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PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

Qualification and performance of electrical insulating compound for printed wiring assemblies

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Qualification and performance of electrical insulating compound for printed wiring assemblies

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QUALIFICATION AND PERFORMANCE OF ELECTRICAL INSULATING COMPOUND FOR PRINTED WIRING ASSEMBLIES

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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
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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

Association Connecting Electronics Industries

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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)

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

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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 IPC[1]

IPC-B-25A Multipurpose Test Board

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

IPC-TM-650 Test Methods Manual[2]

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 Government[3]

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 2012

2.3 American Society for Testing of Materials[4]

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

ASTM-D-1084 Viscosity of Adhesives, Tests for

2.4 Underwriters Laboratories[5]

UL 94 Flammability

2.5 ANSI[6]

NCSL Z540-1 Calibration Laboratories and Measuring and Test Equipment

2.6 ISO[7]

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 conjuction 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:

a. 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
b. 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
c. Cease to burn before the 100 mm [3.937 in] reference mark.

3.6 Electrical Requirements

3.6.1 Dielectric Withstanding Voltage (DWV) 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 flashover (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 ± 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 ± 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 ± 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 Qualication 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 ± 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 ± 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:

a. 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].

b. 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 "Y" 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.

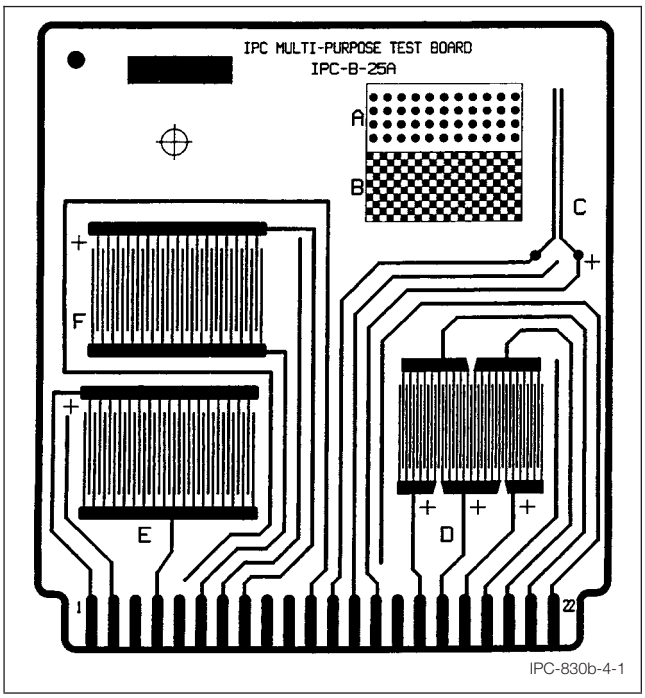

Figure 4-1 IPC-B-25A

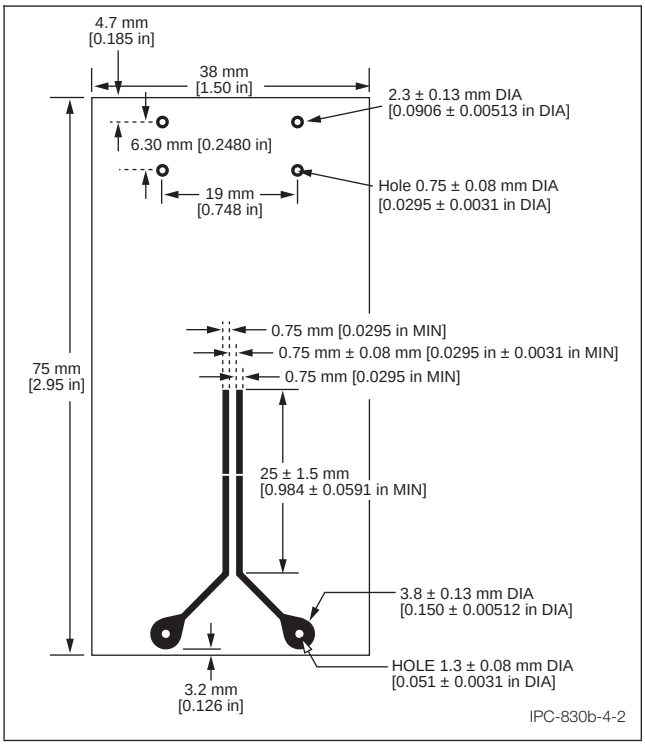

Figure 4-2 Test Coupon with "Y" Shape Pattern

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 ± 2.5 µm [0.5 ± 0.1 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 coating 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 coatedassembly. 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.

