JEDEC STANDARD

Evaluation Procedure for Determining Capability to Bottom Side Board Attach by Full Body Solder Immersion of Small Surface Mount Solid State Devices

JESD22-A111C

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JEDEC SOLID STATE TECHNOLOGY ASSOCIATION

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EVALUATION PROCEDURE FOR DETERMINING CAPABILITY TO BOTTOM SIDE BOARD ATTACH BY FULL BODY SOLDER IMMERSION OF SMALL SURFACE MOUNT SOLID STATE DEVICES

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Introduction

Small Surface Mount Devices (SMDs) may be attached to the bottom side of a printed circuit board by passing them through a wave solder (full body immersion) while simultaneously soldering devices with pins on the top of the board (plated through hole attach). As a result, these small SMDs may be exposed to temperatures as high as 265 °C during this type of board attach method.

If sufficient moisture exists in the package, exposure to the molten solder causes the moisture to turn to vapor, resulting in increased pressure within the package which in turn may cause quality and/or reliability degradation.

The test method in this document will address the issues related to the determination of the capability of a solid state device to withstand the stresses of full body wave solder immersion and subsequent field use.

EVALUATION PROCEDURE FOR DETERMINING CAPABILITY TO BOTTOM SIDE BOARD ATTACH BY FULL BODY SOLDER IMMERSION OF SMALL SURFACE MOUNT SOLID STATE DEVICES

(From JEDEC Board Ballot JCB-25-29, formulated under the cognizance of the JC-14.1 Subcommittee on Reliability Test Methods for Packaged Devices.)

1 Scope

This evaluation procedure is written to provide users of ICs in small surface mount packages with a method to evaluate the capability of a device to withstand full wave solder immersion. This document lists procedures for two solder pot classification temperatures, 245 °C and 260 °C. The 260 °C condition can cover both SnPb and Pb-free solders.

The bottom side board solder attach technique is limited to package types for which reliable solder joints can be formed during full body immersion of the device package. Typically packages capable of full body solder immersion (wave solder immersion) board attach have a lead pitch greater than 0.5 mm. Devices in packages with limited or no data demonstrating the capability to survive full body immersion should not be backside wave soldered. Limited, historical data for eutectic SnPb wave soldering processes showed that QFPs and packages with bodies larger than 5.5 mm x 12.5 mm (or die paddle sizes greater than 2.5 mm x 3.5 mm) were not compatible for full body solder immersion board attach.

The capability of a device to withstand full body immersion is strongly affected by its package structure. Devices with large body packages may have reliability and/or quality problems induced by such a board attach method. Die and paddle sizes, as well as wave solder conditions (board size, package profile, speed, part density, etc.), are some of the factors that modulate quality and reliability problems. Package styles with bottom terminations, such as Ball Grid Array (BGA), Land Grid Array (LGA), and Quad/Dual Flatpack No lead (QFN/DFN) are not suitable for full body solder immersion board attach.

If wave solder immersion results in a different Moisture Sensitivity Level than the J-STD-020 solder reflow level specified by the supplier, the user must take appropriate precautions to ensure that the new floor life is not exceeded during the user's manufacturing processes.

The purpose of this test method is to identify the potential wave solder classification level of small plastic Surface Mount Devices (SMDs) that are sensitive to moisture-induced stress so that they can be properly packaged, stored, and handled per J-STD-033 to avoid subsequent mechanical damage during the assembly wave solder attachment and/or repair operations. This test method also provides a reliability preconditioning sequence for small SMDs that are wave soldered using full body immersion.

This test method, may be used by users to determine what classification level should be used for initial board level reliability qualification.

2 Applicable Documents

JESD22-A113, *Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing*
JESD22-A120, *Test Method for the Measurement of Moisture Diffusivity and Water Solubility in Organic Materials Used in Electronic Devices*

JESD47, *Stress-Test-Driven Qualification of Integrated Circuits*

JESD625, *Requirements for Handling Electrostatic Discharge Sensitive (ESD) Devices*

J-STD-020, *Moisture/Reflow Sensitivity Classification for Non-hermetic Surface Mount Devices (SMDs)*

J-STD-033, *Handling, Packing, Shipping and Use of Moisture, Reflow and Process Sensitive Devices*

J-STD-035, *Acoustic Microscopy for Non-hermetic Encapsulated Electronic Components*

3 Apparatus

3.1 Bake Oven

Ovens capable of operating at 125 °C +5/-0 °C, for use in drying(baking) the SMDs.

