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Solderability test method

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EIA/JEDEC STANDARD

Solderability Test Method

EIA/JESD22-B102-C

SEPTEMBER 1998

ELECTRONIC INDUSTRIES ALLIANCE

JEDEC Solid State Technology Division



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SOLDERABILITY TEST METHOD

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47/1446/PAS	47/1479/RVD

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TEST METHOD B102-C**SOLDERABILITY****CONTENTS**

	Page
1 Purpose	1
2 Apparatus	1
2.1 Solder pot	1
2.2 Dipping device	1
2.3 Optical equipment	1
2.4 Steam aging equipment	1
2.5 Lighting equipment	2
2.6 Materials	2
2.7 SMD reflow equipment	2
3 Procedure for simulated board mounting reflow solderability test in SMDs	3
3.1 Test equipment set-up	3
3.2 Specimen preparation and surface condition	4
3.3 Visual inspection	4
4 Procedure for dip and look solderability testing	7
4.1 Preconditioning	7
4.2 Solder dip conditions	7
4.3 Testing	7
5 Summary	14
Figures	
1 Critical areas in rectangular passive components (SMD method)	5
2 Critical areas in SOIC and QFP packages (SMD method)	5
3 Critical areas in plastic-leaded chip carrier (SMD method)	6
4 Critical areas in tantalum chip capacitor	6
5 Inspected area for gullwing packages (dip and look method)	13
6 Inspected area for J-lead packages (dip and look method)	13
Tables	
1 Altitude versus steam temperature	8
2 Maximum limits of solder bath contaminant	11

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TEST METHOD B102-C

SOLDERABILITY

(From JEDEC Council Ballot JCB-97-71, formulated under the cognizance of the JC-14.1 Subcommittee on Reliability Test Methods for Packaged Devices.)

1 Purpose

The purpose of this test method is to provide a means of determining the solderability of device package terminations that are intended to be joined to another surface using solder for the attachment.

This test method provides optional conditions for aging and soldering for the purpose of allowing simulation of the soldering process to be used in the device application. It provides procedures for dip & look solderability testing of through hole, axial and surface mount devices and reflow simulated use testing for surface mount packages.

2 Apparatus

2.1 Solder pot

A static solder pot of sufficient size to contain at least 2 pounds (4.4 kg) of solder shall be used. The apparatus shall be capable of maintaining the solder at the specified temperature within +/- 5°C.

2.2 Dipping device

A mechanical dipping device capable of controlling the rates of immersion and emersion of the terminations and providing a dwell time (time of total immersion to the required depth) in the solder bath as specified shall be used.

2.3 Optical equipment

An optical microscope capable of providing magnification inspection from 10x to 20x shall be used.

2 Apparatus (cont'd)

2.4 Steam aging equipment

A noncorrodible container and cover of sufficient size to allow the placement of specimens inside the vessel shall be used. The specimens shall be placed such that the lowest portion of the specimen is a minimum of 1.5 inches (38 mm) above the surface of the water. A suitable method of supporting the specimens shall be improvised using noncontaminating material.

2.5 Lighting equipment

A lighting system shall be used that will provide a uniform, nonglare, nondirectional illumination of the specimen.

2.6 Materials

2.6.1 Flux

The flux shall conform to type ROL of J-STD-004, "Requirements for Soldering Fluxes". (25 percent by weight Gum Rosin in a 99 percent Isopropyl Alcohol solvent.) The specific gravity of the flux shall be maintained within the range of 0.838 to 0.913 at 25°C.

2.6.2 Solder

The solder shall conform to type Sn6337A or Sn60Pb40A of J-STD-006, "Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications".

2.7 SMD reflow equipment

2.7.1 Stencil or screen

A stencil or screen with pad geometry opening that is appropriate for the terminals being tested. Unless otherwise agreed upon between vendor and user, nominal stencil thickness should be 0.102 mm (0.004 in) for terminals with less than 0.508 mm (0.020 in) component lead pitch, 0.152 mm (0.006 in) for a component with lead pitch of 0.508 mm to 0.635 mm (0.020 in to 0.025 in), and 0.203 mm (0.008 in) for a component with lead pitch greater than 0.635 mm (0.025 in).

2.7.2 Rubber squeegee or metal spatula

2.7.3 Ceramic substrate

e.g., 0.889 mm (0.035 in) thick.

2 Apparatus (cont'd)

2.7 SMD reflow equipment (cont'd)

2.7.4 Solder paste

The solder paste shall conform to Sn6337A or Sn60Pb40A, ROL, of J-STD-005 “Requirements for Soldering Pastes”, and shall have a mesh size of -325/+500.

Note — Paste storage and shelf life shall be in accordance with manufacturer's specifications.

2.7.5 Reflow equipment

Infrared/convection reflow oven, vapor phase reflow system, or storage oven capable of reaching the reflow temperature of the paste being used.

