IPC-SM-840E
2010 - December

Qualification and Performance Specification of Permanent Solder Mask and Flexible Cover Materials

Supersedes IPC-SM-840D
April 2007

A standard developed by IPC

Association Connecting Electronics Industries

Copyright IPC-Association Connecting Electronics Industries
Provided by IHS under license with IPC
No reproduction or networking permitted without license from IHS
Full document details: IPC SM-840E 2010

Licensee=Sandia National Lab/5932237100, User=sam, albert
Not for Resale, 05/28/2014 10:39:52 MDT

The Principles of Standardization

In May 1995 the IPC's Technical Activities Executive Committee (TAEC) adopted Principles of Standardization as a guiding principle of IPC's standardization efforts.

Standards Should:

- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

Standards Should Not:

- Inhibit innovation
- Increase time-to-market
- Keep people out
- Increase cycle time
- Tell you how to make something
- Contain anything that cannot be defended with data

Notice

IPC Standards and Publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards and Publications shall not in any respect preclude any member or nonmember of IPC from manufacturing or selling products not conforming to such Standards and Publication, nor shall the existence of such Standards and Publications preclude their voluntary use by those other than IPC members, whether the standard is to be used either domestically or internationally.

Recommended Standards and Publications are adopted by IPC without regard to whether their adoption may involve patents on articles, materials, or processes. By such action, IPC does not assume any liability to any patent owner, nor do they assume any obligation whatever to parties adopting the Recommended Standard or Publication. Users are also wholly responsible for protecting themselves against all claims of liabilities for patent infringement.

IPC Position Statement on Specification Revision Change

It is the position of IPC's Technical Activities Executive Committee that the use and implementation of IPC publications is voluntary and is part of a relationship entered into by customer and supplier. When an IPC publication is updated and a new revision is published, it is the opinion of the TAEC that the use of the new revision as part of an existing relationship is not automatic unless required by the contract. The TAEC recommends the use of the latest revision. Adopted October 6, 1998

Why is there a charge for this document?

Your purchase of this document contributes to the ongoing development of new and updated industry standards and publications. Standards allow manufacturers, customers, and suppliers to understand one another better. Standards allow manufacturers greater efficiencies when they can set up their processes to meet industry standards, allowing them to offer their customers lower costs.

IPC spends hundreds of thousands of dollars annually to support IPC's volunteers in the standards and publications development process. There are many rounds of drafts sent out for review and the committees spend hundreds of hours in review and development. IPC's staff attends and participates in committee activities, typesets and circulates document drafts, and follows all necessary procedures to qualify for ANSI approval.

IPC's membership dues have been kept low to allow as many companies as possible to participate. Therefore, the standards and publications revenue is necessary to complement dues revenue. The price schedule offers a 50% discount to IPC members. If your company buys IPC standards and publications, why not take advantage of this and the many other benefits of IPC membership as well? For more information on membership in IPC, please visit www.ipc.org or call 847/597-2872.

Thank you for your continued support.

©Copyright 2010. IPC, Bannockburn, Illinois, USA. All rights reserved under both international and Pan-American copyright conventions. *Any copying, scanning or other reproduction of these materials without the prior written consent of the copyright holder is strictly prohibited and constitutes infringement under the Copyright Law of the United States.*

Documents Document Sharing Hub

Copyright IPC-Association Connecting Electronics Industries
Provided by IHS under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=Sandia National Lab/5932237100, User=sam, albert
Not for Resale, 05/28/2014 10:39:52 MDT
Full document details: IPC SM-840E 2010

IPC-SM-840E

Qualification and Performance Specification of Permanent Solder Mask and Flexible Cover Materials

Developed by the Solder Mask Performance Task Group (5-33B) of the Cleaning and Coating Committee (5-30) and the Covercoat Materials Task Group (D-13B) of the Flexible Circuits Committee (D-10) of IPC

Supersedes:

IPC-SM-840D - April 2007
IPC-SM-840C -
Amendment 1 - June 2000
IPC-SM-840C - January 1995
IPC-SM-840B - May 1988
IPC-SM-840A - July 1983
IPC-SM-840 - November 1977

Users of this publication are encouraged to participate in the development of future revisions.

