



IEC PAS 61249-8-1

Edition 1.0 2014-06

PUBLICLY AVAILABLE SPECIFICATION PRE-STANDARD

Qualification and performance of electrical insulating compound for printed wiring assemblies

IECNORM.COM : Click to view the full PDF of IEC PAS 61249-8-1:2014



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2014 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 55 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IECNORM.COM : Click to view the full text of IEC publications
IEC 61249-8-1:2014



IEC PAS 61249-8-1

Edition 1.0 2014-06

PUBLICLY AVAILABLE SPECIFICATION PRE-STANDARD

Qualification and performance of electrical insulating compound for printed wiring assemblies

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

R

ICS 31.180

ISBN 978-2-8322-1632-3

Warning! Make sure that you obtained this publication from an authorized distributor.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

QUALIFICATION AND PERFORMANCE OF ELECTRICAL INSULATING COMPOUND FOR PRINTED WIRING ASSEMBLIES

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

A PAS is a technical specification not fulfilling the requirements for a standard, but made available to the public.

IEC PAS 61249-8-1, submitted by IPC has been processed by IEC technical committee 91: Electronics assembly technology. It is based on IPC-CC-830B with Amendment 1. It is published as a double-logo PAS. The structure and editorial rules used in this PAS reflect the practice of the organization which submitted it.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
91/1156/PAS	91/1173/RVD

Following publication of this PAS, the technical committee or subcommittee concerned may transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single period up to a maximum of 3 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

IECNORM.COM : Click to view the full PDF of IEC PAS 61249-8-1:2014

IPC-CC-830B

with Amendment 1

Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies

October 2008

Supersedes IPC-CC-830B

August 2002

A standard developed by IPC

IECNORM.COM : Click to view the full PDF of IEC PAS 61249-8-1:2014

Association Connecting Electronics Industries



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.



IPC-CC-830B with Amendment 1

Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies

Developed by the Conformal Coating Task Group (5-33a) of the Cleaning and Coating Committee (5-30)

Supersedes:

IPC-CC-830B - August 2002
IPC-CC-830A with
Amendment 1 - July 1999
IPC-CC-830A - October 1998
IPC-CC-830 - January 1984

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

Acknowledgment

Any document involving a complex technology draws material from a vast number of sources. While the principal members of the Conformal Coating Task Group (5-33a) of the Cleaning and Coating Committee (5-30) 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 the IPC extend their gratitude.

Cleaning and Coating Committee	Conformal Coating Task Group	Technical Liaisons of the IPC Board of Directors
Chair Douglas O. Pauls Rockwell Collins	Chair John P. Waryold HumiSeal Division of Chase Corporation	Peter Bigelow IMI Inc.
Vice Chair Debora L. Obitz Trace Laboratories - East	Vice Chair Debora L. Obitz Trace Laboratories - East	Sammy Yi Flextronics International
Conformal Coating Task Group		
David Adams, Rockwell Collins	Christopher Hunt, National Physical Laboratory	Lynn Norman, Continental Automotive Systems US, Inc.
Greg Alexander, Ascentech, LLC	Joseph Kane, BAE Systems Platform Solutions	Victor Powell, L-3 Communications Aviation Recorders
Gustavo Arredondo, Para Tech Coating Inc.	Jason Keeping, Celestica International Inc.	Barry Ritchie, Dow Corning Corporation
Paul Berry, Dow Corning Corporation	William Kenyon, Global Centre Consulting	John Rohlfing, Delphi Electronics and Safety
Gerald Leslie Bogert, Bechtel Plant Machinery, Inc.	Phil Kinner, HumiSeal Division of Chase Corporation	Henry Sanftleben, Delphi Electronics and Safety
Calette Chamness, U.S. Army Aviation & Missile Command	Sven Kramer, Lackwerke Peters GmbH & Co KG	Jeffrey Sargeant, HumiSeal
David Corbett, Defense Supply Center Columbus	Richard Kraszewski, Plexus Corp.	Lowell Sherman, Defense Supply Center Columbus
Rudiger Dietrich, Lackwerke Peters GmbH & Co KG	Vijay Kumar, Lockheed Martin Missile & Fire Control	Gordon Sullivan, Huntsman Advanced Technology Center
Mahendra Gandhi, Northrop Grumman Space Technology	Kenneht Manning, Raytheon Company	Manfred Suppa, Lackwerke Peters GmbH & Co KG
Hue Green, Lockheed Martin Space Systems Company	Renee Michalkiewicz, Trace Laboratories - East	Crystal Vanderpan, Underwriters Laboratories Inc.
Michael Green, Lockheed Martin Space Systems Company	Roger Miedico, Raytheon Company	David Vaughan, Taiyo America Inc.
Amy Hagnauer, Raytheon Company	Graham Naisbitt, Gen3 Systems Limited	Fonda Wu, Raytheon Company
Steve Henly, Acota Limited	David Nelson, Raytheon Company	Lamar Young, Specialty Coating Systems Inc.

