JEDEC STANDARD

Resistance to Solder Shock for Through-Hole Mounted Devices

JESD22-B106E

(Revision of JESD22-B106D, April 2008)

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JEDEC SOLID STATE TECHNOLOGY ASSOCIATION

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TEST METHOD B106E

RESISTANCE TO SOLDER SHOCK FOR THROUGH-HOLE MOUNTED DEVICES

(From JEDEC Board Ballot JCB-98-98, JCB-05-12, JCB-08-09, and JCB-16-46, formulated under the cognizance of JC-14.1 Committee on Reliability Test Methods for Packaged Devices.)

1 Scope

This test method is used to determine whether solid state devices can withstand the effect of the temperature shock to which they will be subjected during soldering of their leads in a solderwave process and/or solder fountain (rework/replacement) process. The heat is conducted through the leads into the device package from solder heat at the reverse side of the board.

This test method shall not be used to simulate wave soldering of surface mount device packages that are glued onto the same side of the board as the solder wave and are fully submerged into the solder wave. The test method for simulating SMT devices through the wave is JESD22-A111, *Evaluation Procedure for Determining Capability to Bottom Side Board Attach by Full Body Solder Immersion of Small Surface Mount Solid State Devices*.

In order to establish a standard test procedure for the most reproducible methods, the solder dip method is used because of its more controllable conditions. This procedure will determine whether devices are capable of withstanding the soldering temperature encountered in printed wiring board assembly operations, without degrading their electrical characteristics or internal connections. This test is **destructive** and may be used for qualification, lot acceptance and as a product monitor.

2 Apparatus

2.1 Solder Pot

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 the depth specified in 4.3 without touching the bottom of the pot. The apparatus shall be capable of maintaining the solder at the temperature specified in 4.2 at the location where the device leads make contact with the solder.

2.2 Dipping Device

A mechanical dipping device shall be used that is capable of controlling the rates of immersion and emersion of the leads and providing the dwell time specified in 4.3.

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2 Apparatus (cont'd)

2.3 Heatsinks or shielding

If a heatsink or shielding is typically applied to the device prior to the solderwave process, then such heatsinks or shielding shall be attached to the devices prior to this test and shall be specified in the applicable procurement document.

3 Materials

3.1 Solder

The solder shall conform to J-STD-006, *Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications*.

- SnPb alloy composition: Sn60Pb40 or Sn63Pb37 (Sn ± 1%).
- Pb-free solder alloy 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%.
- Other lead-free alloy compositions may be used by agreement between user and supplier.

4 Procedure

4.1 Special preparation of specimens

Any special preparation of the specimens prior to testing shall be as specified in the individual specification. This preparation may include operations such as bending, or other relocation of leads, and the attachment of heat sinks or protective shielding prior to solder dipping.

4.2 Preparation of the solder bath

The dross shall be skimmed from the surface of the molten solder just prior to dipping the part.

4.2.1 SnPb solder bath temperature

The SnPb solder bath shall be maintained at a temperature of 260 °C ± 5 °C as measured per 2.1.

4.2.2 Pb-free solder bath temperature

The Pb-free solder bath shall be maintained at a temperature of 270 °C ± 5 °C as measured per 2.1.

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4 Procedure (cont'd)

4.3 Solder dip

The part shall be attached to the dipping device (see 2.2) and the leads immersed in the molten solder to within 1 mm (0.04") of the body of the device under test. The immersion and emersion rates shall be 25 ± 6 mm (1 ± ¼ ") per second. See sections 4.3.1 and 4.3.2 for the appropriate dwell time in the solder. After the dipping process, the part shall be allowed to cool in air.

4.3.1 SnPb solder bath dip dwell time

The dwell time for a SnPb solder bath shall be 10 +2/-0 seconds.

4.3.2 Pb-free solder bath dip dwell time

4.3.2.1 Pb-free solder bath dip dwell time

The dwell time for a Pb-free solder bath shall be 7 +2/-0 seconds.

4.3.2.2 Optional Pb-free solder bath dip dwell time for solder fountain rework

If the part must survive a solder fountain rework process, the dwell time for a Pb-free solder bath shall be 15 +2/-0 seconds.

4.4 Precautions

Prior to and after the solder immersion, precautionary measures shall be taken to prevent undue exposure of the part to the heat from the solder bath. In addition, care must be taken to prevent thermal shocking the part when placed into flux removal agent.

If there is some concern that the heat from the solder bath may be affecting the results of the test, the test may be performed by inserting the leads through holes in a test board to shield the body of the device from the heat of the solder bath, thus better simulating typical soldering conditions.

4.5 Measurements

Hermeticity tests for hermetic devices, visual examination, and electrical measurements, that consist of parametric and functional tests shall be made as specified in the applicable procurement document.

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4.6 Failure criteria

A device shall be defined as a failure if hermeticity for hermetic devices cannot be demonstrated, if parametric limits are exceeded, or if functionality cannot be demonstrated under nominal and worst case conditions specified in the applicable procurement document. Mechanical damage such as cracking, chipping, or breaking of the package, (10X - 20X magnification), will also be considered a failure provided such damage was not induced by fixturing or handling.