3.2 Temperature Humidity Chambers

Moisture chamber(s), capable of operating at 85 °C/85% RH, 85°C/60% RH, 60 °C/60% RH, and 30 °C/60% RH. Within the chamber working area, temperature tolerance must be ±2 °C and the RH tolerance must be ±3%.

3.3 Wave Solder Equipment

Wave solder equipment with preheat; capable of up to 260 °C (+5/-0 °C) solder temperature. The equipment shall be capable of maintaining this temperature within the flowing solder wave, which is at the location where the body of the device under test contacts the solder.

3.4 Solder Dip Machine

The solder pot in the solder dip machine shall be capable of up to 260 °C (+5/-0 °C) solder temperature for full body immersion evaluation. The equipment shall be capable of maintaining this temperature at the location where the body of the device under test contacts the solder.

If a mechanical dipping apparatus is used, it shall be capable of controlling the rates of immersion and emersion of the device under test and ensuring the immersion depth and dwell time specified in 5.6.2.

3.5 Optical Microscope

Optical microscope should be capable of 40x magnification for external visual examination and 100X magnification for cross-section examination.

3.6 Electrical Test Equipment

Electrical test equipment should be capable of performing at least room temperature DC and functional tests.

3.7 Scanning Acoustic Microscope

Scanning acoustic microscope should be capable of C-Mode and Through Transmission Mode and capable of measuring a minimum delamination of 5% of the area being evaluated.

NOTE 1 The scanning acoustic microscope is used to detect cracks and delamination. However, the presence of delamination does not necessarily indicate a pending reliability problem. The reliability impact of delamination must be established for a particular die/package system.

NOTE 2 Refer to IPC/JEDEC J-STD-035 for operation of the scanning acoustic microscope.

4 Classification

This test method provides four possible classifications with two solder temperature classifications (245 °C and 260 °C) and two dip conditions (single dip and dual dip). The test conditions must be reported with the classification results. Two types of solder procedures are allowed, use of a wave solder and manual dip soldering in a solder pot or solder fountain.

Table 1 — Wave Solder Simulation Conditions

Test conditions		Solder immersion simulation method	
		Wave solder	Solder dip
Preheat Temperature (device body temperature)		25 to 140 °C	145 °C
Preheat Duration		80 seconds min	40 seconds min
Ramp-up Rate (preheat only)		3 °C/second max	3 °C/second max
Solder Temperature (wave or pot/fountain)	245 °C Classification (SnPb solder)	245 °C +5/-0 °C	245 °C +5/-0 °C
	260 °C Classification (SnPb and Pb-free solder)	260 °C +5/-0 °C	260 °C +5/-0 °C
Solder Immersion Duration	Single Wave Simulation	5 +2/-0 seconds	5 +2/-0 seconds
	Extended Single Wave Simulation	10 +2/-0 seconds	10 +2/-0 seconds
	Dual Wave Simulation	First Wave + Second Wave = 10 +2/-0 seconds	10 +2/-0 seconds
Ramp-down Rate		6 °C/second max	6 °C/second max

NOTE Bottom side board attach of small surface mount devices by full immersion in wave solder requires special evaluation of the packages. The profile elements such as preheat, dwell and peak temperatures vary from process to process. Yet the ability of small packages to be exposed to such treatment depends on these parameters. Assessment by dipping in a solder pot or solder fountain usually exposes devices to higher stresses than the wave solder procedure, which results in induced failures. In summation packages that would be attached by wave solder immersion require special evaluations by the USER due to the wave solder process differences.