Table of Contents

1 SCOPE	1	3.7.1 Moisture and Insulation Resistance	4
1.1 Scope	1	3.7.2 Thermal Shock	4
1.2 Purpose	1	3.7.3 Temperature and Humidity Aging (Hydrolytic Stability)	4
1.3 Classification	1	3.8 Special Requirements	5
1.3.1 Types	1		
1.3.2 Classes	1	4 QUALITY ASSURANCE PROVISION	5
1.4 Interpretation	1	4.1 Responsibility for Inspection	5
2 APPLICABLE DOCUMENTS	1	4.2 Categories of Inspection and Frequency	5
2.1 IPC	1	4.2.1 Qualification Inspection	5
2.2 Government	2	4.2.2 Qualification Retention Inspection	5
2.3 American Society for Testing of Materials	2	4.2.3 Quality Conformance Inspection	5
2.4 Underwriters Laboratories	2	4.3 Product Change	5
2.5 ANSI	2	4.4 Test Equipment and Inspection Facilities	5
2.6 ISO	2	4.4.1 Standard Laboratory Conditions	5
3 REQUIREMENTS	2	4.4.2 Permissible Temperature Variation in Environmental Chambers	6
3.1 General Requirements	2	4.4.3 Reference Conditions	6
3.1.1 Terms and Definitions	2	4.5 Inspection Routine	6
3.1.2 Conflict	2	4.6 Inspection Sampling	6
3.2 Inspection and Testing Requirements	2	4.6.1 Test Vehicles	6
3.2.1 Qualification Inspection and Testing	2	4.6.2 Sample Size	6
3.2.2 Qualification Retention Inspection and Testing	2	4.6.3 Preparation Prior to Coating	6
3.2.3 Quality Conformance Inspection Testing	3	4.6.4 Coating	7
3.2.4 Additional Testing	3	4.7 Failures	7
3.3 Materials Requirements	3	4.8 Inspection Reporting	7
3.3.1 Materials	3	4.8.1 Qualification Reporting	7
3.3.2 Shelf Life	3	4.8.2 Qualification Retention Reporting	7
3.3.3 Cure	3	4.8.3 Quality Conformance Reporting	7
3.4 Chemical Requirements	3	5 PREPARATION FOR DELIVERY	7
3.4.1 Fourier Transform Infrared Spectroscopy Test (FTIR)	3	5.1 Containers	7
3.5 Physical Requirements	4	5.2 Packaging	8
3.5.1 Viscosity	4	5.3 Marking	8
3.5.2 Appearance	4	6 NOTES	8
3.5.3 Fluorescence	4	6.1 Order Data	8
3.5.4 Fungus Resistance	4	6.2 Formulation Change	8
3.5.5 Flexibility	4	6.3 Conditioning	8
3.5.6 Flammability	4	6.4 Cleanliness	8
3.6 Electrical Requirements	4	6.5 Adhesion	8
3.6.1 Dielectric Withstanding Voltage (DWV)	4	6.6 Solvent Compatibility	8
3.7 Environmental Requirements	4	6.7 Identification of Solvent Sensitive Conformal Coatings	8

Appendix A	Example of Qualification Inspection Report	9
Appendix B	Example of Qualification Retention Inspection Report	10
Appendix C	Example of Quality Conformance Inspection Report	11

Figures

Figure 4-1	IPC-B-25A	7
Figure 4-2	Test Coupon with “Y” Shape Pattern	7

Tables

Table 3-1	Requirements for Qualification, Qualification Retention and Quality Conformance of Conformal Coating Products	3
Table 4-1	Test Vehicles and Sample Sizes	6
Table 4-2	Thickness Requirements on Test Vehicle	7

IECNORM.COM : Click to view the full PDF of IEC PAS 61249-8-1:2014

Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies

1 SCOPE

1.1 Scope This standard establishes qualification and conformance requirements for electrical insulating compounds (conformal coatings). It has been designed and constructed with the intent of obtaining maximum confidence in the materials with minimum test redundancy. This standard covers:

- The qualification and qualification retention of the conformal coating material (Table 3-1, Column A and B).
- The quality conformance of conformal coating material properties (Table 3-1, Column C).

For the purpose of this standard, the term conformal coating is used herein when referring to a type of protective coating for use on printed wiring assemblies. The conformal coating is intended to provide protection from moisture and contamination and provide electrical insulation; not as a sole source of mechanical support.

For the purpose of this standard, inspections are performed on standardized test vehicles instead of real production assemblies. A standardized test vehicle refers to the test vehicle specified per test method indicated, coated with the conformal coating under inspection.

1.2 Purpose With standardized testing on standardized test vehicles under test conditions specified in test methods listed herein, this standard enables a manufacturer to qualify his conformal coating product and express the qualification it possesses. This standard also enables the manufacturer to attest the conformance of the quality of production to the qualification of each product.

1.3 Classification

1.3.1 Types Conformal coatings **shall** be categorized into types by the cured chemistry of the coating. The type for multifunctional materials **shall** be based on the chemistry type which is the highest percentage by weight.

