Solder Mask: General Information and Testing

Debora L. Obitz
Trace Laboratories-East
5 North Park Drive
Hunt Valley, MD
410-584-9099

Solder Masks are subjected to a wide array of both short and long term testing before their arrival at the assembler/user. This paper will familiarize you with these tests, their usefulness, and shortcomings.

As an overview, it is worth mentioning that the current industry accepted document for Qualification and Performance of Permanent Solder Mask is IPC-SM-840C, Amendment 1.

The vendor formally qualifies their mask in accordance with Table 1 Requirements of Qualification/Conformance of IPC-SM-840C, Amendment 1. The applicable testing is located under the Columns identified as A and B. The use of standard test boards, IPC-B-25A, and substrates are used for qualifying the solder masks.

The fabricator can also use Table 1 for process qualification assessment. The fabricator is required to requalify if one or more of the following changes from the original qualification samples:

a. Solder Mask (formulation change – discussed later in paper)
b. Conductor Surface (copper, nickel, gold, tin-lead, etc.)
c. Substrate Material (glass epoxy, polyimide, etc.)

General Information

The IPC-SM-840C when issued in January 1996 changed from three Class Designations (Class 1, 2, and 3) to two Class designations Class T (Telecommunications) and Class H (High Reliability). Basically, Class T is equivalent to Class 2 and Class H is equivalent to Class 3. Class 1 was not adopted under a new class since it was found that the majority of vendors and fabricators qualified/tested mainly to Classes 2 and 3. Class T was primarily structured from the input of Telcordia (formerly known as Bellcore) representatives to image the TR-NWT-000078 (new revision is GR-78-CORE), Section 13.2 Polymeric Coatings and Adhesive Materials.

Formulation Change: If a solder mask formula has been changed, this paragraph clarifies whether the solder mask is required to again undergo the Qualification process of Table 1.

This excerpt is taken directly from paragraph 3.4.1 of IPC-SM-840C:

> The following constitutes a formulation change and requires requalification of the solder mask.
>
> a. Changes exceeding ±2% in the formula weight of any non-volatile ingredient from the ingredient's original formula weight.
> b. Elimination of a non-volatile ingredient
> c. Addition of a new non-volatile ingredient
> d. Changes in type of dye or pigment, excluding coloring dye or pigment within a defined, tested range of lowest (none) and highest (supplied) loading levels of the specific coloring materials.
> e. Any change in the mask that results in a change in the FTIR spectral response of the dried mask.
> f. Addition, deletion or change in composition of "inert" materials in the formulation such as matting agent(s), excluding a change in quantity of a single "inert" material already present in the formula within a defined, tested range of lowest (none) and highest (supplied) loading levels of that specific "inert" material. Change to more than one material is considered a formulation change.
>
> The following do not constitute a change in formulation and do not require requalification of the solder mask.
>
> a. Changes of less than ±2% in the formula weight of any non-volatile ingredient from the ingredient's original formula weight.
> b. Changes in volatile components (solvents) where the residual amount in the dried coating (under recommended drying conditions) is less than 1% of the dried weight.
> c. Changes in the % solids vs. volatiles of the solder mask as supplied to user.

Testing Changes

Three tests were dropped from the Revision B: Dimensional (thickness requirement), Taber Abrasion and Solder/Desolder.

Other tests were incorporated into the Revision C:

Flammability (Oxygen Index) – This flammability test was added to the specification, as a reflection of the Telcordia required testing.

Dimensional – This test was revised to drop the thickness requirement. The dimensional requirement is the same as Dielectric Strength (500VDC/mil).

Via Protection – This test was added to ensure the adhesion of solder mask to via holes.

Resistance To Assembly and Process and Chemistry – This test was added for the fabricator testing. This encompasses additional testing of solvents and/or cleaning agents used in the fabricator's process which are not covered under the Resistance to Solvents and Cleaning Agents.

Moisture and Insulation Resistance and Electrochemical Migration (Class T) – These tests were added to the specification as a reflection of the Telcordia required testing.

IPC-B-25A board – A newly designed test board combine various test coupons in order to perform qualification testing. Note: The revised board did not incorporate via holes into the design. Via holes are needed for the new section 3.5.2.3 Via Protection; however, this is only required for the fabricator testing.