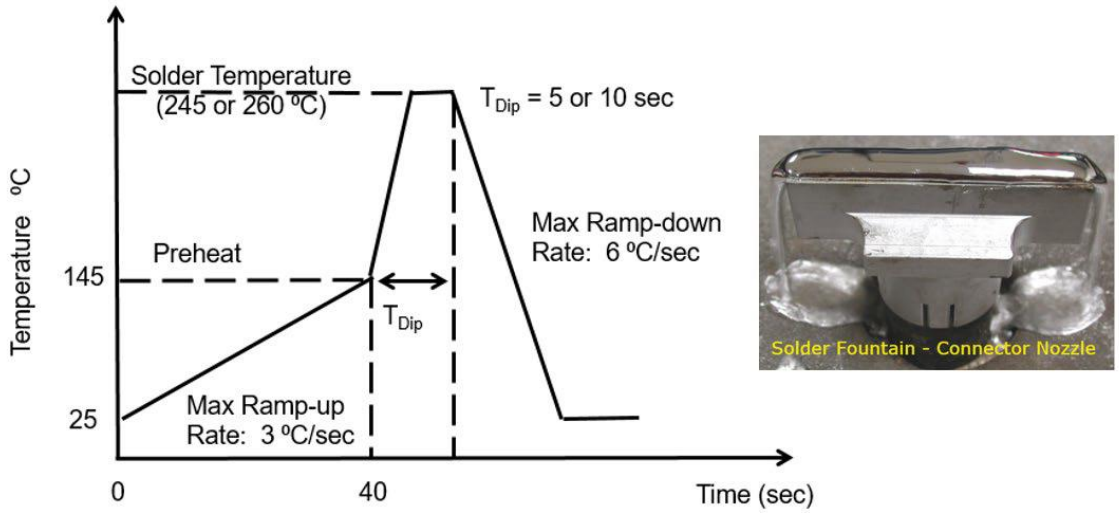

Figure 1 — Classification Profile for Solder Dip

4 Classification (cont'd)

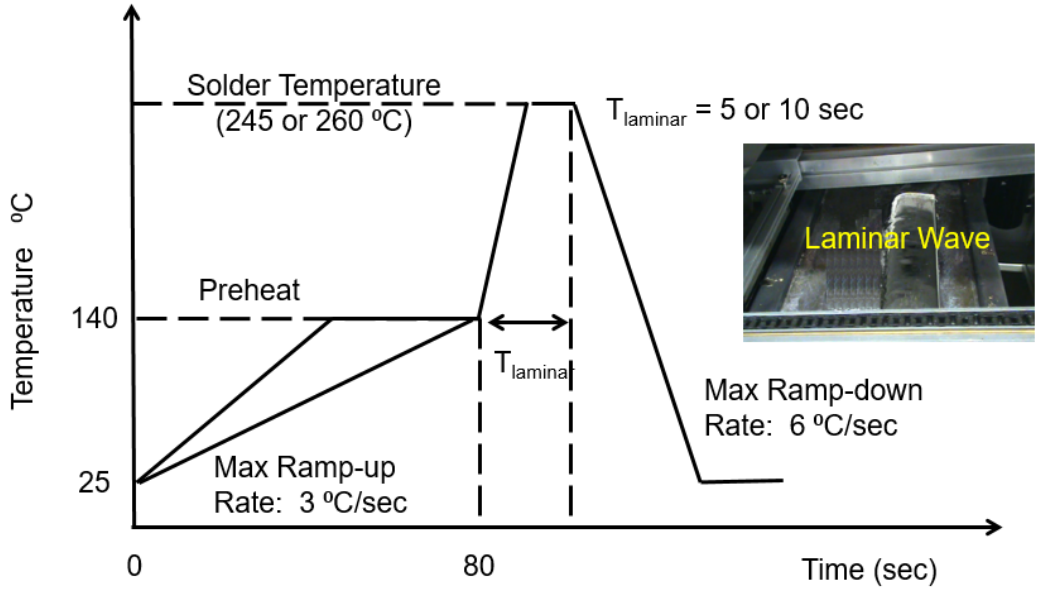

Figure 2 — Classification Profile for Single Wave

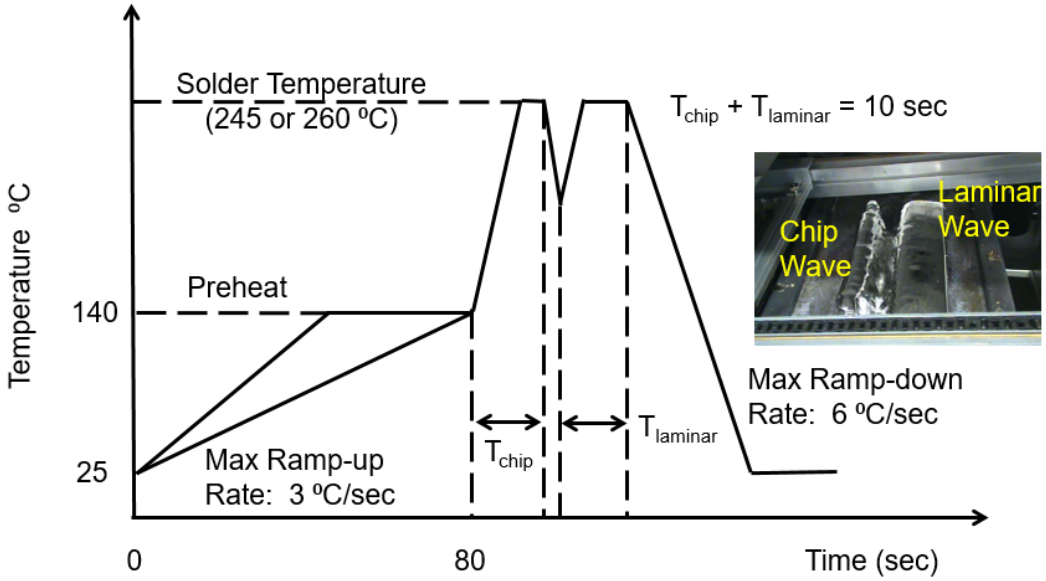

Figure 3 — Classification Profile for Dual Wave

5 Moisture Classification Procedure

5.1 Requirements for Floor Life

The recommended soak condition and soak duration for determining the desired floor life is shown in Table 2.

5.1.1 Sample Requirements

Select a minimum sample of 22 units for each moisture sensitivity level to be tested. If possible, choose samples from two nonconsecutive assembly lots with each lot having approximately the same representation. Sample groups may be run concurrently on one or more moisture sensitivity levels.

Table 2 — Moisture Sensitivity Levels

	FLOOR LIFE[2]		SOAK REQUIREMENTS				
			STANDARD		ACCELERATED EQUIVALENT[1, 3]		
					eV 0.40-0.48	eV 0.30-0.39	
	Duration	Condition	Duration (hours)	Condition	Duration (hours)	Duration (hours)	Condition
1	Unlimited	≤30°C/85% RH	168 +5/-0	85°C/85% RH	NA	NA	NA
2	1 year	≤30°C/60% RH	168 +5/-0	85°C/60% RH	NA	NA	NA
2a	4 weeks	≤30°C/60% RH	696[2] +5/-0	30°C/60% RH	120 +1/-0	168 +1/-0	60°C/60% RH