Conformal coatings **shall** be of the following types:

Type AR — Acrylic
Type ER — Epoxy
Type SR — Silicone
Type UR — Polyurethane
Type XY — Paraxylylene

1.3.2 Classes Although previous versions of IPC-CC-830 made reference to Class A and Class B coating classifications, these classifications have been removed. To be qualified to this specification, a coating must be hydrolytically stable (formerly Class B). Non-hydrolytically stable coatings (formerly Class A) no longer meet the requirements of this specification and usage will only be As Agreed Between User and Supplier (AABUS). Coatings that meet the requirements of Class B coatings in previous document revisions meet the requirements of this revision.

Note: Earlier versions of this specification, as well as other IPC documents, made reference to “Class 1,” “Class 2,” and “Class 3” inspection and testing requirements for these classes that were not directly correlated to the previous Class A and B requirements.

1.4 Interpretation “**Shall**,” the imperative form of the verb, is used throughout this standard whenever a requirement is intended to express a provision that is mandatory. Deviation from a “**shall**” requirement may be considered if sufficient data is supplied to justify the exception.

The words “should” and “may” are used whenever it is necessary to express nonmandatory provisions. “Will” is used to express a declaration of purpose.

To assist the reader, the word “**shall**” is presented in bold characters.

2 APPLICABLE DOCUMENTS

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

2.1 IPC¹

IPC-B-25A Multipurpose Test Board

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

IPC-TM-650 Test Methods Manual²

2.4.5.1 Flexibility

2.5.7.1 Dielectric Withstanding Voltage - Polymeric Conformal Coating

2.6.1.1 Fungus Resistance - Conformal Coating

2.6.3.4 Moisture and Insulation Resistance - Conformal Coating

1. www.ipc.org

2. Current and revised IPC Test Methods are available through IPC-TM-650 subscription and on the IPC Web site (www.ipc.org/html/testmethods.htm).

2.6.7.1 Thermal Shock - Conformal Coating

2.6.11.1 Hydrolytic Stability - Conformal Coating

IPC-4101 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-6012 Sectional Standard for Qualification of Rigid Printed Boards

2.2 Government³

MIL-I-46058 Insulating Compound, Electrical (For Coating Printed Circuit Assemblies)

MIL-STD-1188 Commercial Packaging of Suppliers and Equipment

FED-STD-141 Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing, Method 4061 and Method 1202

2.3 American Society for Testing of Materials⁴

ASTM-D-1005 Measurement of Dry Film Thickness of Organic Coatings

ASTM-D-1084 Viscosity of Adhesives, Tests for

2.4 Underwriters Laboratories⁵

UL 94 Flammability

2.5 ANSI⁶

NCSL Z540-1 Calibration Laboratories and Measuring and Test Equipment

2.6 ISO⁷

ISO 10012-1 Quality Assurance Requirements for Measuring Equipment - Part 1: Metrological Confirmation System for Measuring Equipment

3 REQUIREMENTS

3.1 General Requirements

3.1.1 Terms and Definitions Definitions of terminology applicable to this standard **shall** be in accordance with IPC-T-50 and as stated in 3.1.1.1.

3.1.1.1 AABUS This is an acronym for “As Agreed Between User and Supplier.” Indicates additional or alternate requirements to be decided between the user and supplier in the procurement documentation. Examples include contractual requirements, modifications to purchase documentation, and information on the drawing. Agreements can be used to define test methods, conditions, frequencies, categories or acceptance criteria within a test, if not already established.

3.1.2 Conflict In the event of a conflict between the requirements of this standard and procurement document, the procurement document **shall** take precedence. In the event of a conflict between the test parameters of this standard and the test methods, or a conflict between the requirements in this standard and the applicable documents listed in Section 2, this standard **shall** take precedence.

3.2 Inspection and Testing Requirements Groups of inspection and test listed in Table 3-1 **shall** be performed to verify the ability of a conformal coating product to meet the qualification and/or conformance requirements of this standard using the test methods described herein.

3.2.1 Qualification Inspection and Testing Qualification to this standard is achieved when a conformal coating product meets the requirements listed in Column A of Table 3-1. Tests **shall** be performed in accordance with the test methods specified using test specimens prepared in compliance with 4.6. A qualification inspection report **shall** be completed in accordance with 4.8 and relevant test data retained as substantiation for the qualification. An example of qualification inspection report format is shown in Appendix A.

When a primer material is used in conjunction with a coating in qualification testing, the primer used will be documented in the qualification report.

Conformal coatings presently qualified to MIL-I-46058 **shall** also be recognized as meeting the requirements of IPC-CC-830. These products currently qualified or in the process of being requalified to MIL-I-46058 prior to the publish date of this document will also be recognized as meeting the requirements of this document. It should be noted that MIL-I-46058 is inactive for new designs.

