



IPC-TM-650 TEST METHODS MANUAL

1 Scope This test method is to characterize fluxes by determining the degradation of electrical insulation resistance of rigid printed wiring board specimens after exposure to the specified flux. This test is carried out at high humidity and heat conditions.

2 Applicable Documents

IPC-B-24 Surface Insulation Resistance Test Board

IPC-A-600 Acceptability of Printed Boards

IPC J-STD-004 Requirements for Soldering Fluxes

IPC-9201 Surface Insulation Resistance Handbook

3 Test Specimen A minimum of 10 ml of liquid flux, a representative container of solder paste, cored wire, paste flux, or extracted solder preform flux. The reflow/extraction process should be carried out in accordance with IPC J-STD-004.

3.1 Comb Patterns Use the IPC-B-24 test pattern (see Figure 1), which consists of four comb patterns per coupon. Each individual comb has 0.4 mm lines and 0.5 mm spacing. The metallization shall be unpreserved bare copper.

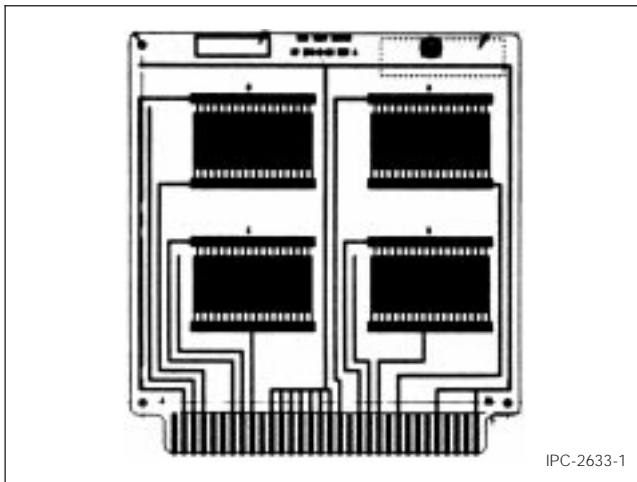


Figure 1 Test Pattern from IPC-B-24

3.2 Laminat The laminate material for this test shall be FR-4 epoxy-glass.

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Originating Task Group Flux Specifications Task Group, (5-24a)	

4 Apparatus

4.1 A clean test chamber capable of programming and recording an environment of $25 \pm 10/-2$ °C [$77 \pm 18/-3$ °F] to at least 85 ± 2 °C [185 ± 3.6 °F] and $20\% \pm 5\%$ to $85\% \pm 2\%$ relative humidity. A salt solution and desiccator may be used to maintain humidity if a tight temperature control is maintained on the chamber.

4.2 A power supply capable of producing a standing bias potential of 45-50 volts DC with a tolerance of $\pm 10\%$.

4.3 A resistance meter capable of reading high resistance (10^{12} ohms) with a test voltage of 100 volts, or an ammeter capable of reading 10^{-10} amps in combination with 100 volts DC power supply.

4.4 Three 2000 ml beakers.

4.5 Exhaust ventilation hood.

4.6 Metal tongs.

4.7 Soft bristle brush.

4.8 Deionized or distilled water (2 megohm-cm minimum resistivity recommended).

4.9 Drying oven capable of maintaining at least 50 °C [122 °F].

5 Procedure

5.1 Test Conditions All fluxes will be tested at 85 ± 2 °C, [185 ± 3.6 °F], $85 \pm 2\%$ relative humidity for 168 hours.

5.2 Specimen Preparation There shall be three test coupons for each liquid flux to be tested in the cleaned state (Table 1, Sample Group A). When testing liquid fluxes which are intended to remain in the uncleaned state, six test coupons are required. Three uncleaned test coupons shall be soldered pattern side down (Table 1, Sample Group B) and three shall be soldered pattern side up (Table 1, Sample Group C).

Solder paste coupons shall be reflowed pattern side up and either cleaned (Table 1, Sample Group D) or not cleaned (Table 1, Sample Group E).

