Measurement Good Practice Guide No. 66

Solderability Testing

of Surface Mount Components and PCB Pads

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Abstract: This document guides you to choose the correct test parameter settings for solderability testing of different type and size surface mount components and PCB pads. Pass/fail criteria are suggested and examples of good and bad solderability curves for each type component and PCB pad are given in the document to help you to judge the solderability of test component.

Guidelines for Solderability Testing of Surface Mount Components and PCB Pads

Contents

1   Introduction

The wetting balance test is the most useful tool for investigating the soldering properties of surface mount components, terminations and leads, and PCB pads. A wetting balance is used to measure the force involved when a molten solder wets the sample surface. This gives a measure of quality of the surface in terms of the ability of solder to wet it. A typical wetting curve is shown in the figure below. Very common solderability indexes are the wetting time T and wetting force F. The wetting time is the time passed until the force has reached two thirds of its maximum, measured from the buoyancy line, a value equal to or less than two seconds is considered an acceptable value. Wetting force is the force measured at two seconds. There is no specification placed upon what the minimum force should be. Measuring the solderability for a range of components and PCB pad sizes has allowed us to assess the pass/fail criteria for acceptable solderability (ref. CMMT(A)284 and MATC(A)003). Test parameters are listed below according to component type along with suggested acceptable values for both T (secs.) and F (mN/mm, mN/mm^2, mN).
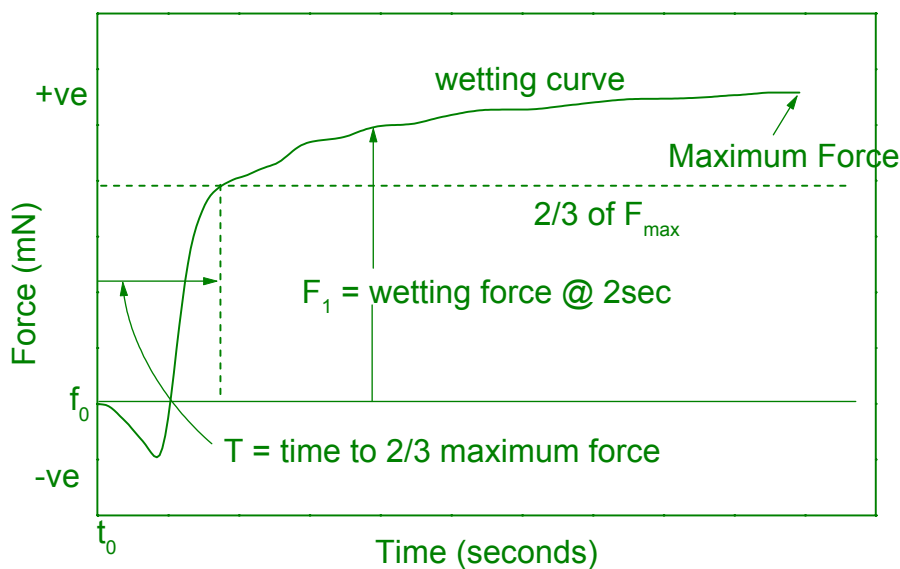
2   Test Description

The tests have been carried out on a Multicore Must II wetting balance. The instrument is used in either the solder globule or solder bath mode, depending on the component type to be tested. A 60/40 SnPb solder alloy or lead-free alloy such as SnAgCu can be used for both types of mode. The solder temperature is dependent on the choice of solder alloy. Immersion speed and immersion depth are dependent on component type. The flux used and recommended here is pure rosin with 0.5% halide, in accordance with IEC 68-2-20, although the IEC standard does allow rosin based fluxes with 0.2% and 0% halide as well. However, the solder globule must be fluxed with rosin with 0.5% halide. Force data is typically acquired over a 5 or 10 second period. More specific details are listed under the individual component headings below. Generally 10 terminations need to be tested for per batch of components or PCB pads.

3   Terminology (According to ANSI/IPC-T-50C)

Component Pad: It is the metallic surface to which the solder wets.

Flux: A chemically/physically active formulation that is capable of enabling and promoting the wetting of metals with solder.

Solderability: The ability of a metal to be wetted by molten solder.

Wetting: The formation of a uniform, smooth, unbroken, and adherent film of the solder to a base metal.

4   Test Method

The component is mounted onto the appropriate clip and liquid flux applied to the component pad. The specimen is hung from a sensitive balance. Rosin based with 0.5% halide flux is added to the solder globule. The solder globule is brought into contact with the component termination, and immersed to the required depth for the directed duration.

5   Methodology

5.1   PCB pad

**Apparatus:**   Wetting Balance, in solder globule mode, 25 mg or 200 mg pellet, depending on PCB pad size.

Schematic view of the component:

Test Conditions:

Component preconditioning:	None, test on as received components.
Special Preparation:	Pads may need to be cut from a board, using a guillotine. Any rough edges resulting from the cut should be lightly abraded using emery paper and gently cleaned with iso-propanol.
Test pad number:	Typically 10 pads per board.

