61189-3-913:2011](https://standards.iteh.ai/catalog/standards/sist/ed065144-9395-4553-b049-78db36798081/iec-pas-61189-3-913-2011)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**TEST METHODS FOR ELECTRICAL MATERIALS, PRINTED BOARDS
AND OTHER INTERCONNECTION STRUCTURES AND ASSEMBLIES –****Part 3-913: Test methods for interconnection structures (printed boards) –
Electronic circuit board for high-brightness LEDs**

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TEST METHODS FOR ELECTRICAL MATERIALS, PRINTED BOARDS AND OTHER INTERCONNECTION STRUCTURES AND ASSEMBLIES –

Part 3-913: Test methods for interconnection structures (printed boards) – Electronic circuit board for high-brightness LEDs

1 Scope

This standard specifies the test methods of the electronic circuit board for high-brightness LEDs (hereafter described as electronic circuit board).

NOTE Reference documents to this standard are listed in Clause 11 Normative references and in the Bibliography.

2 Terms and definitions

For the purpose of this document, the terms used in this PAS shall be in accordance with JPCA-TD01, JIS C 60068-1 and JIC C 5603.

3 Test conditions

3.1 Standard condition

Tests shall be made unless otherwise specified in a specific standard under the standard condition specified in JIS C 60068-1, 5.3.1, Standard atmospheric condition (standard condition), temperature of 15 °C to 35 °C, relative humidity of 25 % to 75 % and atmospheric pressure of 86 kPa to 106 kPa. Condition specified in 3.1 shall be used in case there is any doubt to the experimental results or in case required by a specific standard.

3.2 Specified condition

The specified condition as specified in JIS C 60068-1, 5.2, Standard atmospheric condition (specified condition), is a temperature of 20 °C ± 2 °C, a relative humidity of 60 % to 70 % and an atmospheric pressure of 86 kPa to 106 kPa.

4 Specimen

4.1 Preparation of specimen

Specimen shall be prepared as in (1) or (2) below. The surface of a specimen shall not be contaminated by oil/grease, sweat and others.

- 1) Specimen by sampling: the specimen shall be sampled from the electronic circuit boards to be used in production. The specimen shall be cut to the defined size if its shape and size are defined in a specific standard. A test coupon may be used as the specimen when such coupons are prepared.
- 2) Specimen using a test pattern: a specimen shall be prepared using the test pattern shown in 4.2 using the same materials and method to produce products.

4.2 Test pattern

The test pattern with the shape and dimension shown in Figures A.1 and A.2 shall be used depending on the type of the electronic circuit board.

5 Pre-conditioning

Pre-conditioning described in (1) or (2) below shall be made in accordance to the specific standard.

- 1) Leave a specimen for 24 h in the standard condition.
- 2) Leave a specimen for 60 min in a thermostat chamber at 85 °C and then leave the specimen for 24 h \pm 4 h in the standard atmospheric condition.

6 Appearance, micro-sectioning and dimensions

6.1 Appearance

Appearance check shall be made by naked eyes or using a magnifying glass for appearance of the specimen, finish and conductor pattern according to its detailed specification. Use a micrograph of 250X to check a micro-section of a specimen by cutting it and polishing the cutting face of a specimen embedded usually in epoxy resin or polyester resin.

6.2 Micro-sectioning

Inside of a plated through-hole, conductor or electronic circuit board shall be checked by micro-sectioning to see its cross section.

- 1) Equipment: the equipment for the test is a micrograph capable of measuring a thickness of plated film with an accuracy of better than 0,001 mm, or equivalent.
- 2) Material: the materials needed are as follows: release agent, embedding resin, polishing cloth (#180, #400, #1000 and alike), polishing paper (#180, #400, #1000 and alike), and polishing powder (alumina, chromium oxide, etc.).
- 3) Specimen: the specimen shall be cut to an appropriate size not to make any damage to the observing face and embedded in resin. The cut specimen shall be polished using polishing cloth/paper from coarse to fine particle and then polish using a rotating disc with felt cloth and polishing powder. The polished surface shall be within 85 ° to 95 ° to the board layer.

The diameter of the micro-sectioned hole for measurement of plated film on a through-hole shall be larger than 90 % of the diameter of the hole measured beforehand. If necessary, etch the polished surface to identify layer boundaries of a specimen.

- 4) Test: observe the polished surface of a specimen according to the requirement of specific standard using a micrograph of the specified magnification.