3.2.2 Qualification Retention Inspection and Testing Qualification to this standard can be retained when a conformal coating product meets the requirements listed in Column B of Table 3-1. Tests **shall** be performed in accordance with the test methods specified using test specimens prepared in compliance with 4.6 at a frequency defined in 4.2.2.1. Pertinent test results **shall** be compared with the

3. <http://astimage.daps.dla.mil/quicksearch/>

4. www.astm.org

5. www.ul.com

6. www.ansi.org

7. www.iso.org

Table 3-1 Requirements for Qualification, Qualification Retention and Quality Conformance of Conformal Coating Products

Paragraph	Requirement	Test Method	Column A	Column B	Column C
			Qualification	Retention of Qualification	Quality Conformance
3.3.1	Materials	Visual	X	X	X
3.3.2	Shelf Life	—	X		
3.3.3	Cure	—	X	X	X
3.4.1	Fourier Transform Infrared Spectroscopy Test (FTIR)	AABUS	X	X	
3.5.1	Viscosity	ASTM D-1084	X		X
3.5.2	Appearance	Visual	X	X	X
3.5.3	Fluorescence	Visual under UV Light	X	X	X
3.5.4	Fungus Resistance	IPC-TM-650 2.6.1.1	X	X	
3.5.5	Flexibility	IPC-TM-650 2.4.5.1	X		
3.5.6	Flammability	UL 94 HB	X	X	
3.6.1	Dielectric Withstanding Voltage	IPC-TM-650 2.5.7.1	X		
3.7.1	Moisture and Insulation Resistance	IPC-TM-650 2.6.3.4	X	X	
3.7.2	Thermal Shock	IPC-TM-650 2.6.7.1	X		
3.7.3	Temperature and Humidity Aging (Hydrolytic Stability)	IPC-TM-650 2.6.11.1	X		

results of the original qualification testing. An inspection report **shall** be completed in accordance with 4.8 and relevant test data retained as substantiation for the qualification retention. An example of the qualification retention inspection report format is shown in Appendix B.

3.2.3 Quality Conformance Inspection Testing The consistency in quality of a conformal coating product is verified when the requirements listed in Column C of Table 3-1 are satisfied. Tests **shall** be performed in accordance with the test methods specified using test specimens prepared in compliance with 4.6 at a frequency defined in 4.2.3.1. Pertinent results **shall** be compared with the results of the original qualification testing. An inspection report **shall** be completed in accordance with 4.8 and relevant test data retained as substantiation for the quality conformance. An example of quality conformance inspection report is shown in Appendix C.

Conformal coating quality conformance inspection is generally performed by the coating manufacturer, but may with appropriate agreement be used as an incoming material inspection procedure by the customers.

3.2.4 Additional Testing Additional testing on different test vehicles, at different test frequency or conditions, or for properties outside the scope of this standard may be agreed upon between the manufacturers and the customers. It **shall** not be used as a substitute for any testing requirement specified herein.

3.3 Materials Requirements

3.3.1 Materials The conformal coating materials **shall** be free of deleterious substances.

3.3.2 Shelf Life The conformal coating **shall** meet all requirements of this standard within the shelf life and storage conditions specified by the conformal coating manufacturer. Shelf life of coating with two or more components **shall** be that of the component with the shortest shelf life. Tests to verify shelf life **shall** consist of Insulation Resistance (IR) and Dielectric Withstanding Voltage (DWV).

3.3.3 Cure The conformal coating **shall** exhibit all desired properties when applied and cured using the procedures specified by the conformal coating manufacturer.

When coating materials are tested as specified, the coating material **shall** be cured to full hardness in the time and temperature recommended by the supplier.

3.4 Chemical Requirements

3.4.1 Fourier Transform Infrared Spectroscopy Test (FTIR) Fourier Transform Infrared Spectroscopy (FTIR) test **shall** be performed AABUS as part of data gathering for the conformal coating during qualification inspection. When used in qualification retention inspection, FTIR

spectra **shall** be compared to those obtained during qualification inspection. Absorption peaks completely missing or additional peaks signify change in chemistry present within the conformal coating product. A change in chemistry as detected by FTIR may or may not constitute a product change. See 4.3 for the definition of product change.

3.5 Physical Requirements

3.5.1 Viscosity Viscosity of uncured conformal coating materials, except type xy, **shall** be measured per ASTM D-1084 and the test conditions **shall** be defined by the coating manufacturer. Viscosity **shall** be measured as part of data gathering for the conformal coating during qualification inspection. This viscosity data **shall** be used by the manufacturer to pre-determine an acceptable viscosity range for quality conformance inspection.

3.5.2 Appearance Appearance of conformal coating on the test vehicle specified herein **shall** be observed visually with the aid of a 3-diopter (approximately 1.75x) minimum magnification. Referee inspections **shall** be accomplished at 10x magnification.

The uncured conformal coating materials **shall** be free of deleterious substances, bubbles, pinholes, whitish spots, blistering, wrinkling, cracking, and peeling. The cured conformal coating **shall** be smooth, homogenous, transparent or translucent, and tack-free when observed at ambient conditions. In addition, the conformal coating on the test vehicles **shall** have no bubbles, pinholes, blisters, cracking, crazing, peeling, wrinkles, mealing, or evidence of reversion, or cause a corrosion.

3.5.3 Fluorescence Conformal coating materials, except type XY, **shall** be fluorescent by ultra-violet illumination (black light).

3.5.4 Fungus Resistance The resistance of the conformal coating material to support or be attacked by biological growth **shall** be determined in accordance with IPC-TM-650, Test Method 2.6.1.1.

The cured conformal coating **shall** not contribute to or be attacked by biological growth.