2.7.6 Flux removal solvent

Material used for cleaning flux from leads and terminations shall be capable of removing visible flux residues and meet local environmental regulations.

3 Procedure for simulated board mounting reflow solderability testing of SMDs

This procedure may be used for surface mounted devices as an alternative to the dip & look procedure of section 4. Fine pitch gullwing leads (spacings < 20 mils) cannot be tested adequately with the dip & look method. Also, dip & look is inappropriate for BGA's.

Note — This procedure comes from EIA-638, “Surface Mount Solderability Test”

3.1 Test equipment set-up

3.1.1 Vapor phase reflow

Temperature = 215 - 219°C

Time = 30 - 60 s dwell at reflow temperature

3.1.2 Infrared reflow

	Preheat	Reflow
Temperature (°C)	150-170	215-230
Time (s)	60	60

3 Procedure for simulated board mounting reflow solderability testing of SMDs (cont'd)

3.1 Test equipment set-up (cont'd)

3.1.3 Storage oven

Temperature = 215-230°C

Time = 2-5 min (until reflow is assured)

3.2 Specimen preparation and surface condition

All component leads or terminations shall be tested under the condition that they would normally be in at the time of assembly soldering.

The specimens to be tested shall not be touched by fingers or otherwise contaminated, nor shall the leads or terminations being tested be wiped, cleaned, scraped, or abraded.

3.2.1 Place solder paste onto screen and print the terminal pattern onto the ceramic by wiping the paste over the screen using either a spatula for fine pitch or a squeegee for standard pitch.

3.2.2 Remove the screen carefully so as to avoid smearing the paste print. Verify a paste print equivalent in geometry to the terminal of the device to be tested.

3.2.3 Using tweezers, place the terminals of the unit on the solder paste print. Avoid touching the unit so that the terminals will not be contaminated with skin oils. Verify part placement by appropriate magnification.

3.2.4 Place the ceramic substrate on the applicable reflow equipment and subject the substrate and components to the reflow process.

3.2.5 After reflow, carefully remove substrate with components and allow to cool.

3.2.6 After specimen has cooled to room temperature, remove component from ceramic substrate using tweezers. Terminals may adhere slightly to ceramic material due to flux residue.

3.2.7 Remove any flux residue by using appropriate cleaning solution.

3.3 Visual inspection

3.3.1 Visual magnification criteria

Each termination shall be examined using a magnification of 10X to 20X.

3 Procedure for simulated board mounting reflow solderability testing of SMDs (cont'd)

3.3 Visual inspection (cont'd)

3.3.2 Accept/reject criteria

All terminations shall exhibit a continuous solder coating free from defects for a minimum of 95% of the critical surface area of any individual termination. Anomalies other than dewetting, nonwetting, and pinholes are not cause for rejection. Exposed terminal metal is allowable on the end toe of surface mount components.

Examples of the critical areas for various devices are contained in Figures 1 through 4.

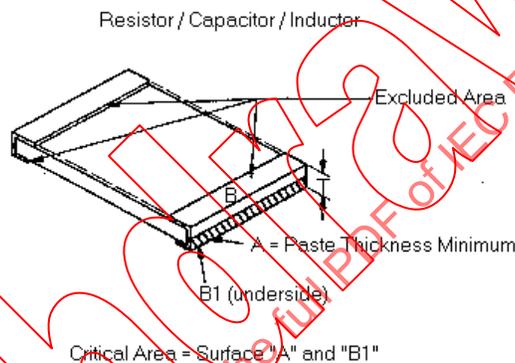


Figure 1 — Critical Areas in Rectangular Passive Components (SMD Method)

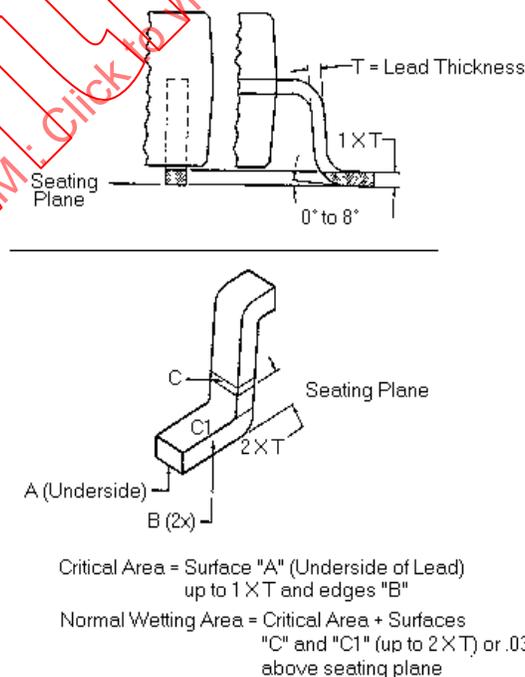


Figure 2 — Critical Areas in SOIC and QFP Packages (SMD Method)

