# ENGINEERING SPECIFICATION

## CONNECTOR HEAT RESISTANCE SPECIFICATION

### 1.0 SCOPE

This specification defines the test procedure and criteria for assessing the capability of connectors to withstand the effects of the temperatures and/or environments that are associated with surface mount reflow or wave soldering methods

### 2.0 PURPOSE

To establish standard test method and evaluation procedures for determining the ability of connector assemblies to withstand the effects of reflow and wave soldering through process simulation.

### 3.0 REFERENCE DOCUMENTS

#### 3.1 DOCUMENTS

- EIA-364 TP-17 Temperature Life with or Without Electrical Load Test Procedures for Electrical Connectors and Sockets
- EIA-364 TP-18 Visual and Dimensional Inspection for Electrical Connector
- EIA-364 TP-31 Humidity Test Procedure for Electrical Connectors and Sockets
- EIA-364 TP-56 Resistance to Soldering Heat Test Procedure for Electrical Connectors
- IPC-6013 Qualification and Performance Specification for Flexible Printed Boards
- IPC/EIA/JEDEC J-STD-006 Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications
- JEDC J-STD 020 Moisture/Reflow Sensitivity Classification for Non Hermetic Sold State Surface Mount Devices
- JEDEC JESD22-B106C Resistance to Soldering Temperature for Through-Hole Mounted Devices

#### 3.2 FORMS / TEMPLATES

- None

#### 3.3 MOLEX NET INFORMATION

- None

## 4.0 DEFINITIONS

### 4.1 CONFORMANCE GLOSSARY

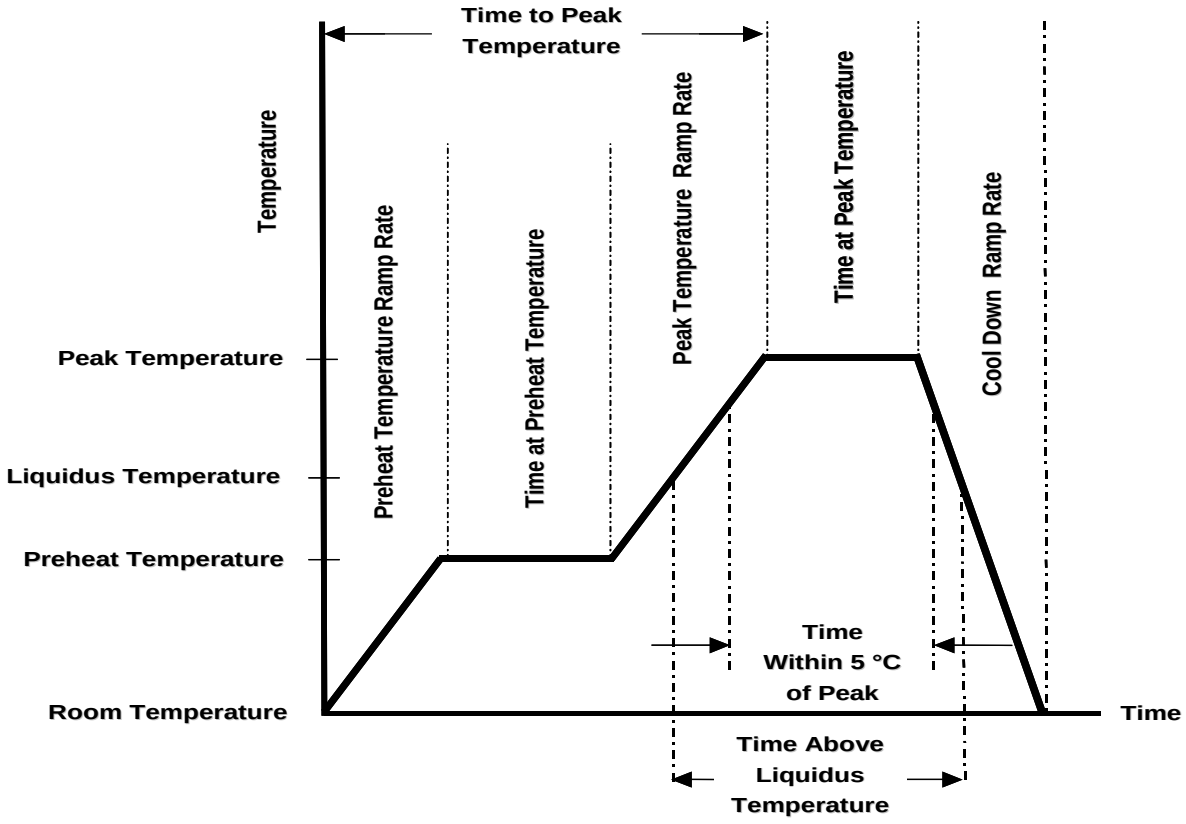
#### 4.1.1 MAY
A keyword that indicates flexibility of choice with no implied preference. Equivalent to the phrase “is optional”.