6.3 Dimension

6.3.1 Appearance

- 1) Equipment: use a slide caliper specified in JIS B 7507 or equivalent accuracy.
- 2) Measurement: measure its length and width with an accuracy of 0,01 mm.

6.3.2 Thickness

- 1) Equipment: use a micrometer specified in JIS B 7502 or equivalent accuracy.
- 2) Measurement: measure the thickness of a board or total thickness if multilayer board with an accuracy of 0,01 mm.

6.3.3 (Through-) Hole diameter

- 1) Equipment: use a magnifying glass with reading scale with an accuracy of 0,01 mm.
- 2) Measurement: measure the diameter of the specified hole.

6.3.4 Hole position

- 1) Equipment: use a coordination measuring instrument or a microscope with an accuracy of 0,01 mm, or an equivalent instrument.

2) Measurement

- a) Measurement of the position of a hole on a grid shall be made by measuring the X and Y coordinate distances by holding the specimen board in an appropriate method.
- b) Measurement of the position of a hole from an arbitrary hole shall be made by measuring the distance of the measuring hole from that reference hole by holding the specimen board in an appropriate method.

6.3.5 Conductor width and minimum conductor spacing

- 1) Equipment: use a coordination measuring instrument or a microscope with an accuracy of 0,01 mm, or an equivalent instrument.
- 2) Measure the conductor width and conductor spacing by holding the specimen board in an appropriate method.

6.3.6 Conductor nick and extraneous copper

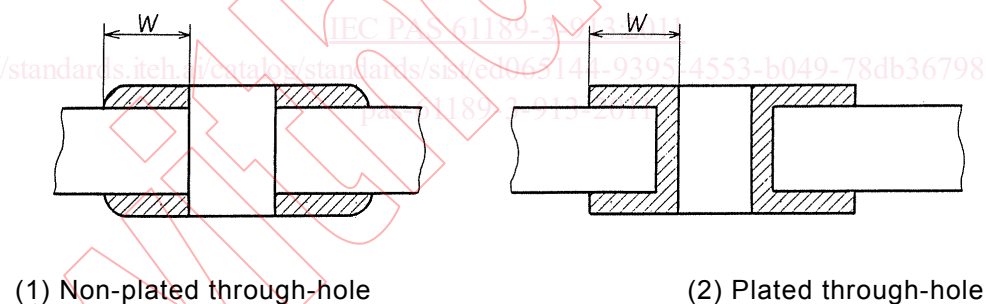
- 1) Equipment: use the equipment specified in 6.3.3 (1) or 6.3.4 (1).
- 2) Measurement: measure the size of a conductor nick or of a extraneous copper of the length and width in the direction of the conductor.

6.3.7 Land

- 1) Equipment: use the equipment specified in 6.3.4 (1).
- 2) Measurement: observe the land to be measured from above and measure its maximum size.

6.3.8 Land width

- 1) Equipment: use the equipment specified in 6.3.4 (1).
- 2) Measurement: measure the distance (w) from the edge of a land and a hole.

**Figure 1 – Land width****6.3.9 Flatness****6.3.9.1 Warpage**

- 1) Equipment: use the height-gauge specified in JIS B 7517 or an equipment with better accuracy.
- 2) Measurement: place the specimen as shown in Figure 2 on a precision base with its convex face upward. Measure the warpage as the maximum gap between the board and base (h_B) to an accuracy of 0,1 mm.

6.3.9.2 Twist

- 1) Equipment: Use the regular class gap gauge specified in JIS B 7524 or a height-gauge specified in JIS B 7517 or an equipment with better accuracy.
- 2) Measurement: place the specimen as shown in Figure 3 on a precision base with its convex face upward with three corners of the board in touch with the base. Measure the twist as the maximum gap between the remaining floating edge of the board and base (h_T) to an accuracy of 0,1 mm.