Solder Mask Testing

For clarity purposes the tests are discussed the in the order that they appear in Table 1 Requirements of Qualification/Conformance of the document.

Visual Requirements

Visual

The visual inspection of the solder mask verifies that the solder mask is uniformly distributed on the board and has no defects, which would interfere with the operation of the board.

The visual inspection is performed on all the submitted test boards (either IPC-B-25A or production boards) and other solder mask coated test specimens using 1.75 to 10X magnification. The solder mask is examined for uniformity, foreign materials, cracks, inclusions, peeling, and roughness, which would affect the operation of the board.

Miscellaneous

Curing

These tests are designed to insure that the solder mask has been properly cured according to the manufacture's specified application and curing requirements. The

three tests, which are later outlined in the body of this article, are Solvent and Cleaning Agent Resistance, Solderability, and Solder Resistance.

Fungus Resistance

Fungus Resistance is performed to determine the resistance of the solder mask to fungi under conditions favorable for their growth; namely high humidity, warm atmosphere, and the presence of inorganic salts.

The solder mask is applied to three unclad 2" X 3" laminate specimens using the manufacturer's specified application and curing requirements.

Aspergillus niger, Chaetomium globosum, Gliocladium virans, Aureobasidium pullulans, and Penicillium funiculosum are grown on nutrient salt agar for approximately two weeks before preparing a mixed spore suspension. Once the spores have reached two weeks maturity, they are scraped from the surface of the agar and are cleansed (three times) with sterile water followed by a final rinse in sterile mineral salts solution. The spores are mixed together into suspension and sprayed onto the surface of the test coating. After the coated test specimens (and cotton duck control specimens) are sprayed they are placed in a test chamber which is cycled for 20 hours at 30° ±1°C, 95 ±5% RH followed by 4 hours at 25° ±1°C, 100% RH, for 28 days. The specimens are removed and visually examined for fungal growth or degradation of the solder mask.

Dimensional

The dimensional testing has been changed from the previous revisions, which was based solely on a thickness requirement. The new test is to visually examine the specimens for complete coverage of solder mask of the areas specified to be coated. The specimens shall also meet the Dielectric Strength (see Electrical Requirement section) test later discussed in the body of this article.

Physical Requirements

Pencil Hardness

This test is designed to evaluate the hardness of the solder mask surface and its resistance to abrasion.

The test is carried out on three IPC-B-25A boards coated with solder mask and cured according to the manufacture's specified application and curing requirements.

The board is placed on a firm horizontal surface. The hardest pencil (Eagle Turquoise brand ranging from 6H to 4B) is selected and is held firmly against the solder mask at a 45°angle. The pencil is then pushed away from the operator with uniform downward and forward pressure in a ¼ inch stroke. If the solder mask is cut or gouged then the next softest pencil is used until one is found which will not cut into the mask. The pencil hardness is then recorded which did not cut or gouge the solder mask.

Adhesion

The adhesion test determines the adhesion of solder mask used over melting metals, non-melting metals, and printed circuit board substrates.

Rigid

The adhesion test is performed on three checkerboard patterns, identified as coupon B on the IPC-B-25A board. The specimens are tested in the as received and after soldering process in accordance with J-STD-003. The solder mask is completely coated and cured according to the manufacture's specified application and curing requirements. The board is placed on a firm horizontal surface and a strip of pressure sensitive tape (3M brand 600) ½ " wide by 2" long is pressed firmly against the checkerboard pattern. All air bubbles need to be removed and the tape should completely cover the coupon area. The tape is then rapidly removed in a 90° angle to the board. An unused strip of tape shall be used for each tape test. The tape shall be removed less than one minute following application of the tape to the test pattern. The same procedure is followed after the board has been subjected to molten solder maintained at 473° ±9°F for five seconds. The tapes are then examined for evidence of film particles, separation, fracturing, or delamination of the coating from the surfaces of the bare material and conductors. Table 2 of the IPC-SM-840 provides the allowable solder mask percentage loss for the test substrates.