Contact:

IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

Documents
Document Sharing Hub

Copyright IPC-Association Connecting Electronics Industries
Provided by IHS under license with IPC
No reproduction or networking permitted without license from IHS
Full document details: IPC SM-840E 2010

Licensee=Sandia National Lab/5932237100, User=sam, albert
Not for Resale, 05/28/2014 10:39:52 MDT

This Page Intentionally Left Blank

Documents
Document Sharing Hub

--`,,,``,,`,,,```,`,,,`,``,,,,`-`-`,,`,,`,`,,`---

Copyright IPC-Association Connecting Electronics Industries
Provided by IHS under license with IPC
No reproduction or networking permitted without license from IHS
Full document details: IPC SM-840E 2010

Licensee=Sandia National Lab/5932237100, User=sam, albert
Not for Resale, 05/28/2014 10:39:52 MDT

Acknowledgment

Any document involving a complex technology draws material from a vast number of sources. While the principal members of the Solder Mask Performance Task Group (5-33B) of the Cleaning and Coating Committee (5-30) and the Covercoat Materials Task Group (D-13B) of the Flexible Circuits Committee (D-10) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of IPC extend their gratitude.

Flexible Circuits Committee

Chair
Douglas O. Pauls
Rockwell Collins

Vice-Chair
Debora L. Obitz
Trace Laboratories - East

Solder Mask Performance Task Group

Chair
David A. Vaughan
Taiyo America, Inc.

Vice-Chair
Douglas O. Pauls
Rockwell Collins

Covercoat Materials Task Group

Chair
Steve A. Musante
Raytheon Missile Systems

Technical Liaisons of the IPC Board of Directors

Peter Bigelow
IMI Inc.

Sammy Yi
Aptina Imaging Corporation

Solder Mask Performance Task Group and Covercoat Materials Task Group

Gregory Bartlett, Teledyne Printed Circuit Technologies
John Bauer, Rockwell Collins
Michael Beauchesne, Amphenol Printed Circuits, Inc.
Joshua Civiello, Defense Supply Center Columbus
Mark Finstad, Flexible Circuit Technologies, Inc.
Thomas F. Gardeski, Gemini Sciences
Marc Goudreau, Vulcan Flex Circuit Corporation
Russell Griffith, Flexible Circuits Inc.
Michael J. Jawitz, Boeing Satellite Development Center
Nick Koop, Minco Products Inc.
Karin LaBerge, Microtek Laboratories
John Leschisin, Minco Products Inc.
Anne Lomonte, Draeger Medical Systems, Inc.
Duane B. Mahnke, DBMahnke Consulting
Thomas McCarthy, Taconic Advanced Dielectric Division
Roger J. Miedico, Raytheon Company
William Ortloff, Raytheon Company
Robert Sheldon, Pioneer Circuits Inc.
Terry Shepler, Electro-Materials, Inc.
Douglas J. Sober, Kaneka Texas Corporation
Brent Sweitzer, Multek Flexible Circuits, Inc.
Steve J. Vetter, NSWC Crane
Clark F. Webster, ALL Flex LLC
Miou Yamaoka, Meiko Electronics Co. Ltd.

Documents
Document Sharing Hub
Copyright IPC-Association Connecting Electronics Industries
Provided by IHS under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=Sandia National Lab/5932237100, User=sam, albert
Not for Resale, 05/28/2014 10:39:52 MDT
Full document details: IPC SM-840E 2010

This Page Intentionally Left Blank

Documents
Document Sharing Hub
Copyright IPC-Association Connecting Electronics Industries
Provided by IHS under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=Sandia National Lab/5932237100, User=sam, albert
Not for Resale, 05/28/2014 10:39:52 MDT
Full document details: IPC SM-840E 2010