5 Summary

The following details shall be specified in the applicable procurement document:

a) The use of heatsinks or shielding, if applicable (see 2.3).

b) Special preparation of specimens, if applicable (see 4.1).

c) Temperature of solder bath, if other than as specified in 4.2.

d) Time and depth of immersion, if other than as specified in 4.3, and if 4.3.2.2 is required.

e) Failure criteria per 4.6 or other used.

f) Sample size and quality level.

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Annex A (informative) Process information collected to generate this revision

For revision D of B106, the Pb-free process data stated below were collected. These data state that solder wave pot temperatures can be 10 °C higher for Pb-free solder than for eutectic SnPb solder, especially for relatively thick, complex boards. However, data were not yet available for the largest and most complex boards.

For revision E, with Pb-free processes now in full production for most member companies, a follow-up survey was performed in 2015 to determine conditions for thick, complex boards and if there were any significant changes in process conditions. The survey includes conditions for boards up to 3.2 mm thick and up to 28 layers. The results of the survey reaffirmed that the conditions stated in this test method were still valid. Solder pot temperatures for initial attach of solid state devices on large boards were in the range that would be covered by the current 265 +/-5 °C conditions in this test method. Dwell times were found to be 3 to 7 seconds for large boards, for both single and dual wave systems, which are slightly longer than the previous survey, but still covered by the requirements of this test method.

Table A.1 — Pb-Free Wave

Company	Solder pot temperature	Dwell time	Board thickness	Preheat temperature, board and/or component temp.	Preheat duration	Other comments
A	265 +/-5 °C	3 to 4 seconds	2.0 mm (79 mils), 6 layer	120 °C comp. lead		0.7 m/min conveyor
	265 +/-5 °C	5 seconds	2.2 mm (87 mils), 14 layer	110 °C comp. lead		0.6 m/min conveyor
B	265 +/-5 °C	2-3 seconds	1.6 to 2.0mm (63 to 79 mils)	140 °C, board max.		1 m/min conveyor,
C	265 +/-5 °C	3 to 6.5 seconds	thick (>90 mils)	140 °C, comp. body		
	260 +/-5 °C	2 to 4 seconds	thin (62 mils)	125 °C, comp body		single wave
D	265-270 °C	2-5 sec., single wave	62 mils	110-140 °C comp. body	< 2 minutes	
E	260-265 °C	3-8 sec	63 to 135 mils	110-130 °C PWB topside	2-3 minutes	

Table A.2 — Pb-Free Rework (solder fountain)

Company	Solder pot temperature	Dwell time / contact with solder pot	# of solder pot 'contacts' for replacement of component	Board thickness	Preheat temperature, board and/or component temp.	Preheat duration
A	265 +/-5 °C	5-10 seconds, (8-10 sec. typical)	2 typical, but could be 3	62 mils	150 °C board and comp. body	~15 minutes in oven
C	277 +/- 5 °C	Depends on component type and board thickness; up to 25 sec for 62 mils, 45 sec for 93 mils & up	Most (~85%) of DT boards rework is due to lead not through (or tilt) so component is not really replaced just re-seated.	62 mils	140 °C for 62 mil thick boards 145 °C for 93 mils and thicker boards	~ 5 minutes in oven
D	265 +/-5 °C	5-10 seconds, (8-10 sec. typical)	2 typical, but could be 3	62 mils	150 °C board and comp. body	~15 minutes in oven
E	271-277 °C	10-15 seconds	1 contact	62 - 135 mils	150 °C (board & comp.)	time to ramp up to 150 °C

The conditions stated in 4.2.2 and 4.3.2 are based on the data in the Table A.1 and Table A.2.

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Annex A (informative) Process information collected to generate this revision (cont'd)

The total dwell time and the preheat conditions for Pb-free solder fountain rework are more severe than initial attach, and the working group concluded that this test method needed to provide test conditions to cover the rework process. In gathering the data from multiple companies, the working group asked each company what criteria were used in determining when solder fountain rework would be used versus hand soldering. The working group found that multiple factors determined the method used. There was no direct correlation between the size of the package being reworked and the method used. For these reasons, it was determined that this revision should include optional conditions for parts that need to be qualified for solder fountain rework.

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Annex B (informative) Differences between JESD22-B106E and JESD22-B106D

This annex briefly describes most of the changes made to entries that appear in this standard, JESD22-B106E, compared to its predecessor, JESD22-B106D (April 2008). If the change to a concept involves any words added or deleted (excluding deletion of accidentally repeated words), it is included. Some punctuation changes are not included.

Page	Description of change
1	Clause 2.1, added clarity on where solder temperature to be measured.
2	Clause 4.1, removed reference to preheat.
3	Clause 4.4, added paragraph to allow for testing with devices mounted on test board.
5	Annex A, added paragraph to discuss results from 2015 industry survey.

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1. I recommend changes to the following:
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   - [ ] Test method number ____________ Clause number ____________

   The referenced clause number has proven to be:
   - [ ] Unclear [ ] Too Rigid [ ] In Error
   - [ ] Other ____________

2. Recommendations for correction:

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____
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3. Other suggestions for document improvement:

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Rev. 9/02

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