Flex

The adhesion test is performed on three custom supplied flexible patterns. The specimens are tested in the as received and after soldering process in accordance with J-STD-003. The solder mask is completely coated and cured according to the manufacture's specified application and curing requirements. The specimen is placed on a firm horizontal surface and a 1/8 " mandrel is placed in the center of the test coupon. The specimen is folded 180° in each direction around the 1/8" mandrel for 25 cycles. The same procedure, using a new area on the specimen, is followed after the board has been subjected to molten solder maintained at 473° ±9°F for five seconds. The solder mask is then examined for evidence of separation or cracking. Table 2 of the IPC-SM-840 provides the allowable solder mask percentage loss for the test substrates.

Via Protection

This test is designed to determine the adhesion of the solder mask over via holes.

A minimum of six protected via holes shall be completely coated with solder mask and cured according to the manufacture's specified application and curing requirements. The specimens are tested in the as received and after soldering process in accordance with J-STD-003. The test vehicle is placed on a firm horizontal surface and a strip of pressure sensitive tape (3M brand 600) ½ " wide by 2" long is pressed firmly against the tented via holes. All air bubbles need to be removed and the tape should completely cover the tented via holes. The tape is then rapidly removed in a 90° angle to the test vehicle. An unused strip of tape shall be used for each tape test. The tape shall be removed less than one minute following application of the tape to the test pattern. The same procedure is followed after the test vehicle has been subjected to molten solder maintained at 473° ±9°F for five seconds. The tapes are then examined for evidence of

film particles, separation, fracturing, or delamination of the coating from the surfaces of the bare material and conductors. Table 2 of the IPC-SM-840 provides the allowable solder mask percentage loss for the test substrates.

Machinability

The machinability test is designed to ensure that the solder mask will not be degraded more than the test substrate when subjected to normal manufacturing processes.

Three IPC-B-25A boards completely coated with solder mask and cured according to the manufacture's specified application and curing requirements. The boards shall be subjected to drilling, routing, sawing, and punching. The boards are examined with corrected 20/20 vision without magnification for cracking and tearing. The cracks or tears of the solder mask shall not be more than that observed on the test substrate.

Chemical Requirements

Resistance to Solvents and Cleaning Agents

The resistance to solvent and cleaning agents is designed to ensure that the solder mask will not degrade when exposed to the most frequently industry used solvents/cleaning agents of the manufacturing process.

Six IPC-B-25A boards completely coated with solder mask and cured according to the manufacture's specified application and curing requirements. The specimens, one per solution, are subjected to the solvents and cleaning agents of Table 3.

Table 3: Resistance to Solvents and Cleaning Agents

Solvent/Cleaning Agent	Test Conditions	
	Temperature	Time (minutes)
Isopropanol	Standard laboratory, room	2
75% Isopropanol/25% Water	46 ±2°C	15
D-limonene	Standard laboratory, room	2
10% Alkaline detergent (for example, ≤40% alkanolamine, ≤20% 2-butoxyethanol, ≤20% glycol ether and the remaining 90% water; pH ≤13	57 ±2°C	2
Monoethanolamine	57 ±2°C	2
Deionized water	60 ±2°C	5

After exposure, the specimens are hung to dry for ten minutes and then visually examined with 20/20 corrected vision without magnification for surface degradation. Examples of surface degradation are roughness, swelling, tackiness, blistering, or color change).

Resistance to Assembly Process and Chemistry
Six IPC-B-25A boards or production boards completely coated with solder mask and cured according to the manufacture's specified application and curing requirements. This testing is carried out by the fabricator only and is designed to test those chemicals, fluxes, and/or cleaning agents used in the fabricators plant which are not listed in Table 3. The fabricator shall supply the solvent/cleaning agent, and also specify testing temperature and exposure time.

Hydrolytic Stability/Aging
This test is designed to determine the resistance of the applied solder mask to reverting to liquid when exposed to high temperature and humidity.

Three 4" X 4" copper or copper clad laminates completely coated with solder mask and cured according to the manufacture's specified application and curing requirements. The specimens are subjected to 97 ±2°C with a relative humidity of 90 - 98% for 28 days. The specimens are examined for resistance to reversion by visually examining the appearance and performing a test for surface tackiness. To test for surface tackiness, the solder mask surface is touched with a swab of absorbent cotton and then visually examined for particles of cotton adhering to the coated surface.

Flammability
The flammability has separate requirements for the two classes (T and H).