3	168 hours	≤30°C/60% RH	192[2] +5/-0	30°C/60% RH	40 +1/-0	52 +1/-0	60°C/60% RH
4	72 hours	≤30°C/60% RH	96[2] +2/-0	30°C/60% RH	20 +0.5/-0	24 +0.5/-0	60°C/60% RH
5	48 hours	≤30°C/60% RH	72[2] +2/-0	30°C/60% RH	15 +0.5/-0	20 +0.5/-0	60°C/60% RH
5a	24 hours	≤30°C/60% RH	48[2] +2/-0	30°C/60% RH	10 +0.5/-0	13 +0.5/-0	60°C/60% RH
6	Time on Label (TOL)	≤30°C/60% RH	TOL	30°C/60% RH	NA	NA	NA

NOTE 1 CAUTION – To use the "accelerated equivalent" soak conditions, correlation of damage response (including electrical, after soak and solder immersion), should be established with the "standard" soak conditions. Alternatively, if the known activation energy (eV) for moisture diffusion of the package materials is in the range of 0.40 eV to 0.48 eV or 0.30 eV to 0.39 eV, the "accelerated equivalent" may be used. Accelerated soak durations may vary due to material properties (e.g., mold compound, encapsulant, etc.). JEDEC document JESD22-A120 provides a method for determining the eV.

NOTE 2 "Floor Life" only relates to moisture/solder immersion related failures and does not take into consideration other failure mechanisms or "shelf life" issues due to long term storage.