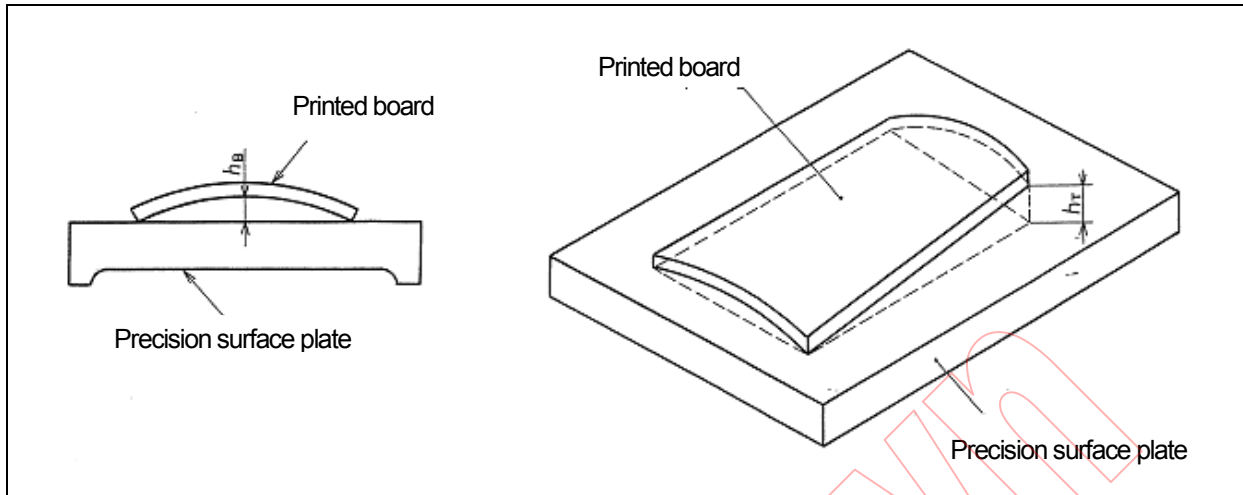


Figure 2 – Warpage

Figure 3 – Twist

7 Electrical tests

7.1 Conductor resistance

7.1.1 Conductor

- 1) Equipment: equipment is for the voltage-drop method (four-terminal method), or equivalent. The current used in the measurement is d.c.
- 2) Specimen: the specimen shall be a conductor long and narrow as much as possible, and shall comply with the detailed specification.
- 3) Pre-conditioning: the pre-conditioning shall be as specified in Clause 5.
- 4) Test: care shall be made to avoid influences caused by contact method of probe and of heating caused by the measuring current. Measure the resistance as shown in Figure 4 to an accuracy of $\pm 5\%$ using the equipment described in (1) above.

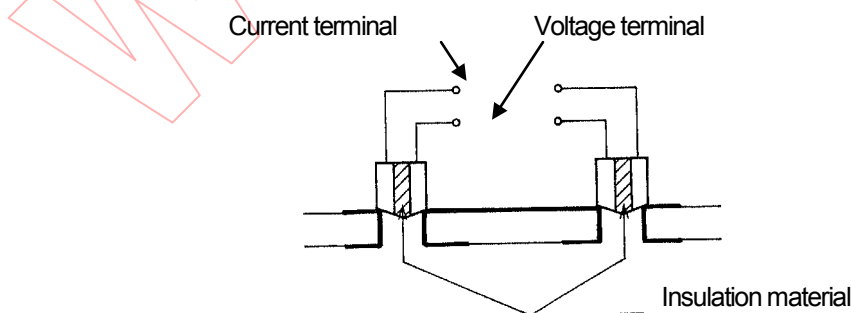


Figure 4 – Electrode arrangement for resistance measurement

7.1.2 Plated through-hole

- 1) Equipment: use the equipment specified in 7.1.1 (1).
- 2) Specimen: specimen is the specified part of a board or a test coupon or with the specified composite test pattern as shown in Figure A.1.

- 3) Pre-conditioning: the pre-conditioning shall be as specified in Clause 5.
- 4) Test: care shall be made to avoid influences caused by contact method of probe and of heating caused by the measuring current. Measure the resistance as shown in Figure 5 to an accuracy of $\pm 5\%$ using the equipment described in (1).

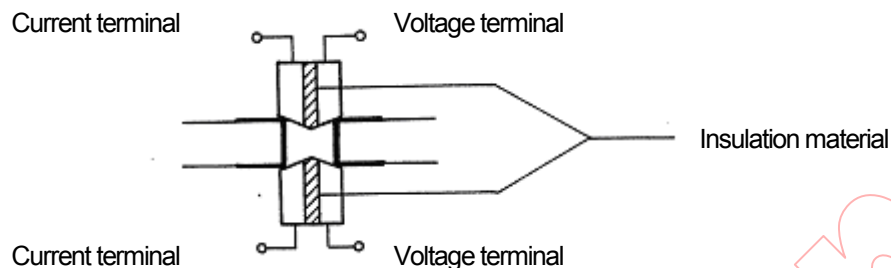


Figure 5 – Electrode arrangement for resistance measurement of a plated through-hole

7.1.3 Interconnection

- 1) Equipment: use the equipment specified in 7.1.1 (1).
- 2) Specimen: specimen is the specified part of a board or a test coupon or with the specified composite test pattern as shown in the Figure A.1.
- 3) Pre-conditioning: the pre-conditioning shall be as specified in Clause 5.
- 4) Test: care shall be made to avoid influences caused by contact method of probe and of heating caused by the measuring current. Measure the contact resistance as shown in Figure 6 to an accuracy of $\pm 5\%$ using the equipment described in (1).