- Class H requires the solder mask meet UL-94 with a rating of "V".
- Class T requires the solder mask meet UL-94 (the "V" rating of the mask shall not be raised by more than one, rating shall be at least V-1, and the solder mask shall meet the oxygen index of being $\geq$ 28%.

Testing for UL-94:
Twenty ½ " X 5" laminate strips completely coated with solder mask and cured according to the manufacture's specified application and curing requirements and ten ½ " X 5" laminate strips uncoated are used for testing.
A set of 10 specimens were preconditioned for a minimum of 48 hours at 23 ± 2°C and 50 ± 5 percent relative humidity. A set of 10 specimens were preconditioned for 168 hours at 70 ± 1°C and then cooled in a desiccator for at least 4 hours at room temperature, prior to testing. Each test specimen was supported from the upper 6 mm (with the longitudinal axis vertical) by a clamp on a ring stand so that the lower end of the test specimen was 10 mm above the top of the burner tube and 300 mm above a layer of dry surgical cotton. The test specimen was ignited using a 20 mm ± 1 mm methane flame for 10 seconds. The flame was then withdrawn from the test specimen at least 150 mm and the duration of flaming (t_1) was noted. When flaming of the test specimen ceased, the methane flame was placed again under the test specimen. After 10 seconds, the test flame was withdrawn, and the duration of the flaming (t_2) and glowing (t_3) was noted.

Testing for Oxygen Index:
Six ½ " X 5" laminate strips completely coated with solder mask and cured according to the manufacture's specified application and curing requirements. The samples were individually conditioned for 24 hours at 23^{o}C, 50% relative humidity. After conditioning, each sample was clamped in the holder, vertically, and in the approximate center of the column, with the tip of the specimen 100 mm below the top of the open column. The initial concentration of oxygen was set. The gas flow rate was set at 4 ±1 cm./sec. The gas was allowed to flood the enclosure for approximately 60 seconds. The sample was then ignited and the time started. The oxygen was adjusted accordingly, until each sample burned consistently for a period of 3 minutes, at the lowest oxygen level obtainable.

Soldering Requirements

Solderability

This test is designed to ensure that the solder mask does not hinder solderability (of the areas intended for solder coverage).

Three IPC-B-25A boards completely coated with solder mask and cured according to the manufacture's specified application and curing requirements. The boards shall be conditioned at 105°C for 1 hour and placed in a desiccator to cool to room temperature. After cooling, the specimens are placed on molten solder maintained at 473 ±9°F for 5 seconds. After five seconds, the specimens are removed from the molten solder and placed on an insulator to cool. After cooling, the specimens are examined to ensure that the solder mask coating did not adversely affect the solderability of the areas intended to be soldered.

Resistance to Solder

This test is designed to ensure that solder will not adhere to the solder mask surface and is also an indicator to complete cure of the solder mask.

Three IPC-B-25A boards completely coated with solder mask and cured according to the manufacture's specified application and curing requirements. The specimens are placed on molten solder maintained at 500 ±10°F for 10 ±1 seconds. After ten seconds, the specimens are removed from the molten solder and placed on an insulator to cool. After cooling, the specimens are examined to ensure that the solder did not adhere to the solder mask coating.

Electrical Requirements

Dielectric Strength

This test is designed to provide assurance that component parts can operate safely at its rated voltage and withstand momentary over potentials due to switching, surges, and other phenomena.

Three 4" X 4" copper or copper clad laminate (one side) coated with a 3" X 3" square of solder mask in the approximate center of the specimen and cured according to the

manufacture's specified application and curing requirements. The ground lead of a high pot tester is attached to the copper of the test specimen. A two-inch diameter electrode attached to the second lead is placed in the center of the 3" X 3" square of solder mask. A test voltage is applied in increments of 500VDC per second until breakdown occurs. After breakdown occurs the breakdown voltage is recorded. The four copper edges are measured for thickness and averaged. The four corresponding solder mask edges (which also includes the copper) are measured for thickness and averaged. The copper average thickness is subtracted from the solder mask thickness giving the solder mask thickness measurement. The breakdown voltage is divided by the solder mask thickness and voltage (volts/mil) is recorded.

Insulation Resistance

The insulation resistance uses separate comb patterns for the two classes (T and H).