Table of Contents

1 SCOPE AND DESIGNATION 1
1.1 Scope 1
1.2 Purpose 1
1.3 Classes 1
1.4 Presentation 2
1.5 Terms and Definitions 2
1.5.1 As Agreed Between User and Supplier (AABUS) 2
1.5.2 Blistering 2
1.5.3 Chalking (Cured Solder Mask or Cover Material) 2
1.5.4 Color Change (Cured Solder Mask or Cover Material) 2
1.5.5 CoC 2
1.5.6 Covercoat 2
1.5.7 Coverfilm 2
1.5.8 Cover Material 2
1.5.9 Crazing (Conformal or Solder Mask or Cover Material) 2
1.5.10 Delamination (Cured Solder Mask or Cover Material) 2
1.5.11 FTIR 2
1.5.12 Liquefaction (Cured Solder Mask or Cover Material) 3
1.5.13 Peeling (Cured Solder Mask) 3
1.5.14 SAC 305 3
1.5.15 Softening (Cured Solder Mask or Cover Material) 3
1.5.16 Solder Mask 3
1.5.17 Swelling (Cured Solder Mask or Cover Material) 3
1.5.18 Tackiness (Solder Mask or Cover Material) 3
1.5.19 Wicking (Solder Mask or Covercoat) 3
1.6 Revision Level Changes 3

2 APPLICABLE DOCUMENTS 3
2.1 IPC 3
2.2 Underwriters Laboratories 4
2.3 ASTM 4
2.4 Precedence of Documents 4

3 REQUIREMENTS 4
3.1 Qualification/Conformance 4
3.1.1 Material Qualification and Conformance 4
3.1.2 Printed Board Process Qualification and Assessment 5
3.1.3 Requalification 5
3.2 Materials 5
3.2.1 Formulation Change 5
3.2.2 Compatibility 5
3.2.3 Shelf Life 7
3.2.4 Color 7
3.2.5 Cure 7
3.2.6 Non-Nutrient 7
3.3 Visual Requirements 7
3.3.1 Appearance 7
3.3.2 Discoloration (Metallic Surfaces) 7
3.3.3 Discoloration (Solder Mask or Cover Material) 7
3.4 Dimensional Requirements 7
3.4.1 Solder Mask or Cover Material Thickness 7
3.5 Physical Requirements 7
3.5.1 Pencil Hardness 7
3.5.2 Adhesion 7
3.5.3 Machinability 8
3.5.4 Flexibility 9
3.6 Chemical Requirements 9
3.6.1 Resistance to Fabrication Solvents, Cleaning Agents and Fluxes 9
3.6.2 Hydrolytic Stability 9
3.6.3 Flammability 9
3.7 Soldering Requirements 9
3.7.1 Solderability 9
3.7.2 Resistance to Tin-Lead Solder 9
3.7.3 Resistance to Lead Free Solder 10
3.8 Electrical Requirements 10
3.8.1 Dielectric Strength 10
3.8.2 Insulation Resistance 10
3.9 Environmental Requirements 10
3.9.1 Moisture and Insulation Resistance 10
3.9.2 Electrochemical Migration 10
3.9.3 Thermal Shock 10

4 QUALITY ASSURANCE PROVISIONS 11
4.1 Responsibility for Testing/Inspection 11
4.1.1 Initial Qualification Testing 11
4.1.2 Test or Inspection Facilities 11
4.2 Qualification Inspection 11
4.2.1 Sample Size 11
4.2.2 Inspection Routine 11
4.2.3 Failures 11
4.3 Quality Conformance Testing/Inspection 11
4.3.1 Testing/Inspection of Product for Delivery 11
4.4 Preparation of Specimens for Test 12
4.4.1 Standard Laboratory Conditions 12
4.4.2 Specimen Selection 13
4.4.3 Coating 13
4.4.4 Number 14

Documents
Document Sharing Hub

Copyright IPC-Association Connecting Electronics Industries
Provided by IHS under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=Sandia National Lab/5932237100, User=sam, albert
Not for Resale, 05/28/2014 10:39:52 MDT
Full document details: IPC SM-840E 2010

5 PREPARATION OF SOLDER MASK OR COVER MATERIAL FOR DELIVERY 15

5.1 Preservation, Packaging and Packing 15

6 NOTES 15

6.1 Specifying Solder Mask or Cover Material on Printed Boards 15

6.2 Class FT/FH Test Methods 15

6.3 Special Requirements 15

Figures

Figure 4–1 IPC-B-25A (Note: No solder mask or cover material shall be applied to contact fingers).....14