Appendix A Example of Qualification Inspection Report

Manufacturer's Identification:	**Inspection Completion Date:**	
Product Identification:	**Conformal Coating Type:**	**Cure Type:**
A primer was used in conjunction with this product during qualification testing [ ] Yes [ ] No **Primer used:**		
Overall Qualification Results **[ ] Pass [ ] Fail**		

Individual Inspection and Test Results

Test	Test Method	Paragraph in IPC-CC-830B	Results	Remarks
Fourier Transform Infrared Spectroscopy Test (FTIR)	AABUS	3.4.1	Spectrum to be retained for future reference	
Viscosity	ASTM D-1084	3.5.1	Measurement to be recorded for future reference. [ ] N/A (type xy)	
Appearance	Visual	3.5.2	[ ] Pass [ ] Fail	
Fluorescence	Visual under UV	3.5.3	[ ] Pass [ ] N/A (type xy) [ ] Fail	
Fungus Resistance	IPC-TM-650 2.6.1.1	3.5.4	[ ] Pass [ ] Fail	
Flexibility	IPC-TM-650 2.4.5.1	3.5.5	[ ] Pass [ ] Fail	
Flammability	UL 94 HB	3.5.6	[ ] Pass [ ] Fail	
Dielectric Withstanding Voltage	IPC-TM-650 2.5.7.1	3.6.1	[ ] Pass [ ] Fail	
Moisture and Insulation Resistance	IPC-TM-650 2.6.3.4	3.7.1	[ ] Pass 500 MΩ minimum [ ] Pass 5000 MΩ minimum [ ] Fail	
Thermal Shock	IPC-TM-650 2.6.7.1	3.7.2	[ ] Pass [ ] Fail	
Temperature and Humidity Aging	IPC-TM-650 2.6.11.1	3.7.3	[ ] Pass [ ] Not Tested [ ] Fail	

Inspection conducted by:	

Appendix B Example of Qualification Retention Inspection Report

Manufacturer's Identification:	**Inspection Completion Date:**	
Product Identification:	**Conformal Coating Type:**	**Cure Type:**
Original Qualification Date:	**Last Qualification Retention Date:**	

Overall Qualification Retention Results

[ ] Pass [ ] Fail

Individual Inspection and Test Results

Test	Test Method	Paragraph in IPC-CC-830B	Results	Remarks
Fourier Transform Infrared Spectroscopy Test (FTIR)	AABUS	3.4.1	Spectrum to be compared with that from the original qualification test [ ] Pass [ ] Fail	
Appearance	Visual	3.5.2	[ ] Pass [ ] Fail	
Fluorescence	Visual under UV	3.5.3	[ ] Pass [ ] N/A (type xy) [ ] Fail	
Moisture and Insulation Resistance	IPC-TM-650 2.6.3.4	3.7.1	[ ] Pass 500 MΩ minimum [ ] Pass 5000 MΩ minimum [ ] Fail	

Inspection conducted by:	

Appendix C Example of Quality Conformance Inspection Report

Manufacturer's Identification:		**Inspection Completion Date:**	
Batch Identification:	**Product Identification:**	**Conformal Coating Type:**	**Cure Type:**
Original Qualification Date:		**Last Qualification Retention Date:**	
Last Conformance Inspection Date:			

Overall Quality Conformance Results

[ ] Pass [ ] Fail

Individual Inspection and Test Results

Test	Test Method	Paragraph in IPC-CC-830B	Results	Remarks
Viscosity	ASTM D-1084	3.5.1	[ ] Pass [ ] N/A (type xy) [ ] Fail	
Appearance	Visual	3.5.2	[ ] Pass [ ] Fail	
Fluorescence	Visual under UV	3.5.3	[ ] Pass [ ] N/A (type xy) [ ] Fail	

Inspection conducted by:	

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