- Class H uses the "D" comb pattern.
- Class T uses the "E" and "F" comb patterns.

Class H: Insulation Resistance is performed on two coated and one uncoated IPC-B-25A boards. One of the coated specimens is subjected to solder as previously stated in the resistance to solder test and cleaned with deionized water and isopropyl alcohol. Insulated wires are attached to the finger tabs of the "D" pattern by soldering or using gold plated tension clips. The flux is not cleaned from the finger tabs. The specimens are conditioned for 24 hours at 50 $\pm$2°C. A test voltage of 100 volts is applied to each of the individual test points 1-2, 2-3, 3-4, and 4-5 for one minute before obtaining the insulation resistance measurement. The minimum insulation resistance shall be 500 megohms.

Class T: Insulation Resistance is performed on two coated and one uncoated IPC-B-25A boards. One of the coated specimens is then subjected to solder as previously stated in the resistance to solder test and cleaned with deionized water and isopropyl alcohol. Insulated wires are attached to the finger tabs of the "E" and "F" patterns by soldering or using gold plated tension clips. The flux is not cleaned from the finger tabs. The specimens are conditioned for 24 hours at 50 $\pm$2°C. A test voltage of 100 volts is applied to each of the individual test points for one minute before obtaining the insulation resistance measurement. The minimum insulation resistance shall be 500 megohms.

Electrical Requirements

Moisture and Insulation Resistance

This test is designed to determine the moisture and insulation resistance of the applied solder mask under two separate prescribed conditions of temperature and humidity.

The moisture and insulation resistance uses separate comb patterns and test conditions for the two classes (H and T).

- Class H uses the "D" comb pattern.
- Class T uses the "E" and "F" comb patterns.

Class H: Moisture and Insulation Resistance is performed on two completely coated IPC-B-25A boards, with solder mask and cured according to the manufacture's specified application and curing requirements and one uncoated IPC-B-25A boards. One of the coated specimens is subjected to solder as previously stated in the resistance to solder test and cleaned with deionized water and isopropyl alcohol. Insulated wires are attached to the finger tabs of the "D" pattern by soldering or using gold plated tension clips. The flux is not cleaned from the finger tabs. The specimens are conditioned for 24 hours at 50 $\pm$2°C. A test voltage of 100 volts is applied to each of the individual test points 1-2, 2-3, 3-4, and 4-5 for one minute before obtaining the insulation resistance measurement. The minimum insulation resistance shall be 500 megohms. Test specimens are subjected to cyclic temperatures of 25°C and 65°C with 90-95% relative humidity. The specimens are electrically biased with 50 VDC while inside the test chamber. The bias is removed before taking measurements inside the test chamber. A test voltage of 100 volts is applied to each of the individual test points 1-2, 2-3, 3-4, and 4-5 for one minute before obtaining the insulation resistance measurement. Electrical measurements are obtained at the high temperature cycle during each of the high cycles (the majority of the measurements are optional – the only required measurements are that of the final inside test chamber and after removal from the test chamber). Upon completion of accelerated cycling (20 cycles), the resistance measurements are again obtained after a minimum of one hour after removal and before two hours stabilization. The specimens are stabilized at laboratory test conditions for 24 hours and then examined for mealing, blistering, delamination, or other surface degradation of the solder mask.

Class T: Insulation Resistance is performed on two completely coated IPC-B-25A boards, with solder mask and cured according to the manufacture's specified application and curing requirements and one uncoated IPC-B-25A boards. One of the coated specimens is then subjected to solder as previously stated in the resistance to solder test and cleaned with deionized water and isopropyl alcohol. Insulated wires are attached to the finger tabs of the "E" and "F" patterns by soldering or using gold plated tension clips. The flux is not cleaned from the finger tabs. The specimens are conditioned for 24 hours at 50 $\pm$2°C. A test voltage of 100 volts is applied to each of the individual test points for one minute before obtaining the insulation resistance measurement. The minimum insulation resistance shall be 500 megohms. Test specimens are subjected to static temperature of 65 $\pm$2°C with 90 $\pm$3% relative humidity for 24 hours. At the 24th hour inside the test chamber, the resistance measurements are obtained and recorded.