Solder Alloy:	Sn/Pb 60/40 (according to ISO 9453). SnAgCu 95.5/3.8/0/7 (according to EN 29453).
Flux for the Component Termination:	Rosin based, 0.5 % activated flux (according to IEC 68-2-20).
Solder Temperature:	235 ^{O}C ± 3 ^{O}C for SnPb solder alloy, for lead-free alloys with a melting point equal to or greater than 215 ^{O}C, a superheat temperature of +40 ^{O}C is used.
Immersion Speed:	1.0 mm/s
Duration of Immersion:	10 seconds
Immersion Depth Termination:	0.1 mm
Preheat:	No preheat.

Component Position above the Solder Globule:
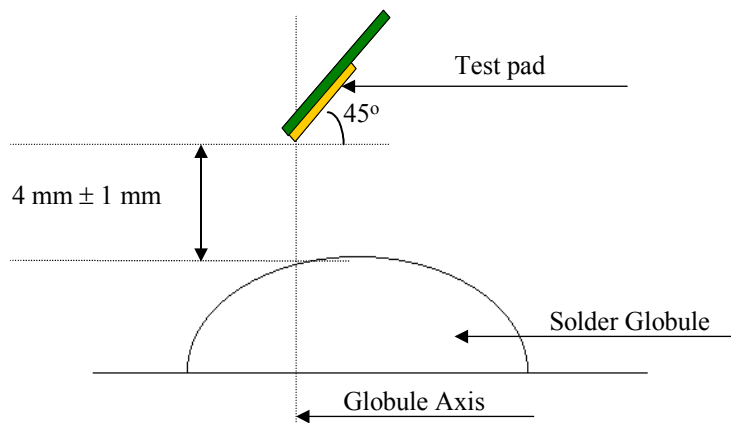
Pass/Fail Criteria:

Wetting Time:	Less than 2 seconds.
Wetting Force at 2 seconds:	Greater or equal to 0.2 mN/mm^2 (area of pad)

Examples of Solderability:

Good Solderability:	Example of good solderability curve
Poor Solderability:	Example of poor solderability curve

Good solderability curve of PCB pad

Poor solderability curve of PCB pad
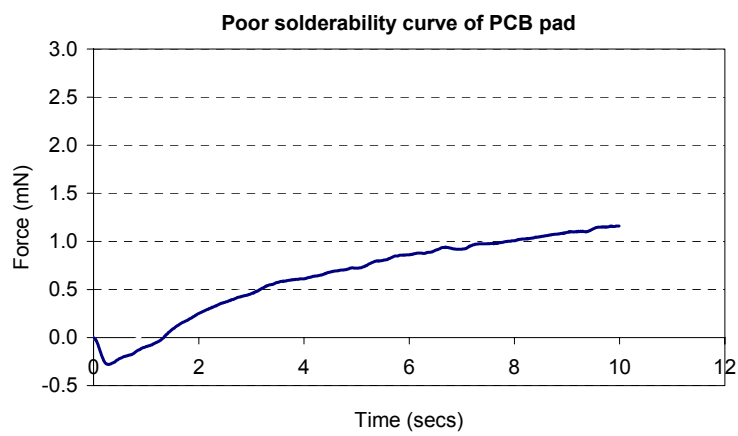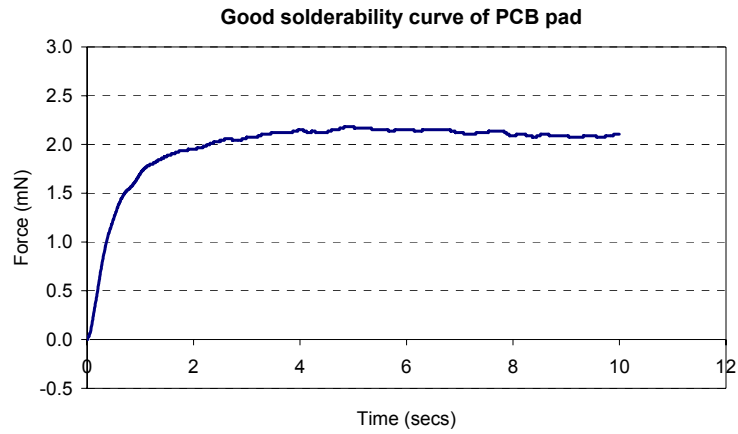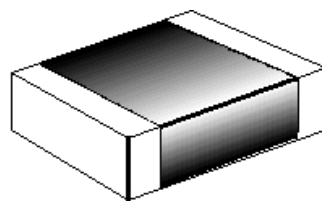