NOTE 3 Table 2 accelerated soak requirements may not apply to mold compounds that do not contain fillers.

5.2 Initial Electrical Test

Test appropriate electrical parameters (e.g., Data sheet values, in house specifications, etc.). Replace any devices that fail to meet tested parameters.

5.3 Initial Inspection

Perform an initial external visual and scanning acoustic microscope examination to establish a baseline for the cracking/delamination criteria in 6.3.1.

NOTE This standard does not consider or establish any time zero requirements for delamination.

5.4 Bake Requirements

Bake the sample for 24 hours minimum at 125 +5/-0 °C. This step is intended to remove moisture from the package so that it will be "dry."

NOTE This duration/temperature may be modified if desorption data on the particular device under test shows that a different condition is required to obtain a "dry" package when starting in the wet condition for 85 °C /85% RH. See 7, 3rd paragraph.

5.5 Moisture Soak

Place devices in a clean, dry, shallow container so that the bodies of parts do not touch or overlap each other. Submit each sample to the appropriate soak requirements shown in Table 2. At all times, parts should be handled using proper ESD procedures in accordance with JESD625.

5.6 Solder Immersion

Not sooner than fifteen (15) minutes and not longer than four (4) hours after removal from the temperature/humidity chamber, subject the sample to the solder immersion conditions per Table 1.

5.6.1 Wave Solder Procedure

Not sooner than fifteen (15) minutes and not longer than four (4) hours after removal from the temperature/humidity chamber, submit the devices to:

a) Preparation

The bottom surface of the device specimen shall be adhered to holder by adhesive agent specified in the relevant solder wave process specification. Flux shall not be applied to the specimen and holder at this point in the wave solder procedure.

NOTE 1 If flux is applied, vaporization of solvent in the flux hinders rising temperature of the specimen. Therefore, the flux shall not be applied to the body of the specimen and should be applied to the lead pins as little as possible (if it is desirable that the effect of fluxing on reliability be evaluated, fluxing may be applied after the wave solder)

NOTE 2 This test method assumes that the devices under test are not soldered (i.e., electrically connected) to the holder, but just held in place to be subjected to the thermal stress of the solder wave. If the size of the device dictates that the device must be soldered to a test board to facilitate electrical testing, then fluxing of the devices is required.

b) Preheating

Unless otherwise specified in the relevant wave solder process specification, the specimen shall be preheated in such a way that the package temperature shall go from 25 °C to 140 °C in 80 seconds minimum.

c) Wave solder (immersion)

Following preheating, the specimen shall be passed through the solder wave as appropriate per the conditions in Table 1.

5.6.2 Solder Dip Procedure (Alternative to Wave Solder)

NOTE When using this method care should be taken to ensure that the package body temperature does not exceed the temperature the device would experience when using the wave solder method above (consideration for heat capacity of the solid state package).

Make sure that the solder (or other medium used to simulate the wave solder) temperature is 260 °C or 245 °C (+5 °C/-0 °C). Not sooner than fifteen (15) minutes and not longer than four (4) hours after removal from the temperature/humidity chamber:

a) Use appropriate fixture to expose devices to molten solder (when using manual means exposing one device at a time make sure that variation is kept at a minimum)

b) Unless otherwise specified in the relevant solder wave process specification, the specimen shall be preheated in such a way that the package temperature shall go from 25 °C to 145 °C in 40 seconds minimum.

c) Submerge the device(s) into the solder for 5 +2/-0 second (single wave simulation) or 10 +2/-0 second for extended single wave or double wave simulation. The immersion and emersion rates should be such so as to minimize gradients across the device being immersed. If automatic equipment is used, record the immersion and emersion rates. An immersion and emersion rate of 25 mm ± 6 mm (1 ± ¼ ") per second is suggested.

5.7 Post Solder Immersion Procedure

After the solder cycle is completed, allow the devices to cool at room ambient for 15 minutes minimum.

a) If the test is for wave solder MSL classification, then proceed to clause 6.

b) If the test is for preconditioning before subsequent reliability testing, then continue with 5.7 item (c) and (d) only.

c) Apply an activated water soluble flux to the devices by bulk immersion (entire device body) of the sample in flux at room ambient for 10 seconds minimum.

d) Clean devices externally using multiple agitated de ionized water rinses. No waiting time is required between flux application and cleaning. Devices should be dried at room ambient conditions prior to submission for reliability testing.