The insulation resistance readings are averaged and shall be greater than 500 megohms. No individual insulation resistance value may be less than 0.1 X IR_{min}. Two measurements may be excluded from calculating the average (see Note 6.3) if there is an assignable cause of low insulation resistance that can be attributable to the laminate itself or to the process used to produce the board. Such assignable causes include:

- Contamination on the insulating surface of the board such as lint, solder splines, or water droplets from the conditioning chamber.

- Incompletely etched patterns that decrease the insulating space between conductors by more than amount allowed in the appropriate design the requirements drawing.

- Scratched, cracked, or obviously damaged insulation between conductors.

The average insulation resistance (IR_{avg}) was calculated from:

$$IR_{avg} = 10^{\left\{ \frac{1}{N} \sum_{1}^{N} \log IR_i \right\}}$$

Where:

N = Number of test points (6 nominal)
IR_i = Individual insulation resistance measurements.

The specimens are stabilized at laboratory test conditions for 24 hours and then examined for mealing, blistering, delamination, or other surface degradation of the solder mask.

Electrochemical Migration
These tests are designed to determine the ability of solder mask's protective coating to withstand an environment conducive to electrochemical migration.

The electrochemical migration test has separate requirements and test conditions for the two classes (H and T).

Class H: Electrochemical Migration is performed on three completely coated IPC-B-25A boards, with solder mask and cured according to the manufacture's specified application. Insulated wires are attached to the finger tabs of the "D" pattern by soldering or using gold plated tension clips. The flux is not cleaned from the finger tabs. The 1, 3, and 5 test points are attached with 10 megohm limiting resistor to the positive terminal of the power supply. Test specimens are subjected to a static temperature of 85 ±2°C with 90% relative humidity. A bias voltage of 10 volts is applied to the specimens for the entire chamber duration of 168 hours. After 168 hours, the test specimens are removed from the test chamber and stabilized to laboratory test conditions. After stabilization, ten volts was applied to each of the individual test points 1-2, 2-3, 3-4, and 4-5 for one minute before obtaining the resistance measurement. The minimum insulation resistance shall be greater than two megohms. The specimens are then examined with backlighting using 10X magnification for electrochemical migration.

Class T: Electrochemical Migration is performed on three completely coated IPC-B-25A boards, with solder mask and cured according to the manufacture's specified application. Insulated wires are attached to the finger tabs of the "D" pattern by soldering or using gold plated tension clips. The flux is not cleaned from the finger tabs. Test specimens are placed in a test chamber and subjected to a static

temperature of 85 ±2°C with 85% minimum relative humidity. After 96 hours, the initial insulation resistance is obtained from each of the test points 1-2, 2-3, 3-4, and 4-5 by applying 45 – 100 volts for one minute. Each of the 1, 3, and 5 test points are attached with 1 megohm-limiting resistor to the positive terminal of the power supply. A bias voltage of 10 volts is applied to the specimens for the entire chamber duration of 500 total hours. After 500 hours, the bias voltage is removed and the resistance measurements of the test specimens are obtained as previously stated. The test specimens are removed from the test chamber and stabilized to laboratory test conditions. The final insulation resistance (500 hours) shall be degraded by more than a decade from the initial (96 hours). The specimens are then examined with backlighting using 10X magnification for electrochemical migration.

The average insulation resistance (IR_{avg}) was calculated from the following equation:

$$IR_{avg} = 10^{\left\{ \frac{1}{N} \sum_{1}^{N} \log IR_i \right\}}$$

Where:

N = Number of test points (12 nominal)
IR_i = Individual insulation resistance measurements.

Two measurements may be excluded from calculating the average (see Note 6.3) if there is an assignable cause of low insulation resistance that can be attributable to the laminate itself or to the process used to produce the board. Such assignable causes include:

- Contamination on the insulating surface of the board such as lint, solder splines, or water droplets from the conditioning chamber.

- Incompletely etched patterns that decrease the insulating space between conductors by more than amount allowed in the appropriate design the requirements drawing.

- Scratched, cracked, or obviously damaged insulation between conductors.

Thermal Shock

The test is designed to determine the physical endurance of the applied solder mask to sudden changes of high and low temperature excursions that cause physical fatigue.