3.5.5 Flexibility Tin panels prepared in accordance with FED-STD-141, Method 2012, **shall** be used as test vehicles for flexibility testing. When the coated panels are tested in accordance with IPC-TM-650, Test Method 2.4.5.1, there **shall** be no evidence of cracking or crazing on the cured conformal coating.

3.5.6 Flammability Flammability testing of the cured conformal coating **shall** be performed in accordance with the detailed requirements of UL 94 HB (Horizontal Burning Test) test methods.

The cured conformal coating **shall** meet UL 94 HB (Horizontal Burning Test) requirements:

- Not have a burning rate exceeding 40 mm [1.57 in] per minute over a 75 mm [2.95 in] span for specimens having a thickness of 3.0 to 13 mm [0.118 to 0.512 in], or
- Not have a burning rate exceeding 75 mm [2.95 in] per minute over a 75 mm [2.95 in] span for specimens having a thickness less than 3.0 mm [0.118 in], or
- Cease to burn before the 100 mm [3.937 in] reference mark.

3.6 Electrical Requirements

3.6.1 Dielectric Withstanding Voltage (DWW) Dielectric withstanding voltage of the cured conformal coating **shall** be measured in accordance with IPC-TM-650, Test Method 2.5.7.1.

There **shall** be no disruptive discharge evidenced by flash-over (surface discharge), sparkover (air discharge) or breakdown (puncture discharge). The leakage rate **shall** not exceed 10 microamperes.

3.7 Environmental Requirements

3.7.1 Moisture and Insulation Resistance The conformal coating materials **shall** be tested in accordance with IPC-TM-650, Test Method 2.6.3.4. After the completion of temperature and humidity testing cycles, the panels **shall** be maintained at the reference conditions at a temperature of 25 ± 5 °C [77 ± 9 °F] and a relative humidity of $50 \pm 5\%$, for a period of 24 hours.

The minimum insulation resistance **shall** be 500 MΩ for type ER and 5000 MΩ for all other types during humidity, after humidity and one to two hours at reference conditions, and after 24 hours at reference conditions.

Appearance **shall** be assessed and dielectric withstanding voltage **shall** be tested and meet the requirements as specified in 3.5.2 and 3.6.1 respectively; after 24 hours at the reference conditions.

3.7.2 Thermal Shock Conformal coating products **shall** be tested in accordance with IPC-TM-650, Test Method 2.6.7.1, with test conditions of -65 °C [-85 °F] to 125 °C [257 °F], 100 cycles.

After the temperature cycles are completed, the coated test vehicles **shall** be maintained at the reference conditions at a temperature of 25 ± 5 °C [77 ± 9 °F] and a relative humidity of $50 \pm 5\%$ for a period of 24 hours; after which appearance **shall** be assessed and dielectric withstanding voltage **shall** be tested and meet the requirements as specified in 3.5.2 and 3.6.1 respectively.

3.7.3 Temperature and Humidity Aging (Hydrolytic Stability) Conformal coating products **shall** be tested in accordance with IPC-TM-650, Test Method 2.6.11.1.

The control specimen **shall** be maintained at the reference conditions at 25 ± 5 °C [77 ± 9 °F] and $50 \pm 5\%$ relative humidity. The aged conformal coating **shall** be tack free to touch.

There **shall** be no evidence of softening, chalking, blistering, surface tack, cracking, loss of adhesion or reversion to the liquid state. The clarity of the conformal coating must remain suitable for the viewing of identification markings and color codes used to identify components over which the conformal coating is applied.

3.8 Special Requirements Any special requirements are AABUS and **shall** be noted in the procurement documentation.

4 QUALITY ASSURANCE PROVISION

4.1 Responsibility for Inspection Unless otherwise specified, the conformal coating manufacturer is responsible for all testing required in this standard. Test facilities utilized must be agreed upon by all parties concerned and may be those of the conformal coating manufacturer, printed board assembler, user, or other mutually acceptable test laboratory or combination thereof. The user reserves the right to confirm that any of the specified inspection procedures and test results conform to the prescribed paragraphs.

4.2 Categories of Inspection and Frequency

4.2.1 Qualification Inspection Qualification inspection allows a conformal coating manufacturer to assess the properties of a conformal coating product on standardized test vehicles using standardized test procedures. Variation to the qualified formulation may or may not imply a change of product, and may or may not be inspected for qualification as a new product accordingly. See 4.3 for definition of Product Change.

4.2.1.1 Qualification Inspection Frequency Conformal coating qualification inspection **shall** be performed once on each conformal coating product.

4.2.2 Qualification Retention Inspection The qualification of a conformal coating product can be retained with the satisfaction of qualification retention inspection.

4.2.2.1 Qualification Retention Inspection Frequency Conformal coating qualification retention inspection **shall** be performed once every two years on each conformal coating product in order to prove consistent compliance to the original qualification.

4.2.3 Quality Conformance Inspection Quality conformance inspection **shall** be performed in order to express consistency of material properties and process control.

Batches of conformal coating material **shall** be inspected for compliance to the original requirements fulfilled during qualification testing at a frequency adequate to assure continuing performance. Quality conformance inspection **shall** be integrated into statistical process control programs or other quality assurance programs (e.g., ISO 9000).