3.3 Visual inspection cont'd

3.3.2 Accept/reject criteria (cont'd)

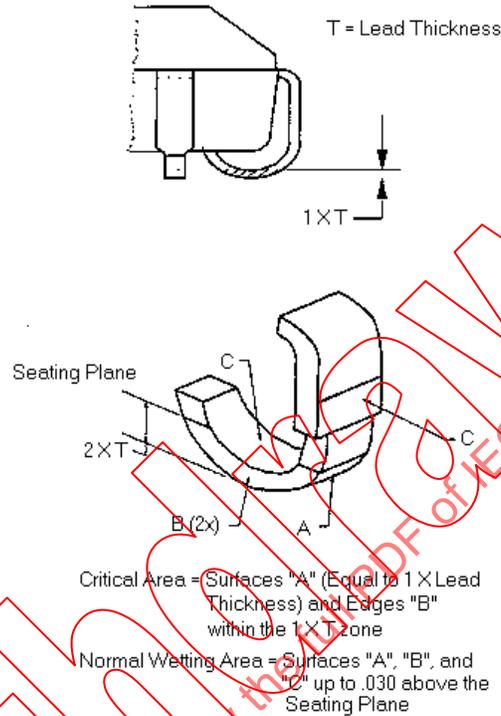


Figure 3 — Critical Areas in Plastic-Leaded Chip Carrier (SMD Method)

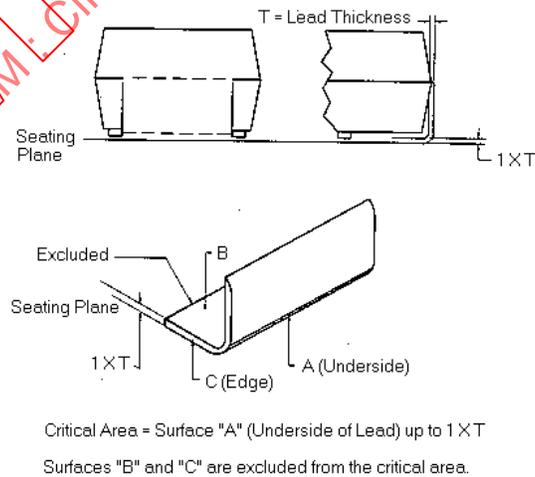


Figure 4 — Critical Area in Tantalum Chip Capacitor

4 Procedure for dip and look solderability testing

The test procedure shall be performed on the number of terminations specified in the applicable procurement document. During handling, care shall be exercised to prevent the surface to be tested from being abraded or contaminated by grease, perspirants, etc.

All solderability testing shall be done under a fume hood in accordance with applicable safety rules and procedures.

Solderability tests shall be considered destructive unless otherwise specified in the applicable procurement document.

4.1 Preconditioning

Steam age preconditioning options are:

Condition	Exposure Time(Hours, +/-0.5)
A	1
B	4
C	8
D	16

Note — Aging may be interrupted once for 10 minutes maximum.

PRECAUTION Mounting must be such that water does not collect on the surface to be tested.

4.2 Solder dip conditions

Solderability test condition options are:

Condition	Solder Temperature (Degrees C +/-5)	Dwell Time (Seconds +/-0.5)
A	215	5
B	245	5

4.3 Testing

The test procedure shall consist of the following operations:

- Preparation of the terminations, if applicable.
- Aging, if applicable.
- Application of flux and immersion of the terminations into molten solder.
- Examination and evaluation of the tested portions of the terminations.

4 Procedure for dip and look solderability testing (cont'd)

4.3 Testing (cont'd)

4.3.1 Preparation of terminations

No wiping, cleaning, scraping, or abrasive cleaning of the terminations shall be performed. Any special preparation of the terminations, such as bending or reorientation prior to test, shall be specified in the applicable procurement document. If the insulation on stranded wires must be removed, it shall be done in a manner so as not to loosen the strands in the wire.

4.3.2 Steam aging

Prior to the application of the flux and subsequent solder dips, all specimens shall be subjected to aging by exposure of the surfaces to be tested to steam in the container specified in 2.4. The specimens shall be suspended so that no portion of the specimen is less than 1.5 inches (38 mm) above the boiling distilled or deionized water for the specified exposure time. If an exposure time is not specified, condition C (4.1) shall be used. The water vapor temperature at the component lead level shall be in accordance with Table 1.

The devices shall be removed from the test apparatus upon completion of the specified test period.

Table 1 — Altitude versus steam temperature.