Thermal Shock is performed on three completely coated IPC-B-25A boards, with solder mask and cured according to the manufacture's specified application. The boards were subjected to molten solder as outlined in the solderability test and cleaned with deionized water and isopropyl alcohol. Three of the boards were coated with conformal coating that meets the specified requirements of IPC-CC-830 and cured according to the manufacture's specified application. The boards are placed in a thermal shock test chamber and the parameters are set. The boards are tested for 100 cycles at -65°C to

125°C with dwell times of 15 minutes at each temperature extreme. The transfer times are typically two minutes (or less)
maximum. Following the test exposure, the boards are removed and examined for detrimental damage to the solder mask with 10X magnification.

Additional Fabricator Testing – Physical Requirements

Nomenclature Compatibility

When nomenclature is to be applied in a subsequent operation, careful definition of adhesion requirements and the required test methods for that nomenclature to the production board system must be agreed upon by the printed board fabricator and his user customer.

Conformal Coating Adhesion

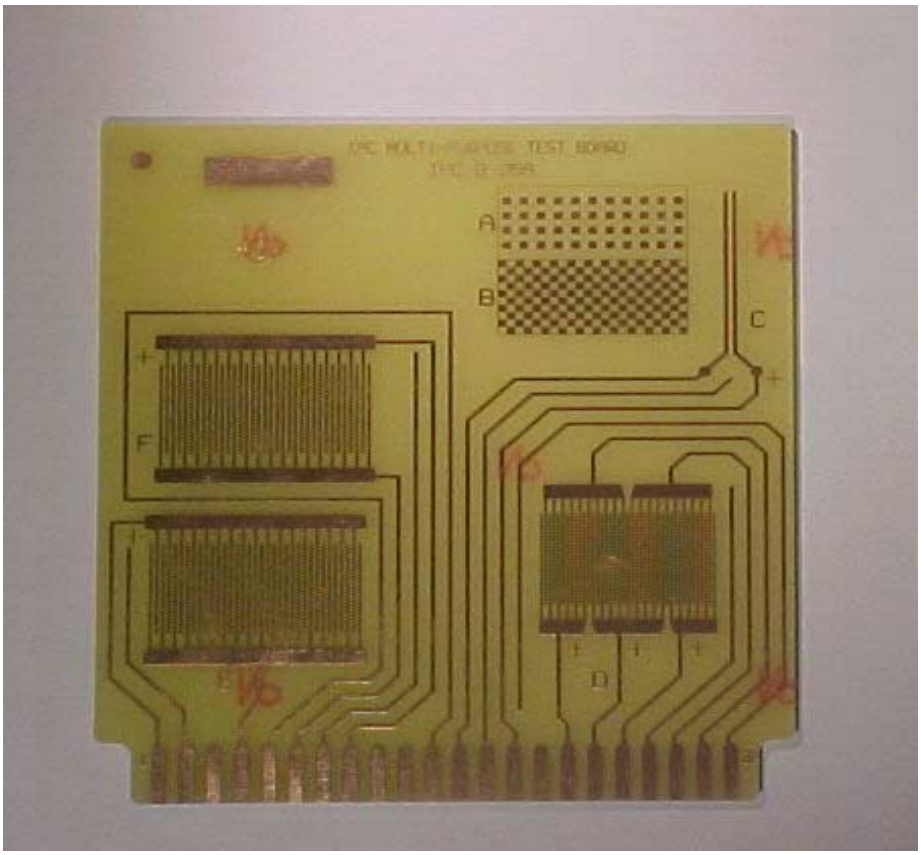
When conformal coating is to be applied in a subsequent operation, careful definition of adhesion requirements and the associated test methods for that conformal coating in relation to the production board system must be agreed upon by the printed board fabricator and his end customer.

This concludes the testing for the current IPC-SM-840C, Amendment 1. I hope that I have provided some insight into the rigorous testing solder masks have endured before their purchase.

In closing, I should note that although materials level specifications such as IPC-SM-840 provide a solid baseline for purchasing product, they cannot guarantee performance or compatibility with all applications. That said, it is critical that product be screened at user level.

References

IPC-TM-650
IPC-SM-840C, Amendment 1



IPC-B-25A test board

Moisture and Insulation Resistance Testing

Thermal Shock Testing

Fungus Resistance Testing