4.2.3.1 Quality Conformance Inspection Frequency Quality conformance inspection **shall** be performed for every batch of conformal coating product. A batch **shall** consist of all conformal coating materials produced by one continuous run. Batch identification is required (see 5.3).

4.3 Product Change The following variations in the formulation of a conformal coating material originally qualified by a supplier constitute a product change and **shall** require a new name or product designation. The extent of the name change is up to the supplier, but the change in the name or designation must be prominently displayed and/or obvious to the customer or end-user. Additional qualification of the changed conformal coating formulation **shall** be required. Qualification results of the original formula are not to be assumed for the new formula:

- Changes exceeding $\pm 2\%$ in the formula weight of any nonvolatile ingredient from the ingredient's original formula weight.
- Addition or elimination of any nonvolatile ingredient.
- Changes in type or dye of pigment.
- Addition, deletion or change in composition of "inert" materials in the formulation.

The following do not constitute a change in formulation and do not require additional qualification of the change, but do require notification of the customer:

- Changes of less than $\pm 2\%$ in the formula weight of any nonvolatile ingredient from the ingredient's original formula weight.
- Addition, elimination or changes in any volatile ingredient (solvent) with less than 1% dried weight of residue in the dried conformal coating (using recommended drying procedures).
- Changes in the ratio of solids to volatile for viscosity adjustment.

4.4 Test Equipment and Inspection Facilities Test and measuring equipment and inspection facilities **shall** be of sufficient accuracy, quality and quantity to permit the performance of required inspection and **shall** be established and maintained by or be accessible to all concerned parties. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment **shall** be in accordance with ANSI/NCSL Z540-1 or ISO 10012-1.

4.4.1 Standard Laboratory Conditions Test measurements and conditions, unless otherwise specified herein, or

in the individual test method, **shall** be made at temperature of 15 to 35 °C [59 to 95 °F], air pressure of 650 to 800 millimeters mercury [0.86 to 1.05 bar], and a maximum relative humidity of 75%. Whenever the test conditions must be closely controlled in order to obtain reproducible results for referee purposes, temperature, relative humidity and atmospheric pressure conditions of 25 ± 3 °C [77 ± 5.4 °F], 40 to 60% RH, and 650 to 800 millimeters mercury [0.86 to 1.05 bar], **shall** be specified.

4.4.2 Permissible Temperature Variation in Environmental Chambers When chambers are used, specimens under test **shall** be located only within the working area defined as follows:

- Reference temperature variation within working area:
The controls for the chambers **shall** be capable of maintaining the temperature of any single reference point within the working area within ± 2 °C [± 3.6 °F].
- Spatial temperature variation within working area:
Chambers **shall** be so constructed that, at any given time, the temperature of any point within the working area **shall** not deviate more than 3 °C [5.4 °F] from the reference point, except for the immediate vicinity of specimens generating heat.

4.4.3 Reference Conditions Reference conditions as a base for calculations **shall** be 25 °C [77 °F] for temperature, 760 millimeters mercury [1.01 bar] of air pressure, and a relative humidity of 50%.

4.5 Inspection Routine Inspections **shall** be performed in accordance with testing requirements defined in 3.2 thereof. Test specimens **shall** be prepared in accordance with 4.6 and subjected to the procedure of test methods listed in Table 3-1.

4.6 Inspection Sampling

4.6.1 Test Vehicles Test vehicle to be used **shall** be in accordance to specific test method as outline in Table 4-1.

A IPC-B-25A Standard Test Board is illustrated in Figure 4-1. Test pattern to be used **shall** be as specified in test method.

Test assemblies for temperature and humidity aging test **shall** be made with the base material in accordance with IPC-4101/21, IPC-4101/24, IPC-4101/25 or IPC-4101/26, with tin plated or solder coated 17 µm copper "X" shape conductor, as illustrated in Figure 4-2. Test assemblies **shall** contain two resistors, one with marking ink and one with color code bars.

Glass plates to be used **shall** be standard laboratory glass plates of 50 mm x 50 mm [1.97 in x 1.97 in] minimum size.

Test strips for flammability testing **shall** be 13 mm [0.512 in] wide by 130 mm [5.118] long in accordance with UL 94 specification.

Tin panels **shall** be prepared in accordance with FED-STD-141, Method 2012.

4.6.2 Sample Size The minimum number of test specimens **shall** be as outlined in Table 4-1, or it **shall** be of sufficient quantity to achieve statistical confidence required by agreement between customer and supplier.

4.6.3 Preparation Prior to Coating The prepared test vehicles **shall** be cleaned, handled and stored so that, at the time of priming and/or coating, they meet the cleanliness requirements of IPC-6012 (see 6.3 and 6.4).

