

BUILD ELECTRONICS BETTER

IPC MICROVIA VIRTUAL SUMMIT 2020

Performance Based Microvia Reliability Testing - What You Need to Know



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Performance Based Acceptance Testing

Test sample (coupon) <u>must</u> match the product board

- Via structures
 - Hole & land sizes
 - Staggers (offsets)
 - Spacings (grid)
 - Fill
- Signal & plane layers
- Soldermask

Test method must simulate the real conditions

- Heating method
- Time vs. <u>surface</u> temperature profile





IPC TM-650 2.6.27B Convection Reflow Assembly Simulation **IPC** IPC MICROVIA VIRTUAL SUMMIT 2020

Convection Reflow

Time vs. <u>surface</u> temperature

Four regions

- Preheat
- Activation
- Reflow
- Cooling

Multiple heating zones are used to achieve profile specifications



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4

IPC Reflow Profiles

PC

IPC TM-650 2.6.27B

- 230C
- 245C
- 260C (Default)

Developed to replace solder float for SMT applications

IPC timeline

- Established in 2008 by the D-32 subcommittee
- Invoked by IPC 6012C in 2010

Specific requirements for each

- Profile
- Zone





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Resistance data

1 reading/second throughout the entire test

IPC TM-650 2.6.27B Data Requirements

- Default failure threshold is 5% change
- Total allowable system contribution is <0.5%
 - Chamber non-uniformities
 - Cycle-to-cycle temperature control
 - Data acquisition resolution & noise

Temperature data

- 1 reading/second throughout the entire test for both coupon & air stream
- Control for each coupon at peak is ±5C

Association Connecting Electronics Industries	Number 2.6.27 Subject Thermal Stress, Convection Reflow Assembly Simulation
IPC-TM-650 TEST METHODS MANUAL	Late Hexason 2/2020 B Crighating Task Group B Thermal Stress Test Methodology Subcommittee (D-32)
1 Scope and Purpose	3 Test Specimen
 Seger This method is intended to simulate exposure to the thermal control by correction methow assembly. 2. Purpose: This method shall be used to replicite the thermalonamic effects by assembly on the test spectroms. The use of this method is intended to simulate those effects that are the result of soldering thermal excursions. 2.1. This method shall be used for qualification heating of an applicable test specimen. The evaluation of a cooptiability orgalification shall be in accodinate with the regurements defined in 5.3. 2.2. This method may be used for lot acceptance. The evaluation for lot acceptability should be in accordance with the requirements defined in 5.3 or as agreed upon between user and supplier (ARBUS). 2. Applicable Documents IPC-520 Terms and Definitions IPC-520 Acceptability of Printed Baards IPC-6400 Acceptability of Printed Baards IPC-6401 Acceptability of Printed Baards IPC-6401 Couldication and Performance Specification for Flight Printed Boards IPC-6403 Couldination All Performance Specification for Flight Printed Boards IPC-6403 Could activity of Printed Baards 	 Design/Construction Orderia A.1. The test specimen shall be the AB, AB-R, and/or the Document is designed in accordance with the requirements of location and selected A or B. Lee of atternate specimens shall be ABUS. The test specimen(s) shall be constructed with holes contained in the printed bard it represents as follow: A.9.A.9.R. and D coupons shall be constructed with both the larget plated through holes (PTHs) and the smallest vias. Prospatient B and D coupons shall be constructed with the structed V as structure, (Mattiple B and D coupons and used for designs with multiple entries bard respective sector structure). A.1. The test specimen(s) shall contain the representa- ing of designs with multiple entries bard wide, via- ture structure, with any structures. The test specimen(s) shall contain the representa- hend the specimen(s) shall contain the representa- ional of the specimen(s) shall contain the representa- bend the tructure, with any structure bard wide vias. The test specimen(s) shall contain the representa- bend the structure, and the applicable, representative PTHs and vias datafiel of its 1.2.2 after exposure to the contains of this Test test. Mer test specimen(s) and the specimentian the structure of the structure. The test specimen(s) and the speciment of the Test test.
IPC-6018 Qualification and Performance Specification for High Frequency (Microwave) Printed Boards IPC-9241 Quidelines for Microsection Preparation	3.1.4 Deviations to the test specimen design/construction or use of an alternate test specimen such as the printed board or a section of the printed board shall be AABUS.
IPC-9631 User's Guide for IPC-TM-650, Method 2.6.27	4 Apparatus
IPC-TM-650 Test Methods Manual	4.1 Drying Oven
2.1.1 Microsectioning – Microsectioning, Manual and Semi or Automatic Method	4.1.1 The oven shall be capable of maintaining a uniform set temperature within the 105 to 125 °C [221 to 257 °F] range.
1. Current and revised IPC Test Methods are available on the IPC Web site (www.)	pc.org/test-methods.aspx).
Material in this Test Mathods Manual was voluntarily established by Technical Committees of i and its use or adaptation is entirely voluntary. IPC disclams all fability of any kind as to the un material. Listers are also midig maporable for protocoling themselves against all cleans or take Explorement Information as for the communicant of the user and does not might workement by	PC: This material is advisory only as, application, or adjustedon of this bline for particular inforgament.



Cycle-to-Cycle Variations

Delta

• 1.8C

• 0.7% change in resistance

1C variation from cycle-tocycle is 80% of the allowable error budget



Reflow is Dynamic

Coupons are in a dynamic state

Temperature gradients exists within the coupons which vary throughout the profile

1 reading/second is required

If a "static state" is achieved the test is not "real world" & the coupons are over stressed

Modeling considerations

- Dynamic state of the coupon
- X & Y axis CTEs



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70

• Healing (reconnect) occurs below 200C

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μVia Failures

General observations

- No measurable change in resistance at room temperature
- Often will pass thermal shock (TM-650 Method 2.6.7.2C)



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"There have been many examples of post fabrication microvia failures over the last several years. Typically, these failures occur during reflow, however they are often undetectable (latent) at room temperature. The further along the assembly process that the failures manifest themselves the more expensive they become. If they remain undetected until after the product is placed into service, they become a much greater cost risk, and more importantly, may pose a safety risk."

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IPC *µ***Via Reliability Warning**

Conventional Microsection

After Broad Beam Ion Milling



Source: IPC Press Release on Microvia Reliability, March 2019

IPC μ Via Reliability Warning

"Many of these failures occurred within products that had already passed traditional production lot acceptance testing in accordance with existing IPC-6010, Printed Board Qualification and Performance Specifications. IPC has been provided with data showing that traditional inspection techniques utilizing thermally stressed microsections and light microscopes alone is no longer an effective quality assurance tool for detecting microvia-to-target plating failures."

Source: IPC Press Release on Microvia Reliability, March 2019

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More Information

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- OM Thermal Stress System
- IPC D Coupon generator
- IPC PCQR² test patterns
- Technical papers & presentations



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