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In addition, there shall be at least two unprocessed control coupons for comparison purposes (Table 1, Sample Group F).

Table 1 Coupons for SIR Testing

Sample Group	Flux/Solder	Clean	Number of Coupons
A	Yes	Yes	3
B	Yes	No	3
C	Yes	No	3
D	Yes	Yes	3
E	Yes	No	3
F	No	No	2

A = Pattern down/cleaned
 B = Pattern down/not cleaned
 C = Pattern up/not cleaned
 D = Solder paste/reflow/cleaned
 E = Solder paste/reflow/not cleaned
 F = Control (precleaned, unprocessed)

5.2.1 Positive, permanent and noncontaminating identification of test specimens is of paramount importance. (For example, a vibrating scribe.) Permanent ink may be used on the back side of the test coupon if areas beneath conductors are avoided.

5.2.2 Visually inspect the test specimens for any obvious defects, as described in IPC-A-600. If there is any doubt about the overall quality of any test specimen, the test specimen should be discarded.

5.2.3 Clean each test or control coupon with deionized or distilled water and scrub with a soft bristle brush for a minimum of 30 seconds. Spray rinse thoroughly with deionized or distilled water. Rinse the cleaned area thoroughly with fresh 2-propanol.

An alternative cleaning method is to place the test coupon in an ionic contamination tester containing 75% 2-propanol, 25% deionized water and process the solution until all ionics have been removed.

During the remainder of the specimen preparation, handle test specimens by the edges only, and use noncontaminating rubber gloves.

5.2.4 Dry the cleaned boards for two hours at 50 °C [122 °F].

5.2.5 If boards are to be stored before treatment, place the boards in Kapak® bags or other contamination-free containers (do not heat seal) in a desiccator.

5.3 Sample Preparation Flux application and soldering.

5.3.1 Liquid Flux or Flux Extract Coat the test pattern with a thin coating of the liquid flux or flux extract under test.

5.3.1.1 Preheat the flux coated test coupon using the temperature profile recommended by the vendor. If no profile is available, preheat the test coupon in an oven set at a temperature such that the test coupon reaches a temperature of 140 °C [284 °F] in 30 to 45 seconds.

5.3.1.2 Immediately expose the test coupon to solder by floating the fluxed comb patterns of the test specimen face down on the solder pot at 245-260 °C [473-500 °F] for 4 ± 1 seconds. Be sure that all dross is removed from the solder pot surface just before contact with the specimen.

5.3.1.3 Alternatively, the specimen can be wave soldered face down at 245-260 °C [473-500 °F] and a conveyor speed with a contact time of 3 ± 1 seconds.

5.3.1.4 For fluxes to be tested in the uncleaned state, a second set of test patterns shall be fluxed and floated pattern up on the solder pot or passed pattern up over the solder wave.

5.3.2 Solder Paste or Paste Flux Stencil print the solder paste or paste flux onto the comb pattern using a 0.15 mm [0.00591 in] (6 mil) thick stencil (the IPC-A-24 artwork contains the stencil design).

5.3.2.1 The samples shall be run through a reflow soldering process using the temperature profile recommended by the vendor.

5.3.3 Cored Wire Using a clean fine-tip soldering iron apply the cored wire to the comb patterns being careful not to bridge the conductors. The iron temperature should be as specified by the cored wire vendor.

5.4 Cleaning of Samples

5.4.1 After exposure to flux and solder, samples to be tested in an uncleaned state shall be tested as outlined in 5.5 through 5.6.1.

5.4.2 After exposure to flux and solder, samples to be tested in the cleaned state shall be cleaned using one of the

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procedures listed below. The cleaning parameters shall be reported in the Qualification Test Report of J-STD-004.

5.4.2.1 The samples to be cleaned shall be cleaned with an appropriate environmentally safe solvent or aqueous cleaning medium. The use of a commercial in-line or batch cleaner is preferred. If this is not available, the following laboratory cleaning process shall be followed.

