



ASSOCIATION CONNECTING
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IPC-TM-650 TEST METHODS MANUAL

1 Scope and Purpose

1.1 Scope This method **shall** be used to simulate exposure to the thermal conditions of convection reflow assembly.

1.2 Purpose This method **shall** be used to replicate the thermodynamic effects of assembly on the test specimen. The use of this method in accordance with the requirements defined herein **shall** cover those effects that are the result of convection reflow assembly, rework or repair.

1.2.1 This method **shall** be used for qualification testing of an applicable test specimen. The evaluation of acceptability for qualification **shall** be in accordance with the requirements defined in 5.3.

1.2.2 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 (AABUS).

2 Applicable Documents

IPC-T-50 Terms and Definitions

IPC-A-600 Acceptability of Printed Boards

IPC-TM-650 Test Methods Manual

2.1.1 Microsectioning

2.1.1.2 Microsectioning - Semi or Automatic Technique
Microsection Equipment (Alternate)

IPC-2221 Generic standard on Printed Board Design

IPC-6012 Qualification and Performance Specification for Rigid Printed Boards

IPC-6013 Qualification and Performance Specification for Flexible Printed Boards

IPC-6016 Qualification and Performance Specification for High Density Interconnect (HDI) Layers or Boards

IPC-6018 Microwave End Product Board Inspection and Test

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Subject Thermal Stress, Convection Reflow Assembly Simulation	
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Originating Task Group Thermal Stress Test Methodology Subcommittee (D-32)	

3 Test Specimen

3.1 Design/Construction Criteria

3.1.1 The test specimen **shall** be the A/B coupon in accordance with the requirements of IPC-2221.

3.1.2 The test specimen **shall** be constructed with both the largest plated-through holes (PTHs) and the smallest vias contained in the printed board (PB) it represents.

3.1.2.1 The test specimen **shall** contain the representative ground and power planes of the PB design.

3.1.2.2 The test specimen **shall** contain the representative/applicable blind and/or buried vias of the PB design.

3.1.2.3 The test specimen **shall** contain a minimum of four (4) of the smallest vias that represent the via protection strategy incorporated in the PB design.

3.1.3 The test specimen **shall** allow for microsection evaluation of all the applicable, representative PTHs and vias defined in 3.1.2 after exposure to the conditions of this Test Method.

3.1.4 Deviations to the test specimen design/construction or use of an alternate test specimen such as the PB or a section of the PB **shall** be AABUS.

4 Apparatus

4.1 Drying Oven

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.

4.2 Thermal Excursion Simulator

4.2.1 The system used to simulate the thermodynamic effects of assembly **shall** be convection reflow.



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4.2.1.1 The system **shall** have adequate environmental controls to maintain the tolerance range and limits in accordance with the reflow profile depicted in either Figure 5-1 or Figure 5-2.

4.2.1.2 The system should accommodate verifiable calibration compliance and reflow profile generation. See note 6.1 for additional considerations.

4.2.1.3 The test specimen **shall** be handled and stored in a controlled environment to minimize moisture ingress.

4.2.2 Deviations to the equipment requirements and acceptability of the alternative methods **shall** be AABUS.

4.3 Microscope

4.3.1 The magnification used for defect recognition must be in agreement with the inspection requirements/capabilities defined in IPC-A-600 and the applicable performance specification (e.g., IPC-6012, IPC-6013, IPC-608, etc.).

5 Procedure

5.1 Conditioning

5.1.1 The test specimen **shall** be conditioned by drying in an oven to remove moisture for a minimum of six (6) hours at 105 to 125 °C [221 to 257 °F]. This conditioning process is mandatory if this method is used for qualification purposes.

This method **shall** replicate the assembly process. The requirement for conditioning (bake/drying) **shall** be in accordance with product/process lot acceptance criteria. If conditioning of the PB is not part of the normal assembly process, and this method is being used for acceptance testing, then conditioning is not a requirement.

5.1.2 Test specimens that are thicker or more complex may require longer baking times to achieve acceptable moisture levels. Record the bake times and temperature if different than those stated in 5.1.1 (see 6.2).

5.1.3 Deviations to the conditioning requirements in 5.1.1 such as when used for acceptance criteria and/or any changes to the time and temperature **shall** be AABUS (see 6.3).

5.2 Reflow Profile

5.2.1 Reflow the test specimen in accordance with Table 5-1 (default) or Table 5-2 (low temperature profile).

5.2.2 The reflow profile **shall** be in accordance with either Figure 5-1 or Figure 5-2. Figure 5-1 represents the default reflow profile. Figure 5-2 represents the low temperature profile. The attachment of thermocouples to the sample test specimen **shall** be such that the reflow profile is calibrated to the surface temperature of the test specimen.

5.2.3 The test specimen **shall** be subjected to six (6) complete reflow cycles.

5.2.4 The cool down rate **shall** be in accordance with Table 5-1. The cool down is complete when the test specimen reaches 30 °C. The test specimen **shall** achieve a thermal equilibrium of 30 °C or less prior to starting the next reflow cycle. If the time it takes to achieve thermal equilibrium cannot be determined, then a five (5) minute dwell between reflow cycles **shall** be required.

5.2.5 Deviations to the reflow profile or number of cycles **shall** be AABUS.

5.3 Evaluation

5.3.1 Microsection After the test specimen has been conditioned and reflowed in accordance with the requirements of 5.1 and 5.2, microsection the test specimen in accordance with the requirements defined in IPC-TM-650, Method 2.1.1 or Method 2.1.1.2 and evaluate for compliance to the applicable performance specification.

5.3.2 Deviations to the stated requirements or additional requirements defined here **shall** be AABUS.

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Table 5-1 260 °C Reflow Profile Specifications (Default)

Value	Time (Seconds)	Temperature (°C)	Description
t1	210 ± 15	–	Target preheat time
t2	270 ± 10	–	Target peak reflow time
t3	330 ± 15	–	Target cool-down start time
t3 - t1	120 ± 30		Target time above T1
T1	–	230	Maximum preheat temperature
T2	–	260 ± 5	Target reflow temperature
Point	Time (Seconds)	Temperature (°C)	Description
A	0	30	Upper specification limit values
B	100	230	
C	195	230	
D	255	265	
E	285	265	
F	345	230	
G	550	30	
H	30	30	Lower specification limit values
I	157	93	
J	225	230	
K	260	255	
L	280	255	
M	315	230	
N	383	30	
Segment	Slope (°C / second)		Description
A-B & I-J	2.0		Maximum preheat rate
H-I	0.5		Minimum preheat rate
F-G	-1.0		Minimum cool-down rate
M-N	-3.0		Maximum cool-down rate