6 Criteria

6.1 Failure Criteria

If one or more devices in the test sample fail, the device shall be considered to have failed the tested level. A device is considered a failure if it exhibits any of the following:

a) External crack visible under 40X optical microscope. It is highly desired to use 100X optical magnification or low vacuum scanning electron microscopy (SEM) to better observe any cracks that could be precursors to problems during the stress of operational life.

b) Electrical test failure.

c) Internal crack that intersects a bond wire, ball bond, or wedge bond.

d) Internal crack extending from any lead finger to any other internal feature (lead finger, chip, die attach paddle).

e) Internal crack extending more than two-thirds (2/3) the distance from any internal feature to the outside of the package.

f) Changes in package body flatness caused by warpage, swelling, or bulging not visible to the naked eye per JESD22-B101. If parts still meet co-planarity and standoff dimensions as measured at room temperature per JESD22-B108, they shall be considered passing.

If the devices pass the requirements of 6.1, and there is no evidence of cracks observed by acoustic microscopy or other means, the device is considered to pass that level of moisture sensitivity. If internal mold compound cracks are indicated by acoustic microscopy, they must be considered a failure or verified that it has not failed the criteria above using polished cross-sections through the identified site.

NOTE 1 For packages known to be sensitive to vertical cracks, it is recommended that polished cross-sections be used to confirm the nonexistence of near vertical cracks within the mold compound or encapsulant.

NOTE 2 Failing devices must be evaluated to a higher numeric level of moisture sensitivity (i.e., more susceptible) using a new set of samples.

6.2 Criteria Requiring Further Evaluation

Delamination is not necessarily a cause for rejection. To evaluate the impact of delamination on device reliability, the user may either meet the delamination requirements shown in
6.2.1 or perform their own reliability assessment, which may consist of stress testing, historical generic data analysis, etc.

If the devices pass electrical tests and there is delamination on the back side of the die paddle, heat spreader, or die back side (lead on chip only), but there is no evidence of cracking or other delamination and they still meet specified dimensional criteria, the devices are considered to pass that level of moisture sensitivity.

6.2.1 Peripherally Leaded IC Packages

The following delamination change criteria for the specific package type are measured from before the moisture soak to after solder immersion. A delamination change is the difference between pre- and post-solder immersion delamination. The percent (%) delamination or delamination change is calculated in relation to the total area being evaluated.

a) No delamination on the active side of the die.

b) No delamination on any wire bonding surface including the downbond area or the lead-frame of lead on chip (LOC) devices.

c) No delamination change >10% along any polymeric film bridging any metallic features that is designed to be isolated (verifiable by through transmission acoustic microscopy).

d) No delamination/cracking >50% of the die attach area:

   1. In packages with exposed die pad used for thermal conductivity, or

   2. For devices that require electrical contact to the backside of the die.

e) No surface-breaking feature delaminated over its entire length. A surface-breaking feature includes: lead fingers, tie bars, heat spreader alignment features, heat slugs, etc.

NOTE No data is available at present to indicate that Ball Grid Array (BGA), Land Grid Array (LGA), and Quad/Dual Flatpack No lead (QFN/DFN) packages are capable for wave solder bottom side attach.

6.3 Failure Verification

All failures should be analyzed to confirm that the failure mechanism is associated with moisture sensitivity. If there are no moisture/solder immersion induced failures in the level selected, the device meets the tested level of moisture sensitivity.

If the acoustic microscope scans show failure to any of the criteria listed in 6.2.1, the devices shall be tested to a higher numeric level of moisture sensitivity, or the user may subject the device to a reliability assessment.

7 Moisture/Solder Immersion Sensitivity Classifications

If a device passes Level 1, it is classified as not moisture sensitive and does not require dry pack. Other factors beyond MSL may need to be considered, such as those included in JEP160, for long term storage.

If a device fails Level 1, but passes a higher numerical level, it is classified as moisture sensitive and must be dry packed in accordance with J-STD-033, and, if required for long term storage, per the guidelines of JEP160 for long term storage.

