The Institute for Interconnecting and Packaging Electronic Circuits
2215 Sanders Road • Northbrook, IL 60062-6135

IPC-TM-650
TEST METHODS MANUAL

Number	
2.6.19	
Subject	
Environmental and Insulation Resistance Test of Hybrid Ceramic Multilayer Substrate Boards	
Date **12/87**	Revision
Originating Task Group **N/A**	

1.0 Scope This test method is to evaluate the insulation resistance of ceramic plated-through hole multilayer printed wiring boards before, during and after the deteriorative effects of the high humidity heat conditions, and low temperature thermal shock exposures. Hybrid ceramic multilayer boards are employed as the dimensionally stable interconnection media between conventional printed boards and a variety of hybrid packages.

Tropical degradation results from absorption of moisture vapors by vulnerable insulating materials and surface wetting of both metal conductors and the insulating laminate material. These phenomena may produce corrosion of metals, distortion of the boards, leaching, and detrimental changes in electrical properties.

This method by virtue of the temperature cycling provides alternate cycles of condensation and temperature changes which is essential to the development of the corrosion process, and in addition produces a ''breathing'' action of moisture.

The low temperature thermal shock phase of the test reveals otherwise undiscernible deterioration. The stresses caused by freezing moisture tends to widen cracks and fissures. As a result the deterioration can be detected by insulation resistance or interconnection resistance of the plated-through hole barrels.

2.0 Applicable Documents

IPC-HM-860 Performance Specification for Hybrid Multilayers

3.0 Test Specimens Qualification test board of design approved by the customer or a randomly selected production board.

4.0 Test Equipment/Apparatus

4.1 Condition Chamber An oven capable of continually maintaining 120°C ± 2° drying conditions.

4.2 Humidity Chamber A test capable of programming and recording temperatures from 25°C ± 2° to 65°C ± 2° and capable of delivering a minimum of 90% relative humidity continuously (see Figure 1).

4.3 Low Temperature Chamber A test chamber capable of maintaining a constant ambient temperature of -10°C ± 2°. The low temperature may be achieved by mechanical refrigeration or with the use of gasses such as carbon dioxide (CO_2) or liquid nitrogen (Ln_2).

4.4 A DC power supply unit capable of producing a standing bias potential of 100 Vdc with a tolerance of ± 10%.

4.5 An electrical resistance meter capable of reading high resistance, 10^{12} or greater, with a voltage range of up to 500 Vdc or greater.

4.6 Scotchbrite very fine pads, pumice, or equivalent

4.7 Two 3500 ml. beakers

4.8 Electric hot plate

4.9 Exhaust ventilation hood

4.10 Metal tongs

4.11 Alkaline cleaning detergent (i.e., 40% alkanolamine, 20% 2-butoxyethanol, glycol ether and the remainder water with a pH factor of 13 or less)