5.2   Chip Capacitor

Methodology: 0402, 0603, 0805, 1206, 1812

Apparatus: Wetting Balance, in solder globule mode, 25 mg pellet for 0402s and 0603s, 200 mg pellet for 0805s, 1206s and 1812s.
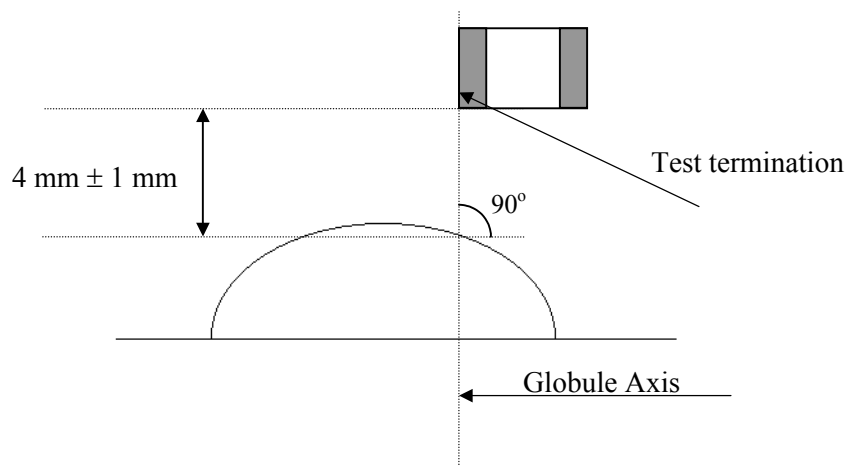
Schematic view of component:

4

Test Conditions:

Component preconditioning:	None, test on as received components.
Special Preparation:	None.
Test termination number:	One termination per component.
Solder Alloy:	Sn/Pb 60/40 (according to ISO 9453). SnAgCu 95.5/3.8/0.7 (according to EN 29453).
Flux for the Component Termination:	Rosin based, 0.5 % activated flux (according to IEC 68-2-20).
Solder Temperature:	235 ^{O}C $\pm$ 3 ^{O}C for SnPb solder alloys, for lead-free alloys with a melting point equal to or greater than 215 ^{O}C, a superheat temperature of +40 ^{O}C is used.
Immersion Speed:	1.0 mm/s
Duration of Immersion:	5 seconds
Immersion Depth Termination:	0.1 mm
Preheat:	No preheat.

Component Position above Solder Globule:

0402s and 0603s
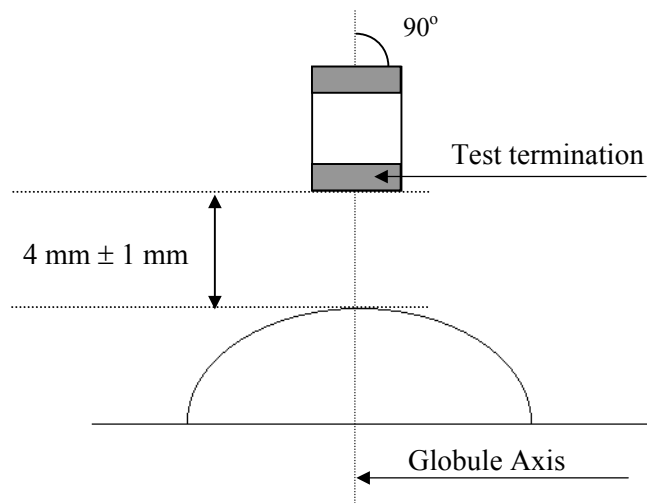
4 mm $\pm$ 1 mm

90°

Test termination

Globule Axis

0805s, 1206s and 1812s

Pass/Fail Criteria

Wetting Time:	Less than 2 seconds.

Examples of Solderability:

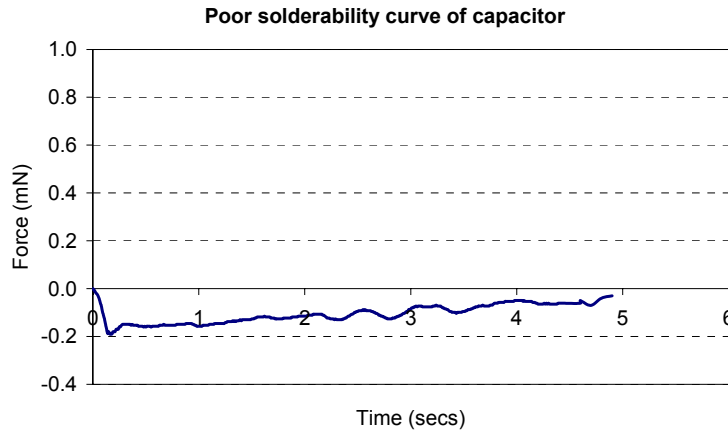|	
Good Solderability:	Example of good solderability
Poor Solderability:	Example of poor solderability