If a device will only pass Level 6, it is classified as extremely moisture sensitive and dry pack will not provide adequate protection. The user should consider adding a warning label stating that the device's Backside Wave Attach MSL rating is 6 and that it must be baked dry within the TOL (Time on Label) before full solder immersion attach. The minimum bake duration and temperature needed to fully dry MSL 6 devices prior to solder immersion attach should be determined from desorption studies of the device under test.

8 Summary

Documentation of the evaluation shall include as a minimum:

a) Device selection criteria if different than clause 1.

b) Test procedure if different than clause 5.

c) Sample size if different than 5.1.1.

d) Package types to be evaluated (specify size in x, y, z dimensions as well as die paddle size in x, y dimensions)

e) Any failure criteria (including acoustic microscope criteria) in addition to those specified in clause 6.

f) Any preconditioning requirements beyond those shown in clause 5.7.

g) Conditions or frequency under which retest is required.

Annex A (Informative) Wave Solder Process Information Collected to Generate this Revision

To support the changes in revision B of JESD22-A111, specifically to expand its scope to cover Pb-free solder wave processes, this test method referenced Pb-free wave solder temperature data gathered by industry surveys conducted for the last two revisions to JESD22-B106, Resistance to Solder Shock for Through-Hole Mounted Devices.

For revision D of JESD22-B106, the Pb-free process data stated below were collected in the 2007 timeframe. These data state that solder wave pot temperatures had nominal values of 260 °C to 265 °C, especially for relatively thick, complex boards. However, data were not yet available for the largest and most complex boards.

Table A.1 — Pb-Free Wave Conditions per 2007 Industry Survey

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

For revision E of JESD22-B106, 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 included conditions for boards up to 3.2 mm thick and up to 28 layers. The results of the survey re-affirmed that the conditions were still valid. Solder pot temperatures for initial attach of solid state devices on large boards had not changed and nominal solder wave pot temperatures were still in the range of 260 °C to 265 °C. Dwell times were found to be 3 seconds to 7 seconds for large boards, for both single and dual wave systems, which were slightly longer than dwell times from the previous survey.

Data was presented to the JC-14.1 committee that showed that the temperature of the solder at the top of wave where it contacts the bottom of the printed wiring board was 5 °C to 7 °C lower than at the center of the solder pot where the temperature is typically controlled. This would suggest that if the solder temperature for a solder wave machine was set to a nominal temperature of 265 °C, devices exposed to the wave would only be subjected to solder at or slight below 260 °C. Based on this, it was agreed that for this standard, the evaluation temperature for Pb-free solder would be 260 °C, which was the same as the higher temperature option currently in this standard for SnPb solder.

Annex B (Informative) Differences between Revisions

This annex describes most of the changes made to entries that appear in this standard, JESD22-A111C, compared to its predecessors. 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.

B.1 Differences between JESD22-A111C and JESD22-A111B

This sub-clause comprises a summary of changes made to this standard, JESD22-A111C, compared to its predecessor, JESD22-A111B (March 2018).

Clause	Description of changes
All	This standard was brought into style/formatting compliance with the latest style standard, *Style Manual for Standards and Other Publications of JEDEC*, JM7A (July 2024). Replaced all incorrect references to "reflow" with "solder immersion" or similar phrase.
TOC	A Table of Contents was added.
Introduction	Editorial change to the first sentence, that backside wave attach is not commonly performed.
Scope	Replaced the phrase 'nominal temperatures with 'classification temperatures' in the first Paragraph, and revised several sentences in the second paragraph to clarify test method intent.
2	Updated titles for several referenced documents and added reference to JESD22-A120.
4	Updated text to reference use of solder fountain equipment, including in Table 1. Table 1 - Deleted second occurrence of "Preheat Temperature" and merged cells in first column, also corrected the tolerance for solder immersion duration for single wave simulation from "-01" to "-0". Figure 1 - Added image of solder fountain.
5	Replaced the term "time" with "duration" where appropriate, including in Table 2. 5.1.1 - Added recommendation that samples be from two assembly lots. Table 2 - Removed NOTES 2 & 3 which were copied from J-STD-020 but do not apply to users performing this test method, renumbered subsequent NOTES, updated NOTE numbers in the table, and corrected the referenced table number in what is now NOTE 3. 5.6 - Replaced the phrase "relevant specification" with "relevant solder wave process Specification" in several locations. 5.6.1 a) - Removed the second sentence regarding flux usage, and added NOTE 2 to address the topic. 5.7 - Changed "cycle(s)" to "cycle".
6	Replaced the phrase "SMD Packages" with "devices". NOTE 2 - Removed incorrect "No" at the start of the sentence.
6 and 7	6.2, 6.3, 7 - In each of these clauses, text that had been copied from J-STD-020 comprising device supplier requirements that do not apply to procedures that a user would follow for this test method, was deleted.