4.12 Soft bristle brush

4.13 Deionized water, 2 megohm/cm minimum resistivity

4.14 Isopropyl alcohol

4.15 Black light (ultraviolet)

4.16 A microscope capable of 10x to 30x magnification

4.17 Silica gel desiccant

5.0 Test

5.1 Specimen Preparation

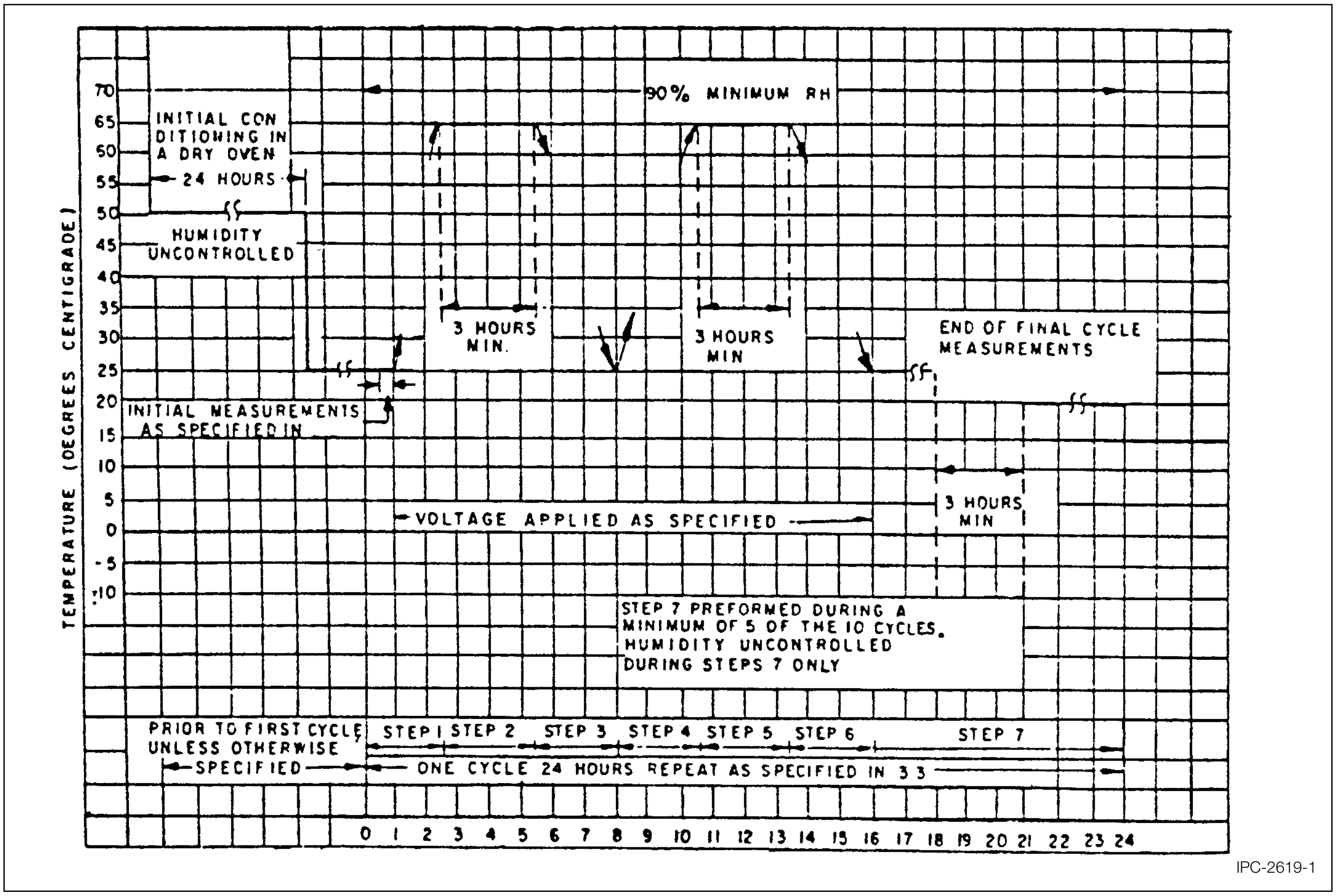

Figure 1 Graphical representation

5.1.1 Identify Specimen Positive and permanent identification of test specimen is of paramount importance, i.e., serial number, date code, part number, etc.

5.1.2 Visually inspect the test specimens for any obvious defects. If there is any doubt about the overall quality of any test specimen, the test specimen should be discarded.

5.1.3 Solder single strand teflon coated test leads in place and remove flux.

5.1.4 Scrub the test specimen for 15 to 20 seconds by hand using a Scotchbrite very fine pad or equivalent under running tap water, or for one normal cycle through an industrial quality circuit board scrubber. See note 6.1. Handle boards with clean metal tongs for the remainder of the specimen preparation.

5.1.4.1 Clean board in vapor degreaser.

(a) Pour a sufficient amount of solvent (Freon TMS or 1,1,1, trichloroethane) into a 3500 ml. beaker to vapor degrease the number of test boards on hand.

(b) Place the 3500 ml. beaker on an electric hot plate and heat the solvent to the boiling point (under a hood or in a well ventilated area).

(c) Using metal tongs, hold the board suspended over the solvent until the vapor condenses on the board and drips off freely.

(d) Remove the board from the solvent vapor and allow to dry for approximately 5 minutes.