#### 4.1.2 SHALL
A keyword that indicates a mandatory requirement. Designers are required to implement all such mandatory requirements to ensure consistency with other products and related standards. Equivalent to the phrase “is required” or “must”.

#### 4.1.3 SHOULD
A keyword that indicates flexibility of choice with a strong preference alternative. Equivalent to the phrase “is recommended”.

### 4.2 ILLUSTRATIONS

#### 4.2.1 SURFACE MOUNT REFLOW SOLDERING PROFILE



### 4.3 TECHNICAL GLOSSARY

#### 4.3.1 PRINTED CIRCUIT BOARD FOOTPRINT
The mounting pattern specified to terminate the connector assembly terminals to the printed circuit board holes and or surface mount patterns.

#### 4.3.2 PRINTED CIRCUIT BOARD (PC BOARD)
A substrate used to interconnect components electrically and acts as the primary structure to support those components. Also known as printed wiring board.

#### 4.3.3 PROCESS COMPATIBILITY
A component's ability to withstand the manufacturing process from a stabilized temperature and humidity condition.

#### 4.3.4 SPECIMEN
The component under evaluation.

## 5.0 REQUIREMENTS

### 5.1 EQUIPMENT

#### 5.1.1 DIMENSIONAL
The dimensional inspection tools, gages and equipment **shall** be capable of verifying the dimensions specified on the Molex Sales Drawing.

#### 5.1.2 DIPPING DEVICE (DIP METHOD)
A mechanical dipping device capable of controlling the rates and angle of immersion of the specimen, and providing a dwell time (time of total immersion to the required depth) in the solder bath as specified in 5.3.3 **shall** be used.

#### 5.1.3 OPTICAL EQUIPMENT
An optical system capable of providing magnification between 10X and 20X **shall** be used. Lighting **shall** provide a uniform non-glare, non-directional illumination of this specimen.

#### 5.1.4 TEMPERATURE HUMIDITY CHAMBER
Chambers **shall** be of an appropriate size to accommodate all test specimens under evaluation and capable of operating and maintaining the specified test environment temperature with and accuracy of ± 2° C and at the specified relative humidity with an accuracy of ± 3 %.

### 5.1.5 THROUGH-HOLE WAVE SOLDERING

#### 5.1.5.1 SOLDER POT (DIP METHOD)

A solder pot of sufficient size to contain at least 0.91 kg (2 lbs.) of solder **shall** be used. Its dimensions **shall** allow immersion of the leads to a depth specified in 5.3.1.3 without touching the bottom of the pot. The apparatus **shall** be capable of maintaining the solder at the specified temperature.

### 5.1.6 REFLOW EQUIPMENT (PROCESS SIMULATION METHOD)

#### 5.1.6.1 CONVECTION REFLOW SYSTEM

A test chamber using convection heating **shall** be of an appropriate size to accommodate all test specimens under evaluation. The chamber **shall** be capable of operating and maintaining the specified temperature profile within the defined time period. The profile **shall** be generated by monitoring the temperature on the top surface of the board and as such, the connector housing may not necessarily experience the same temperature profile.

#### 5.1.6.2 INFRARED/CONVECTION SYSTEM

A test chamber using infrared (IR)/convection heating **shall** be of an appropriate size to accommodate all test specimens under evaluation. The chamber **shall** be capable of operating and maintaining the specified temperature profile within the defined time period. The chamber shall use IR to heat only the air and not directly impinge upon the test specimens. The profile **shall** be generated by monitoring the temperature on the top surface of the board and as such, the connector housing may not necessarily experience the same temperature profile.