Table 4-1 Test Vehicles and Sample Sizes

Paragraph	Test to Run	Test Method	Test Vehicle	Number of Specimen
3.5.2	Appearance	Visual	Glass Plate*	4 coated, 1 uncoated
3.5.3	Fluorescence	Visual under UV		
4.6.4	Thickness	ASTM-D-1005		
3.5.4	Fungus Resistance	IPC-TM-650 2.6.1.1	Glass Plate	4 coated
3.5.5	Flexibility	IPC-TM-650 2.4.5.1	Tin Panel	4 coated
3.5.6	Flammability	UL 94 HB	UL 94 Test Strip	20 coated
3.6.1	Dielectric Withstanding Voltage	IPC-TM-650 2.5.7.1	IPC-B-25A Test Board	5 coated
3.7.1	Moisture and Insulation Resistance	IPC-TM-650 2.6.3.4	IPC-B-25A Test Board	4 coated, 1 uncoated
3.7.2	Thermal Shock	IPC-TM-650 2.6.7.1	IPC-B-25A Test Board	5 coated
3.7.3	Temperature and Humidity Aging (Hydrolytic Stability)	IPC-TM-650 2.6.11.1	"Y" Shape Test Assembly	5 coated (1 as control)

* Same specimens are used for these inspections.

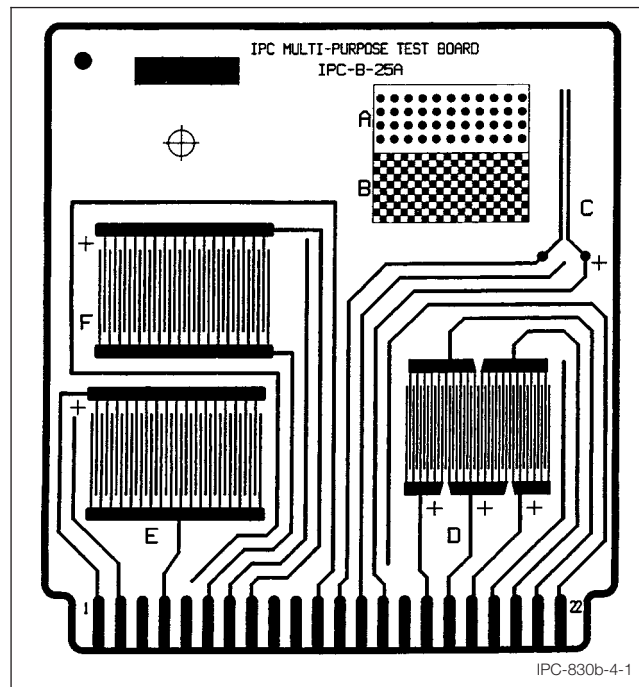


Figure 4-1 IPC-B-25A

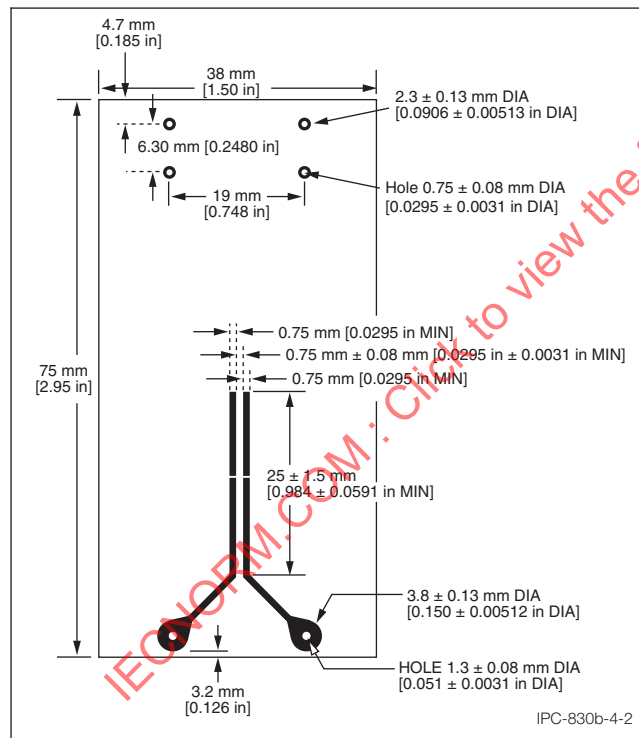


Figure 4-2 Test Coupon with "Y" Shape Pattern

If and when a conformal coating manufacturer recommends a primer for use with a conformal coating (as a system), the primer **shall** be used in conjunction with the conformal coating material during qualification testing.

4.6.4 Coating The conformal coating **shall** be applied to the test vehicles over the patterns and/or assemblies and

cured for the time and temperature recommended by the manufacturer. Thickness **shall** be measured in accordance with ASTM-D-1005 or by micrometer or indicator accurate to $12.5 \pm 2.5 \mu\text{m}$ [$0.5 \pm 0.1 \text{ mil}$]. For Type XY, the thickness may be measured optically. A glass plate may be used for referee in conformal coating thickness measurement.

For the purpose of qualification, qualification retention and quality conformance inspection, the cured conformal coating on the test vehicle **shall** have a thickness as specified in Table 4-2. For actual thickness requirements of applied and cured conformal coating on a printed wiring assembly product, refer to J-STD-001 or IPC-2221.