B.2 Differences between JESD22-A111B and JESD22-A111A

JESD22-A111B was a major revision. Table B.1 briefly describes the more significant changes made, as compared to its predecessor, JESD22-A111A (November 2010). Grammar, punctuation, and other minor corrections/changes are not included.

Table B.1 — Changes between JESD22-A111B and JESD22-A111A

Location	Change
1 Scope, and rest of document	Expanded scope of test method to also cover Pb-free solder
1 Scope, and rest of document	Replaced the term “component” with the term “device”
1 Scope	Added statement that this test method is not applicable to grid array and bottom termination packages (e.g., BGA, LGA, and DFN/QFN)
1 Scope, and 2 Applicable documents	Added reference to J-STD-033
3.3 Wave solder equipment, and 3.4 Solder dip machine	Specifically stated that solder wave and solder pot temperatures are to be measured at the location where the device is dipped.
3.4 Solder dip machine	Added text regarding the capabilities of mechanical dipping equipment
4 Classification and 5 Moisture classification procedure	Removed the term “reclassification” from each title, since there is no text in either clause regarding reclassification.
Table 1 - Wave solder simulation conditions	Multiple changes to add condition for Pb-free solder, align tolerances with JESD22-B106, added ramp-up and ramp-down requirements to align with J-STD-020, and modified dip preheat duration to not contradict the ramp-up requirement
4 Classification	Added three figures, diagrams showing classification profiles for solder dip, single wave, and dual wave
Table 2 — Moisture sensitivity levels	Table and corresponding notes were updated to align with requirements in the current revision of J-STD-020
5.6 Solder immersion	Replaced all references of the term “solder reflow” and “solder heating” with “solder immersion” where appropriate.
Item b) in 5.6.2 Solder dip procedure	Modified duration of preheat to align with change in Table 1. Modified text to allow for alternate methods to preheat the samples
Item c) in 5.6.2 Solder dip procedure	Modified tolerances to align with change in Table 1. Added text for suggested immersion and emersion rates, to align with JESD22-B106.
6 Criteria	Whole clause was updated to align with requirements in the current revision of J-STD-020
7 Moisture/reflow sensitivity classifications	Whole clause was updated to align with requirements in the current revision of J-STD-020
Annex A	Added new Annex, text and table from Annex in JESD22-B106, which describes industry surveys used to gather Pb-free solder wave profiles

B.3 Differences between JESD22-A111A and JESD22-A111

Table B.2 briefly describes most of the changes made to entries that appear in JESD22-A111A, compared to its predecessor, JESD22-A111 (May 2004). Some punctuation changes are not included.

Table B.2 — Changes between JESD22-A111A and JESD22-A111

Location	Changed from	Changed to
Table 1, Preheat Time	80 seconds	80 seconds min
Table 1, Solder Immersion Time	Does not exist	Extended Single Wave, 10+/-1 seconds, 10+/-1 seconds
Table 1, Dual Wave Simulation	First Wave - 5 +/-1 seconds Second Wave - 5 +/-1 seconds	First Wave + Second Wave = 10 +/-1 seconds
Clause 5.7 (b) (Contained references that do not exist and were identified during the JEDEC ballot response.)	(b) If the…5.7.3 and 5.7.4 only.	(b) If the …5.7 item (c) and (d) only.

STANDARD IMPROVEMENT FORM **JEDEC** **JESD22-A111C**

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1. I recommend changes to the following:

☐ Requirement, clause number _____

☐ Test method number _____ Clause number _____

The referenced clause number has proven to be:

☐ Unclear ☐ Too Rigid ☐ In Error

☐ Other _____

2. Recommendations for correction:

_____

_____

_____

_____

3. Other suggestions for document improvement:

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