5.4.2.2 Samples shall be cleaned within 30 minutes or less after soldering. For solvent or aqueous detergent cleaning, three 2000 ml beakers each containing 1000 ml of solvent shall be used such that one beaker serves as the primary cleaning stage and the other two are used for rinsing purposes. Each test coupon shall be agitated in each beaker for one minute. In the case of aqueous detergent, one beaker shall contain the cleaning agent and the remaining beakers shall contain deionized water for rinsing purposes. Beaker solutions shall be used to clean or rinse a maximum of three specimens before the solutions are replaced. After the cleaning procedure, dry the samples for two hours at 50 °C [122 °F]. Following cleaning and drying, the specimens shall be tested as outlined in 5.5 through 5.6.1.

5.5 Preparation of Samples for Chamber Visually inspect all combs and discard (or replace, if possible) any combs with bridging of conductors or visible (at 10-30X with backlighting) metallic debris between conductors. Shield the comb patterns during soldering of the connection points. Use water white rosin to solder Teflon®-insulated wires to the connection points of the specimens. Do not attempt to remove the flux residues. Connectors may be used in lieu of soldering wires but are not recommended. In the event of a dispute, the samples with soldered wires shall be used as a referee.

5.5.1 Place the specimens in the environmental chamber in a vertical position such that the air flow is parallel to the direction of the board in the chamber. Set the chamber temperature at 85 ± 2°C [185 ± 3.6 °F] and humidity at 20% RH and allow the oven to stabilize at this temperature for three hours. Then slowly ramp the humidity to 85 ± 2% over a minimum 15 minute period. Allow the specimens to come to equilibrium for at least one hour before applying the bias voltage to begin the test. If a salt solution and desiccator are used for humidity, specimens shall be held for 24 hours before beginning the test.

5.5.2 Connect the 45-50v DC voltage source to the specimen test points to apply the bias voltage to all specimens.

Place a 1 MΩ current limiting resistor in series with each test point.

5.6 Measurements Measurements shall be made with test specimens in the chamber under the test conditions of temperature and humidity at 24, 96 and 168 hours. To take these measurements, the 45 - 50v DC bias voltage source must be removed from the test specimen and a test voltage of -100v DC shall be applied. (Test voltage polarity is opposite the bias polarity.)

5.7 Evaluation

5.7.1 Each comb pattern on each test specimen shall be evaluated by the insulation resistance values obtained at 96 and 168 hours. If the control coupon readings are less than 1000 megohms, a new set of test coupons shall be obtained and the entire test repeated. The reading at 24 hours may fall below the required value provided that it recovers by 96 hours.

5.7.2 Any reason for deleting values (scratches, condensation, bridged conductors, outlying points, etc.) must be noted. Deletion of results for more than two combs shall require the test to be repeated.

5.7.3 All specimens shall also be examined under a 10x to 30x microscope using backlighting within 24 hours of completing the testing. If the coupons are to be held longer, they shall be placed in Kapak® or other noncontaminating container and stored in a desiccator. All samples must be evaluated within seven days. If dendritic growth is observed, it shall be determined if the dendrite spans 25% or more of the original spacing. This latter condition will constitute a failure. It should be determined whether dendritic growth is due to condensation from the chamber (see 6.1). Visible discoloration, corrosion, or dendritic growth shall be reported.

6 Notes

6.1 If condensation occurs on the test specimens in the environmental chamber while the samples are under voltage, dendritic growth will occur. This can be caused by a lack of sufficient control of the humidification of the chamber. Water spotting may also be observed in some chambers where the air flow is from back to front. In this case, water condensation on the cooler chamber window can be blown around the chamber as microdroplets that deposit on test specimens and cause dendritic growth if the spots bridge the distance

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between two electrified conductors. Both of these conditions must be eliminated for proper testing.

6.2 IPC-B-24 test board artwork and electronic data is available from IPC.

6.3 Safety Observe all appropriate precautions on MSDS for chemicals involved in this test method.