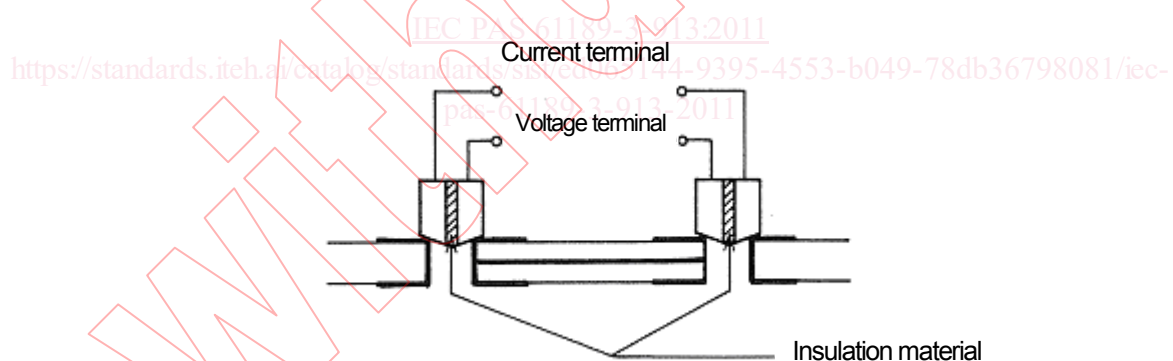


Figure 6 – Electrode arrangement for resistance measurement of interconnection measurement

7.2 Current tolerance of conductor (when specified in a detailed specification)

- 1) Equipment: equipment shall be a d.c. or an a. c. power supply capable of supplying the test current specified in 7.2.4), an ammeter and a temperature measuring instrument.
- 2) Specimen: the specimen shall be an electronic circuit board with the specified composite test pattern (select the pattern in reference to Figure A.2).
- 3) Pre-conditioning: the pre-conditioning shall be as specified in Clause 5.
- 4) Test: test shall be made by supplying the specified d.c. or a.c. current to the specimen for a specified time and measure the temperature rise of the specimen (see Figure A.3 for the current). This test shall be performed only when current tolerance is required.

7.3 Current tolerance of plated through-hole

- 1) Equipment: equipment shall be a d.c. or an a. c. power supply capable of supplying the test current specified in 7.2.3), and an ammeter.

- 2) Specimen: the specimen shall be an electronic circuit board or a test coupon with the specified composite test pattern with a plated through-hole.
- 3) Pre-conditioning: the pre-conditioning shall be as specified in Clause 5.
- 4) Test: test shall be made by supplying the specified current to the plated through-hole for 30s and check if there is any anomaly. Examples of test current are shown in Table 1.

Table 1 – Examples of test current

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

This test shall be made only when current tolerance is required.

7.4 Withstanding voltage of surface layer

- 1) Equipment: equipment shall be an current breaker specified in JIS C 2110-2, 8.1 or equivalent.
- 2) Specimen: the specimen shall be the specified section of an electronics circuit board with the specified composite test pattern (as shown in Figures A.1 and A.2, E). The damaged specimen in this test such as mechanical damage, flush over, spark over or breakdown shall be used in other test.
- 3) Pre-conditioning: the pre-conditioning shall be as specified in Clause 5.
- 4) Test: test shall be made by the specified d.c. voltage or 50 H or 60 H a.c. voltage with a peak voltage specified in the detailed specification. The applying voltage shall be increased to the specified voltage in 5 s and keep at the voltage for 1 min. Damages such as mechanical damage, flush over, spark over or breakdown shall be checked.

7.5 Interlayer withstanding voltage

- 1) Equipment: equipment shall be as specified in 7.4.1).
- 2) Specimen: the specimen shall be the specified section of an electronics circuit board with the specified composite test pattern (as shown in Figure A.2.1, M).
- 3) Pre-conditioning: the pre-conditioning shall be as specified in Clause 5.
- 4) Test: test shall be as specified in 7.4.4).