## 5.2 MATERIALS

### 5.2.1 SOLDER

Solder **shall** conform to **IPC/EIA/JEDEC J-STD-006**.

Except where otherwise indicted, the component elements in each alloy **shall not** deviate by more then 0.20% of the alloy mass when their nominal percentage is equal to or less than 5.0% or by more than 0.50% when their nominal percentage is greater than 5.0%.

#### 5.2.1.1 TIN LEAD ALLOY COMPOSITION

The tin lead alloy solder **shall** conform to composition Sn60Pb40 or Sn63Pb37.

The composition of the solder including contamination levels **shall** be maintained during the testing.

| | Tin Lead Alloy | Sn60Pb40 or Sn63Pb37 |
|---|---|---|
| Maximum Contaminant Weight Percentage (wt %) Limit | Copper (Cu) | Not Applicable |
| | Gold (Au) | 0.200 |
| | Cadmium (Cd) | 0.005 |
| | Zinc (Zn) | 0.005 |
| | Aluminum (Al) | 0.006 |
| | Antimony (Sb) | 0.500 |
| | Iron (Fe) | 0.020 |
| | Arsenic (As) | 0.030 |
| | Bismuth (Bi) | 0.250 |
| | Silver (Ag) | Not Applicable |
| | Nickel (Ni) | 0.010 |
| | Lead (Pb) | 0.100 |
| | Sum total of the Aluminum, Copper, Gold, Cadmium and Zinc | 0.400 |

#### 5.2.1.2 LEAD FREE ALLOY COMPOSITION

The lead free alloy solder **shall** conform to composition Sn95.5Ag3.9Cu0.6, allowing variation of the Ag content between 3.0 – 4.0 wt% and Cu content between 0.5 – 1.0 wt. %

The composition of the solder including contamination levels **shall** be maintained during the testing.

| | **Lead Free Alloy** | Sn95.5Ag3.9Cu)0.6 |
|---|---|---|
| Maximum Contaminant Weight Percentage (wt %) Limit | Copper (Cu) | 0.300 |
| | Gold (Au) | 0.200 |
| | Cadmium (Cd) | 0.005 |
| | Zinc (Zn) | 0.005 |
| | Aluminum (Al) | 0.006 |
| | Antimony (Sb) | 0.500 |
| | Iron (Fe) | 0.020 |
| | Arsenic (As) | 0.030 |
| | Bismuth (Bi) | 0.250 |
| | Silver (Ag) | 0.100 |
| | Nickel (Ni) | 0.010 |
| | Lead (Pb) | Not Applicable |
| | Sum total of the Aluminum, Copper, Gold, Cadmium and Zinc | 0.400 |

### 5.2.2 TEST BOARDS

The test printed circuit boards **shall** meet the requirements per **IPC-6013.** Test boards **should** be glass epoxy FR4 without copper cladding. All holes **shall not** be plated.

## 5.3 PROCEDURE

Product specific temperature ratings and reflow parameters if different than in this document, take precedence.

### 5.3.1 SPECIMENS

A minimum of eleven (11) connector specimen assemblies from a minimum of two nonconsecutive production lots **shall** be used for each test. Specimens shall be representative of current production product available for sale.

### 5.3.2 DIMENSIONAL AND VISUAL SOLDERING

Conduct dimensional and visual inspection per **EIA 364 TP18** before and after testing. The entire specimen **shall** be examined using a magnification between 10x and 20x. See 5.3.5.

### 5.3.3 PROCEDURE 1 - DIP METHOD (THROUGH HOLE WAVE SOLDERING)

#### 5.3.3.1 TEST SPECIMENS

The test specimens **should** be inserted in a printed circuit board with a footprint specified on the appropriate Sales drawing. The engineer **may** choose to conduct the test without the use of the printed circuit board to evaluate a worse case scenario.