Table 4-2 Thickness Requirements on Test Vehicle

Type of Coating	Thickness
AR	25-75 μm [0.98-2.95 mil]
UR	25-75 μm [0.98-2.95 mil]
ER	25-75 μm [0.98-2.95 mil]
SR	50-200 μm [1.97-7.87 mil]
XY	12.5-50 μm [0.49-1.97 mil]

4.7 Failures One or more failures **shall** be cause for repeating the failed test after the failure mode has been determined and corrected. If the corrective action results in a product change per 4.3, qualification of the changed product **shall** be verified.

4.8 Inspection Reporting

4.8.1 Qualification Reporting Because samples, equipment, procedures and conditions may vary between locations or test systems, complete and precise reporting of sample preparation, test details and verifying data is required. Results of inspection **shall** be summarized in a qualification inspection report, with classification attained clearly indicated. An example of the format is shown in Appendix A.

4.8.2 Qualification Retention Reporting Complete and precise reporting of sample preparation, test details and verifying data is required for qualification retention inspection. Results **shall** be compared with the original qualification inspection results and reported accordingly. Results of inspection **shall** be summarized in a qualification retention inspection report. An example of the format is shown in Appendix B.

4.8.3 Quality Conformance Reporting Results from the quality conformance inspection **shall** be compared with the original qualification inspection results and previous quality conformance inspection results. Results of inspection **shall** be summarized in a quality conformance inspection report. An example of the format is shown in Appendix C.

5 PREPARATION FOR DELIVERY

5.1 Containers Containers for packaging **shall** be in accordance with good commercial practices. Containers

shall be of a corrosion resistant material that will not react, deteriorate or affect the quality of the conformal coating product being packaged. When a conformal coating product consist of more than one component, each component **shall** be individually furnished in sufficient quantities necessary to react with the other and total amount to be that specified in the purchase order.

5.2 Packaging Preservation, packing and marking **shall** be in accordance with MIL-STD-1188.

5.3 Marking The following markings are required:

- a. Manufacturer's part number
- b. Manufacturer's lot or batch number
- c. Name of manufacturer
- d. Date of manufacture
- e. Expiration date
- f. Precautionary handling

6 NOTES

6.1 Order Data It is recommended that the following information be specified in procurement documents:

- a. Title, number and date of this standard; type (see 1.3.1) and class (see 1.3.2) of material contained in the package
- b. Solvent compatibility information
- c. Special packing instructions if required
- d. Size of containers
- e. Quantity of material required
- f. Other special instructions

6.2 Formulation Change It is important that the properties of conformal coating material remain consistent throughout the life of the product. Small changes in the composition of the material may have dramatic effects upon certain properties (such as flammability, adhesions, etc.) and hence behaviors of the product during the application process and in end use environment. Compatibility of conformal coating with associated materials can often be a sensitive issue. Therefore, it is important that formulation consistency be maintained and users be informed when any change has been made.

6.3 Conditioning It is recommended that the test boards be baked at 121 °C [249.8 °F] for minimum one hour, but no more than four hours, prior to coating. It is also suggested that the environment in which the conformal coating is applied should be clean. Monitoring of relative humidity, temperature and particle counts ensures a better-coated assembly.

6.4 Cleanliness It is of paramount importance that the test vehicle be thoroughly cleaned prior to conformal coat-

ing application. A "dirty" test vehicle will decrease values for dielectric withstanding voltage, insulation resistance, and will adversely impact adhesion. An unclean test vehicle cannot yield an accurate evaluation of the conformal coating material.

6.5 Adhesion The level of adhesion between conformal coatings and substrates varies greatly. Among the factors which influence adhesion are soldering procedures, primer and/or coating application, curing process, chemistry of conformal coating, solder mask, flux and cleaning agent (if any).

Some applications require high-level adhesion; others desire easy removal of conformal coating from the coated assembly. The key to the determination of adhesion requirement is an agreement between manufacturer/ assembler or assembler/user of conformal coating, supported by adequate understanding of subsequent manufacturing processes and end use environments.

The adhesion test used **shall** be agreed upon the manufacturer/assembler or assembler/user of conformal coating. A standard paint type tape test may be used for some coated printed wiring assemblies. Alternate methods, such as temperature and/or humidity cycling etc., may be employed. The applicability of test result **shall** be determined by the user.

6.6 Solvent Compatibility The compatibility of a conformal coating product with solvents may be evaluated to avoid potential degradation of conformal coating and coated printed wiring assemblies in subsequent manufacturing processes or end use environments.

Described below is a recommended procedure for the evaluation of solvent compatibility of a conformal coating product.

- a. Immerse a coated specimen in the solvent at 25 ± 5 °C [77 ± 9 °F] for two minutes.
- b. Remove the coated specimen from solvent, air dried for 10 minutes at ambient laboratory conditions.
- c. Oven bake the coated specimen for 30 minutes at 65 ± 3 °C [147 ± 5.4 °F].
- d. Cool to room temperature.
- e. Examine coated specimen for evidence of surface tack, blistering, dilation and color change.

6.7 Identification of Solvent Sensitive Conformal Coatings It is recommended that solvent sensitive conformal coating be identified on the coated printed wiring assemblies by using labels, bar codes, color-coding, etc. This will provide useful cautionary information for subsequent manufacturing processes and/or end use applications, which might otherwise incur solvent incompatibility.