7.6 Insulation resistance of surface layer (normal and resistance to humidity (temperature-humidity cycle and steady state))

- 1) Equipment: equipment shall be as the insulation tester as specified in JIS C 1302, or a standard resistance, universal shunt and a galvanometer calibrated to an accuracy of $\pm 10\%$.
- 2) Specimen: the specimen shall be a solder resist coated test coupon as specified in Figure A.3 (1).
- 3) Pre-conditioning: the pre-conditioning shall be as follows for each condition.
 - a) Normal: specimen shall be left in a thermostat chamber at $85\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 4 h and then leave it at temperature $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and relative humidity of $60\% \pm 10\%$ for $24\text{ h} \pm 4\text{ h}$.
 - b) Resistance to humidity (temperature-humidity cycle): specimen shall be conditioned for 10 cycles (9.4) and then measure the resistance in an environment of $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and relative humidity of $60\% \pm 10\%$ within 30 min to 60 min after conditioning.
 - c) Resistance to humidity (steady state): specimen shall be conditioned for 96 h with the condition of an environment of $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and relative humidity of $90\% \pm 95\%$ and then measure the resistance in an environment of $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and relative humidity of $60\% \pm 10\%$ within 30 min to 60 min after conditioning.
- 4) Test: measurement shall be made for insulation resistance after applying a voltage to the specimen for 1 min of a voltage as specified in the detailed specification of either $10\text{ V} \pm 1\text{ V}$, $100\text{ V} \pm 15\text{ V}$, $500\text{ V} \pm 50\text{ V}$.

7.7 Insulation resistance of inner layer (normal and resistance to humidity (temperature-humidity cycle and steady state))

- 1) Equipment: equipment shall be as specified in 7.6 (1).
- 2) Specimen: the specimen shall be a coupon with a comb pattern as shown in Figure A.3 (2). The conductor spacing of the specimen shall be the minimum spacing of actual production board.
- 3) Pre-conditioning: the pre-conditioning shall be as in 7.6 (4).
- 4) Test: test shall be as described in 7.6 (4).

7.8 Insulation resistance between inner layers (normal and resistance to humidity (temperature-humidity cycle and steady state))

- 1) Equipment: equipment shall be as specified in 7.6 (1).
- 2) Specimen: the specimen shall be a coupon with a comb pattern as shown in Figure A.3(3). The diameter of the hole, ϕ , shall be 10 mm, nominal hole diameter of through holes for interconnections to inner layers shall be 0,8 mm and nominal land diameter shall be 2 mm.
- 3) Pre-conditioning: the pre-conditioning shall be as in 7.6 (3).
- 4) Test: measurement shall be made for insulation resistance after applying a d.c. voltage to the specimen for 1 min of a voltage as specified in detailed specification of either $100\text{ V} \pm 15\text{ V}$, or $500\text{ V} \pm 50\text{ V}$.

7.9 Electric integrity

7.9.1 Circuit insulation

- 1) Equipment: equipment shall consist of a power supply which can supply the test voltage to a specimen, resistance meter and probes which can contact to the measuring points.
- 2) Specimen: specimen shall be a product or the specified part of a test coupon.
- 3) Pre-conditioning: preconditioning shall be as specified in Clause 5.
- 4) Test: measurement shall be made to confirm that no electric contacts exists to unintended section of the specimen in the intended specification (art-work, computer generated test data, or detailed specification). Apply the specified test voltage to the specified part of the test pattern and measure the resistance. Insulation shall be confirmed when the resistance is above the specified minimum resistance. The applied voltage and applying time, and the minimum allowed resistance shall be specified in detailed specification.

7.9.2 Conduction

- 1) Equipment: equipment shall consist of a power supply which can supply the test current to a specimen, resistance meter and probes which can contact to the measuring points.
- 2) Specimen: specimen shall be the specified part of a product.
- 3) Pre-conditioning: preconditioning shall be as specified in Clause 5.
- 4) Test: measurement shall be made to confirm that no electric contacts exists to unintended section of the specimen in the intended specification (art-work, computer generated test data, or detailed specification). Apply the specified test voltage to the specified part of the test pattern and measure the resistance. Insulation shall be confirmed when the resistance is above the specified minimum resistance. The applied voltage and applying time, and the minimum allowed resistance shall be specified in detailed specification.

8 Mechanical tests

8.1 Peel strength of conductor

- 1) Equipment: the instrument shall be a testing machine which can keep the pulling speed of the cross head to 50 mm/min. The accuracy shall be within $\pm 1\%$ of the indication within its effective measuring range and the pulling force shall be within 15 % to 85 % of the capability of the testing machine. Use a jig to hold the specimen to keep the peeling angle to 90° to the specimen surface.