#### 5.3.3.2 SPECIMEN IMMERSION

The dross and burned flux **shall** be skimmed from the surface of the molten solder. The molten solder **shall** be maintained at a uniform temperature of 260 ± 5° C. The surface of the molten solder **shall** be skimmed again just prior to immersing the specimens in the solder. The parts **shall** be attached to a dipping device (see 5.1.2) and the specimen immersed ONCE in molten solder to the same depth.

The immersion and removal rates **shall** be 25 ± 6mm/sec (1 ± .25 inch per second) and the dwell time in the solder bath **shall** be 10 +2/-0 seconds, unless otherwise specified. After the dipping process, the part **shall** be allowed to cool in air.

### 5.3.4 PROCEDURE 2 – PROCESS SIMULATION METHOD (SURFACE MOUNT REFLOW SOLDERING)

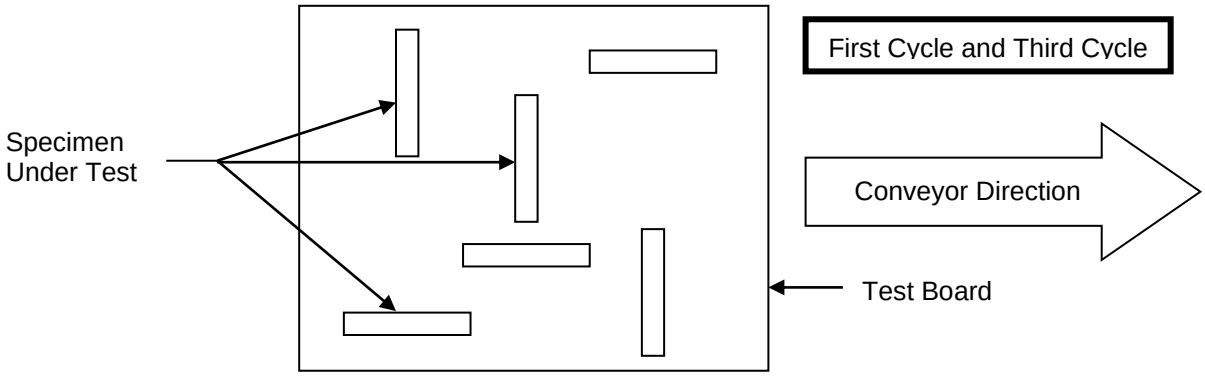
#### 5.3.4.1 PRECONDITIONING

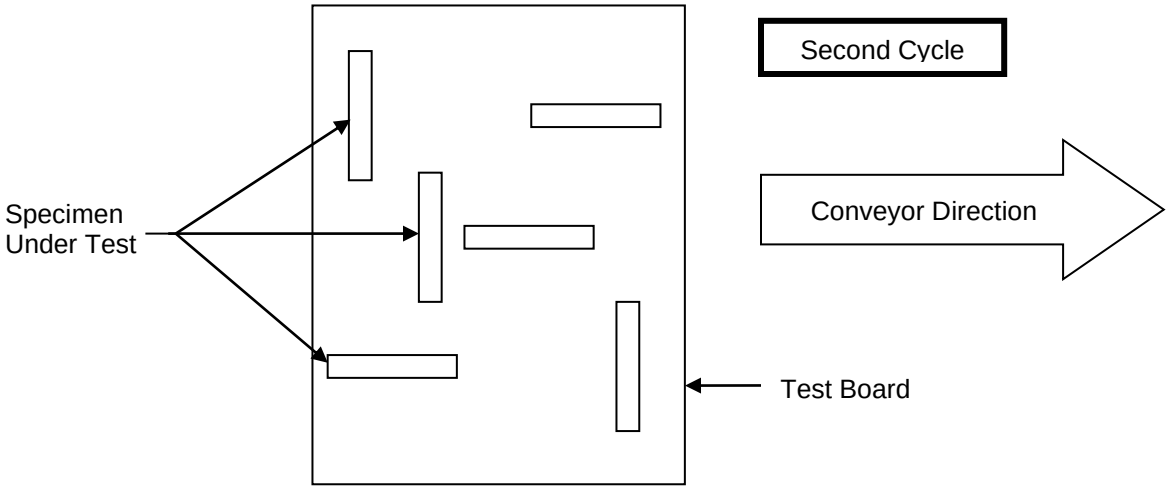
Place specimens in a clean, dry, shallow container so that they do not touch or overlap each other.