Figure 4–2 IPC-2221 Test Coupon E Layer 1 (“Y” Configuration).....14

Tables

Table 3–1 Requirements of Qualification 6

Table 3–2 Adhesion to Rigid Printed Boards (IPC-B-25A Test Board and/or Production Printed Board) 8

Table 3–3 Moisture & Insulation Resistance 10

Table 3–4 Electrochemical Migration 10

Table 3–5 Thermal Shock Conditions 11

Table 4–1 Sample Requirements/Suggested Test Sequence for Table 3–1, Column A IPC-B-25A Standard Test Boards 12

Table 4–2 Sample Requirements/Suggested Test Sequence for Table 3–1, Column B IPC-B-25A Boards – Production Process or Conformance Coupons Or Production Printed Boards 13

Documents
Document Sharing Hub
Copyright IPC-Association Connecting Electronics Industries
Provided by IHS under license with IPC
No reproduction or networking permitted without license from IHS
Full document details: IPC SM-840E 2010
Licensee=Sandia National Lab/5932237100, User=sam, albert
Not for Resale, 05/28/2014 10:39:52 MDT

Qualification and Performance Specification of Permanent Solder Mask and Flexible Cover Materials

1 SCOPE AND DESIGNATION

1.1 Scope This specification **shall** define the criteria for and method of obtaining the maximum information about and confidence in cured permanent solder mask and cover material under evaluation with the minimum of test redundancy.

This specification **shall** establish the requirements for:

- The evaluation of solder mask and cover materials
- The conformance of solder mask and cover material properties
- The qualification of the solder mask and cover material via the appropriate test substrate
- The qualification assessment of the solder mask and cover material in conjunction with the production printed board process

1.2 Purpose This specification **shall** establish the requirements, based on applicable test methods and conditions, for the evaluation of a solder mask and cover material and for the determination of the acceptability of use on a printed board. These same requirements **shall** also be used to qualify a printed board production process based on conformance criteria defined by the reliability requirements of the end use environment. Acceptability and/or verification criteria of the production printed board **shall** be determined in accordance with the applicable performance requirements (e.g., IPC-6012, IPC-6013, IPC-6018, etc.).

The solder mask materials described herein, when applied to the printed board substrate are intended to prevent and/or minimize the formation and adherence of solder balls, solder bridging, solder build-up and physical damage to the printed board substrate. The solder mask material **shall** retard electromigration and other forms of detrimental or conductive growth.

The cover materials described herein, when applied to the printed board substrate, **shall** provide a flexible dielectric protective layer over the etched conductors and other conductive features. The cover materials are intended to prevent and/or minimize the formation and adherence of solder balls, solder bridging, solder build-up and physical damage to the printed board substrate. The cover materials **shall** retard electromigration and other forms of detrimental or conductive growth.

NOTE: The determination of compatibility between solder mask and cover materials and post soldering products and processes is beyond the scope of this specification. The use of Test Methods specified herein to determine the compatibility and the requirement to do so **shall** be as agreed between user and supplier (AABUS).

This specification **shall** list the base requirements for solder mask and cover materials and their production processes. The solder mask and cover material **shall** be cured per the manufacturer's recommended process in accordance with those conditions specified for that product. Additional requirements or deviations from these requirements **shall** be AABUS.

1.3 Classes This specification provides four classes of requirements, T, FT, H, and FH to reflect functional performance requirements and testing severity based on industry/end use requirements. Qualification to a particular class **shall not** be extended to cover any other class.

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

T — Telecommunication This includes computers, telecommunication equipment, sophisticated business machines, instruments, and certain non-critical military applications. Solder mask and cover material on printed 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 This 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 and cover material on printed boards of this class is suitable for applications where high levels of assurance are required and uninterrupted service is essential.

FT — Flexible Printed Board Applications (Telecommunications) This applies to cover materials for flexible printed board applications used in Telecommunications applications.

AVA Documents
Document Sharing Hub

Copyright IPC-Association Connecting Electronics Industries
Provided by IHS under license with IPC
No reproduction or networking permitted without license from IHS
Full document details: IPC SM-840E 2010
Licensee=Sandia National Lab/5932237100, User=sam, albert
Not for Resale, 05/28/2014 10:39:52 MDT