Altitude (feet)	Steam Temperature (°C +3, -5)
0 - 2,000	93
2,001 - 4,000	91
4,001 - 6,000	89
Greater than 6,000	87

4.3.2.2 Cleaning of the system

The apparatus shall be drained and cleaned at least once per month or prior to use. A more frequent cleaning cycle may be necessary as indicated by resistivity, visual, or general cleanliness of the water. No contaminating solvents shall be used.

4 Procedure for dip and look solderability testing (cont'd)

4.3 Testing (cont'd)

4.3.2.3 Drying and storage procedures

Upon removing the test specimens from the apparatus, the parts may be dried using one of the following procedures:

- (a) Bake at 100°C maximum for no more than 1 hour in a dry atmosphere (dry nitrogen atmosphere is recommended).
- (b) Air dry at ambient temperature for a minimum of 15 minutes.

Note — Parts not solderability-tested within 2 hours after removal from the aging apparatus shall be stored in a desiccant jar or dry nitrogen cabinet for a maximum of 72 hours before testing. The parts shall not be used for testing if they have exceeded the storage requirements.

4.3.3 Application of flux

Type R flux shall be used, unless otherwise specified, (see paragraph 2.6.1). Terminations shall be immersed (using a mechanical dipper) in the flux, which is at room ambient temperature, to the minimum depth necessary to cover the surface to be tested. The fixturing should be designed to avoid trapping of excess flux. The surface to be tested shall be immersed in the flux for a period of 5 to 10 seconds, and shall be drained 5 to 20 seconds prior to dipping into the solder pot. The flux shall be covered when not in use and discarded a minimum of once a day.

4.3.3.1 Surface mounted devices

For surface mount packages, that portion of the package lead that will be inspected shall be covered by the flux application. Perform the test using the leads on only one side of the package at a time. The fluxing and solder dipping operations shall be performed sequentially on the leads of the package side under test.

4.3.3.2 All other devices

Unless otherwise specified in the applicable procurement document, terminations shall be immersed to the seating plane or to within 0.05 inch (1.27 mm) of the body of the device under test.

4 Procedure for dip and look solderability testing (cont'd)

4.3 Testing (cont'd)

4.3.3.3 Component termination attitude relative to flux and solder surfaces

Leaded (THM) Through Hole Mounting	90 deg
Leaded (SM) Surface Mount	20 to 45 deg or 90 deg
Leadless (SM) Surface Mount	20 to 45 deg

4.3.4 Solder dip

The dross and burned flux shall be skimmed from the surface of the molten solder specified in 2.6.2. The molten solder shall be maintained at the specified temperature. If the temperature is not specified, condition B (4.2) shall be used. The surface of the molten solder shall be skimmed again just prior to immersing the terminations into the solder. The part shall be attached to a dipping device (see 2.2) and the flux-covered terminations immersed once in the molten solder to the same depth specified in 4.3.3. The immersion and emersion rate shall be 1.00 +/-0.25 inch (25.4 +/-6.4 mm) per second and the dwell time in the solder bath shall be 5.0 +/- 0.5 seconds, unless otherwise specified. After the dipping process, the part shall be allowed to cool in the air. Residual flux shall be removed from the terminations either by sequential rinses in isopropyl alcohol, or by a rinse in a suitable commercial non-CFC solvent. If necessary, a soft damp cloth or cotton swab moistened with clean isopropyl alcohol or solvent may be used to remove all remaining flux.

4.3.4.1 Solder dipping of gold plated terminations

Gold plated terminations shall be cycled twice in flux and solder. The first immersion is to scavenge the gold on the terminations.

4.3.4.2 Solder bath contaminants control

The solder in solder baths used for solderability testing shall be chemically or spectrographically analyzed or replaced each 30 operating days. The levels of contamination and Sn content must be within those listed in Table 2.

4.3.5 Inspection and failure criteria

All flux is to be removed prior to visual inspection of the terminal surface.

4.3.5.1 Inspect all devices at 10x to 20x magnification.

4.3.5.2 The inspected area of each lead must have 95% solder coverage minimum.

4 Procedure for dip and look solderability testing (cont'd)

4.3 Testing (cont'd)

TABLE 2 — Maximum Limits of Solder Bath Contaminant

Maximum Contaminant	Contaminant Weight Percentage Limit
Copper	0.300
Gold	0.200
Cadmium	0.005
Zinc	0.005
Aluminum	0.006
Antimony	0.500
Iron	0.020
Arsenic	0.030
Bismuth	0.250
Silver	0.100
Nickel	0.010

Notes

1 The tin content of the solder shall be maintained within +/-1% of the nominal alloy being used. Tin content shall be tested at the same frequency as testing for copper/gold contamination. The balance of the bath shall be lead and/or the items listed above.

2 The total of copper, gold, cadmium, zinc, and aluminum contaminants shall not exceed 0.4%.

3 An operating day consists of any 8-hour period, or any portion thereof, during which the solder is liquefied and used.