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*The Institute for  
Interconnecting  
and Packaging  
Electronic Circuits*

# IPC-SM-840C

## Qualification and Performance of Permanent Solder Mask

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# Qualification and Performance of Permanent Solder Mask

## 1.0 SCOPE AND DESIGNATION

**1.1 Scope** This standard has been designed and constructed with the intent of obtaining the maximum information about and confidence in the solder mask material under evaluation with the minimum of test redundancy. (See 6.1)

This standard covers:

- The evaluation and conformance of permanent solder mask material properties (Table 1, Column A).
- The qualification of the solder mask/standard IPC-B-25A test board (Table 1, Column B).
- The qualification assessment of the solder mask/production board process (Table 1, Column C).

For purposes of this specification, the term “solder mask” is used herein when referring to any type of permanent polymer coating material applied prior to assembly, but excluding marking (legend) inks and temporary hole plugging materials.

**1.2 Purpose** This standard enables a vendor to evaluate solder mask, and express the characteristics it possesses, when tested in a standard board system according to the test methods and conditions contained in this document. It also enables a printed board designer, manufacturer, and/or user to jointly qualify a production board process using the test methods and conditions contained in this document based on end use and environmental reliability requirements. Quality conformance of production boards shall be evaluated in accordance with IPC-RB-276.

The materials described herein are intended for use on printed boards in order to provide a solder mask to prevent solder bridging, and/or for the retardation of electromigration and other forms of conductive growth, and/or for the physical protection of the printed board.

This specification does not determine the compatibility of solder mask materials with post soldering products and processes. The determination of this compatibility is the responsibility of the board fabricator/board user. The test procedures specified herein may be useful tools to determine this compatibility.

Solder mask materials covered in the standard are not intended for use as a substitute for conformal coatings that are applied after assembly to cover components, component leads/terminations and solder connections.

This document lists the base requirements for solder mask and solder mask production board process. Additional

requirements can be required as agreed upon between the solder mask vendor and the board fabricator, or between the board fabricator and end user.

This document assumes that the mask is processed and cured per the manufacturer’s recommended process. The curing of the solder mask material that has been applied to printed boards shall be in accordance with those conditions specified by the solder mask vendor for that product or a qualified alternate method as agreed to between the board fabricator and the end user. When (other) alternate methods are used, the board fabricator has full responsibility for the performance of the solder mask.

**1.3 Classes** This specification provides classes of requirements to reflect functional performance requirements and testing severity based on industry/end use requirements.

**Note:** The reference of a single class does not preclude invoking or allowing specific requirements defined in other classes.

T — Telecommunication (Includes computers, telecommunication equipment, sophisticated business machines, instruments, and certain non-critical military applications.) Solder mask on boards in this class is suitable for high performance commercial and industrial products in which extended performance life is required but for which interrupted service is not life threatening.

H — High Reliability/Military (Includes that equipment where continued performance is critical, equipment down-time cannot be tolerated and/or the equipment is a life support item.) Solder mask on boards of this class is suitable for applications where high levels of assurance are required and uninterrupted service is essential.

**Note:** Class Designations - Previous versions of this specification, and other IPC documents, make reference to “Class 1”, “Class 2”, and “Class 3”. For all practical purposes there is no Class 1 solder mask. Class 2 is equivalent to Class T (Telecommunications). Class 3 is the equivalent of Class H (Military/high reliability).

**1.4 Presentation** Dimensions and tolerances are expressed in metric units, with English units shown in brackets [ ], and are not necessarily direct conversions in order to provide usable numbers. Users are cautioned to

employ a single system and to not intermix millimeters and inches. Reference information is shown in parentheses ( ).

## 2.0 APPLICABLE DOCUMENTS

The following documents of issue currently in effect form a part of this specification to the extent specified herein.

### 2.1 IPC<sup>1</sup>

**IPC-A-25A** Multipurpose Test Board Artwork Films

**IPC-B-25A Master Drawing** Master Drawing, Multipurpose Test Board

**IPC-T-50** Terms and Definitions

**IPC-RB-276** Qualification and Performance of Rigid Printed Boards

**IPC-TM-650<sup>2</sup>** Test Methods Manual

**TM 2.1.1** Microsectioning

**TM 2.3.23** Cure (Permanency) Thermally Cured Solder Masks

**TM 2.3.23.1** Cure (Permanency) UV Initiated Dry Film Solder Masks

**TM 2.3.25** Detection of Ionizable Surface Contamination (Static Method)

**TM 2.3.26** Detection of Ionizable Surface Contamination (Dynamic Method)

**TM 2.3.26.1** Ionizable Detection of Surface Contaminants (Static Method)

**TM 2.3.31** Relative Degree of Cure in UV Curable Material

**TM 2.3.38** Inspection Test for Organic Contaminates on Printed Wiring Board and Assembly Surfaces

**TM 2.3.39** Identification of Residual Organic Non-Ionic Contaminates on Printed Wiring Boards and Assembly Surfaces

**TM 2.3.42** Identification of Solder Mask Products Using Fourier Transform Infrared Spectroscopy (FTIR)

**TM 2.4.27.2** Solder Mask Abrasion (Pencil Method)

**TM 2.4.28.1** Adhesion, Solder Mask (Over Melting and Non-Melting Metals)

**TM 2.4.29** Adhesion, Solder Mask—Flexible Circuits

**TM 2.5.6.1** Dielectric Strength, Polymer Solder Mask, and/or Conformal Coatings

**TM 2.6.1** Fungus Resistance, Printed Wiring Materials

**TM 2.6.3.1** Moisture and Insulation Resistance Polymeric Solder Masks and Conformal Coating

**TM 2.6.7.1** Thermal Shock—Polymer Solder Mask Coatings

**TM 2.6.11** Hydrolytic Stability—Solder Masks and Conformal Coatings

**TM 2.6.14** Resistance to Electrochemical Migration Solder Masks

**IPC-CC-830** Qualification and Performance of Electrical Insulating Compound for Printed Board Assemblies

**J-STD-003** Solderability Test Methods for Printed Wiring Boards

**J-STD-004** General Requirements for Electronic Soldering Fluxes

**J-STD-006** Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications

### 2.2 Underwriters' Laboratories<sup>3</sup>

**UL 94** Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

### 2.3 ASTM<sup>4</sup>

**ASTM D2863** Oxygen index testing

## 3.0 REQUIREMENTS

**3.1 Terms and Definitions** The definition of terms shall be in accordance with IPC-T-50 and the following. In the event of conflict, the definitions specified herein shall take precedence.

**3.1.1 Bleeding** The flowing of a liquid solder mask coating beyond the areas of the image as applied.

**3.1.2 Blisters** Loss of adhesion typically caused by air or entrapped volatiles which appear under the mask during any high temperature thermal excursion.

**3.1.3 Hydrolytic Stability** The ability of an organic or polymeric material to withstand an irreversible change of state when exposed to an elevated temperature and humidity.

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

2. For convenience, all IPC-TM-650 Test Methods referenced herein are reprinted at the end of this standard

3. Underwriters' Laboratories, Inc., 1285 Walt Whitman Road, Melville, Long Island, NY 11746

4. American Society for Testing of Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959