5.1.4.2 Mix a solution of clean, warm deionized water and the alkaline cleaning detergent in a 3500 ml. beaker (approximately 3 oz. per gallon of water). The board shall not be allowed to dry prior to proceeding.

(a) Scrub both sides of the board with a soft bristle brush in the warm (120°F - 130°F) solution (see note 6.1).

(b) Immerse the board in warm, running deionized water and agitate for 30 seconds minimum.

(c) Immerse board in clean deionized water and agitate for a minimum of 30 seconds to remove detergent solution. Handle board by the edges using metal tongs.

(d) Spray rinse thoroughly with deionized water. Hold board at an approximate 30° angle and spray from top to bottom.

5.1.4.3 Immerse board in clean isopropyl alcohol and agitate for a minimum of 30 seconds. Scrub with a soft bristle brush to remove flux residue. Handle board by the edges using metal tongs. Be sure to use a brush that does not leave loose bristles on the specimen.

5.1.4.4 Rinse board and components thoroughly with a second isopropyl alcohol bath. Hold board by edges and agitate in the liquid.

5.1.4.5 Examine for cleanliness. Use black light to detect contaminants that will fluoresce.

5.1.4.6 Dry board in drying oven for a minimum of 3 hours at 100°C.

5.1.4.7 Test specimen cleanliness. For the remainder of the test, the surface of the test specimens should not be handled or exposed to any other contaminating influence.

5.2 Test Procedure

5.2.1 Dry specimens at 50°C ± 2° (122°F) for 24 hours.

5.2.2 Allow specimen to cool and take initial insulation reading at laboratory ambient conditions. Apply electrification voltage of 500 Vdc to the test leads with the resistance meter for 1 minute, then take measurement and record as the initial reading (clip meter to test leads).

5.2.3 Place specimen in humidity chamber in a vertical position and under a condensation drip shield. Apply 100 Vdc polarized voltage.

5.2.4 Start humidity exposure with 90% minimum relative humidity at 25°C, and raise temperature to 65°C over a time span of 2 1/2 hours ± 3/4 hours.

5.2.5 Maintain temperature at 65°C and 90% minimum relative humidity for 3 hours ± 1/4 hour.

5.2.6 Lower temperature from 65°C to 25°C over a time span of 2 1/2 hours ± 1/4 hours while maintaining 80% minimum relative humidity.

5.2.7 Three humidity cycles constitute one 24-hour exposure. Repeat for 10 days.

5.2.8 Subcycle of step 5.2.7. During at least five of the ten cycles a low temperature subcycle shall be performed.

5.2.8.1 Disconnect the 100 Vdc polarized voltage during steps 5.2.7 exposure. At least 1 hour but not more than 4 hours after step 5.2.7 begins, the specimens shall be either removed from the humidity chamber, or the temperature of the chamber shall be reduced, for performance of the subcycle.

5.2.8.2 Specimens during the subcycle shall be conditioned at -10° ± 2°C, with humidity not controlled, for 3 hours minimum as indicated in Figure 1. When a separate cold chamber is not used, care should be taken to assure that the specimens are held at -10° ± 2°C for the full period.

5.2.8.3 After step 5.2.7, the specimens shall be returned to 25°C at 90% relative humidity (RH) minimum and kept there until the next cycle begins.

5.3 Measurements

5.3.1 After the 10 day exposures, disconnect 100 Vdc polarized voltage before taking insulation resistance measurements.

5.3.2 Measure insulation resistance once every 24 hours during the high temperature phase of the humidity exposure. These measurements are to be made without opening the humidity chamber.

5.3.3 The final insulation resistance measurement must be taken 1 to 2 hours after the specimen has stabilized at laboratory ambient conditions.

5.4 Evaluation

5.4.1 All insulation resistance measurements must be compared with the requirements of IPC-HM-860, Performance Specification for Hybrid Multilayers.

5.4.2 Visual examination at 10x to 30x magnification for cracks, fissures, corrosion or other deleterious effects must also be reported.

6.0 *Notes*

6.1 Documented alternative cleaning procedures may be implemented if there is a concern that scrubbing will adversely affect the test results, i.e., when test specimens have fine spacing and/or are plated with soft metals such as tin/lead, gold, etc.