Subject the specimens to 85 °C ± 2 °C and 85 % ± 3 % relative humidity for 168 hours per **JEDEC J-STD 020**.

#### 5.3.4.2 SPECIMEN PLACEMENT ON TEST BOARDS

Specimens **should** be placed on the test boards to allow an evaluation of all orientations during the solder simulation process and do not affect the temperature profile. Specimens **shall** be spaced to eliminate any potential temperature gradients that could impact the test simulation results. A thermocouple **shall** be mounted on the top of the specimen to record the temperature profile of the specimen.



**5.3.4.3 HEAT RESISTANCE TEST**

Preconditioned specimens **shall** be stabilized at 25°C ± 10 °C and 20 % to 80 % relative humidity for 15 minutes to 4 hours prior to subjecting specimens to solder simulation.

Subject the specimens to three (3) cycles of either of the following suggested reflow profiles with the test board rotated 90 degrees after each cycle or as specified for the product under test:

**REFLOW SOLDERING SIMULATION PEAK PROFILE REFLOW AT 260 °C**

| DESCRIPTION | REQUIREMENT |
|---|---|
| Solder Type | None |
| Solder Flux Type | None |
| Paste Flux Type | None |
| Average Ramp Rate | 3 °C/second maximum |
| Preheat Temperature | 150 °C minimum; 200 °C maximum |
| Preheat Time | 60 to 180 seconds |
| Ramp to Peak | 3 °C/second maximum |
| Time over Liquidus (217 °C) | 60 to 150 seconds |
| Peak Temperature | 260 °C +0/-5 °C |
| Time within 5 °C of peak | 20 to 40 seconds |
| Ramp – Cool Down | 6 °C/second maximum |
| Time 25 °C to Peak | 8 minutes maximum |

**REFLOW SOLDERING SIMULATION PEAK PROFILE REFLOW AT 245 °C**

| DESCRIPTION | REQUIREMENT |
|---|---|
| Solder Type | None |
| Solder Flux Type | None |
| Paste Flux Type | None |
| Average Preheat Ramp Rate | 3 °C/second maximum |
| Preheat Temperature | 150 °C minimum; 200 °C maximum |
| Preheat Time | 60 to 180 seconds |
| Ramp to Peak | 3 °C/second maximum |
| Time over Liquidus (217 °C) | 60 to 150 seconds |
| Peak Temperature | 245 °C +0/-5 °C |
| Time within 5 °C of peak | 20 to 40 seconds |
| Ramp – Cool Down | 6 °C/second maximum |
| Time 25 °C to Peak | 8 minutes maximum |

### 5.3.5 FAILURE CRITERIA

Acceptable number of failures: zero.

A specimen **shall** be considered “FAILED” if it exhibits any of the following defects:

- Any blisters form on the plastic housing after preconditioning or heat resistance exposure.
- The plastic housing shows evidence of gross physical deformation or warpage.
- The critical functional dimensions of the connector exceed the tolerance limits specified in the appropriate sales drawing.

All specimens **shall** not have any of the defects identified to PASS the test.

## 6.0 DETAILS TO BE SPECIFIED

### 6.1 PROCEDURE 1

The following Soldering information **should** be specified:

- Material Number, Description, Sales and Product Specification numbers and revisions
- Evaluation method
- PC Board Description (material, thickness, single or double sided, etc.) [If applicable]
- Solder type used
- Preconditioning
- Immersion time in solder
- Solder temperature
- Number of specimens evaluated
- Pass/Fail criteria
- Test Results

### 6.2 PROCEDURE 2

The following information **should** be specified in the test report:

- Material Number, Description, Sales and Product Specification numbers and revisions
- Evaluation Method
- PC Board Description (material, thickness, single or double sided, etc.)
- Solder type used: None
- Flux type used: None
- Preconditioning
- Process Equipment
- Process Time and Temperature Profile of PC Board
- Process Time and Temperature Profile of the Specimen
- Specimen placement illustration
- Number of specimens evaluation
- Pass/Fail criteria
- Test Results