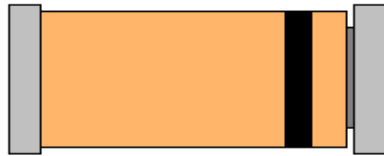**Poor solderability curve of capacitor**
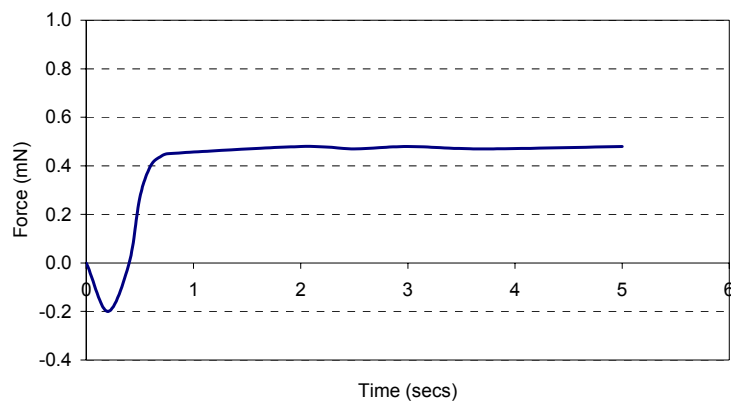
5.3 Minimelf

Methodology:

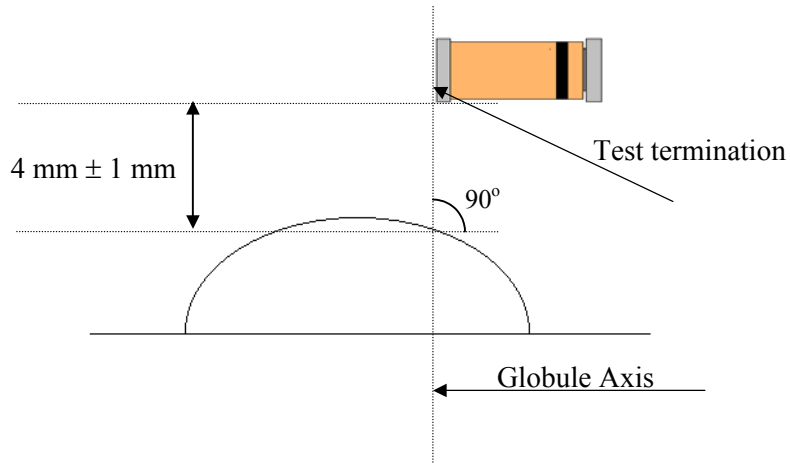**Apparatus:** Wetting Balance, in solder globule mode, 200 mg pellet.

Schematic view of component:

Test Conditions:

Component preconditioning:	None, test on as received components.
Special Preparation:	None.
Test termination number:	One termination per component.
Solder Alloy:	Sn/Pb 60/40 (according to ISO 9453). SnAgCu 95.5/3.8/0.7 (according to EN 29453).
Flux for the Component Termination:	Rosin based, 0.5 % activated flux (according to IEC 68-2-20).
Solder Temperature:	235 ^{O}C ± 3 ^{O}C for SnPb solder alloys, for lead-free alloys with a melting point equal to or greater than 215 ^{O}C, a superheat temperature of +40 ^{O}C is used.
Immersion Speed:	1.0 mm/s
Duration of Immersion:	5 seconds

Immersion Depth Termination: 0.25 mm

Preheat: No preheat.

Component Position above Solder Globule:

Pass/Fail Criteria:

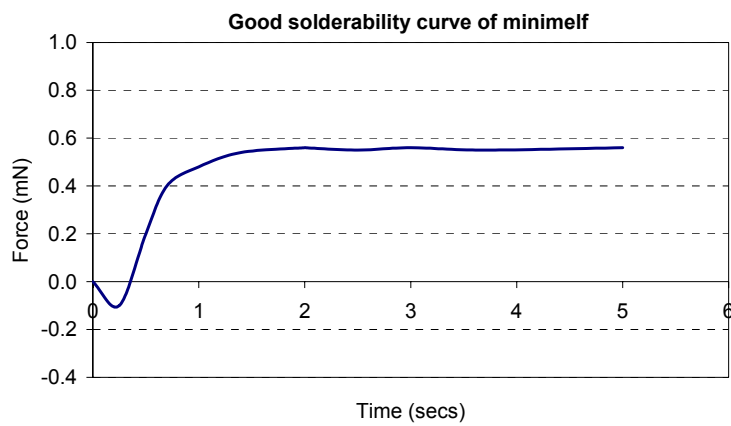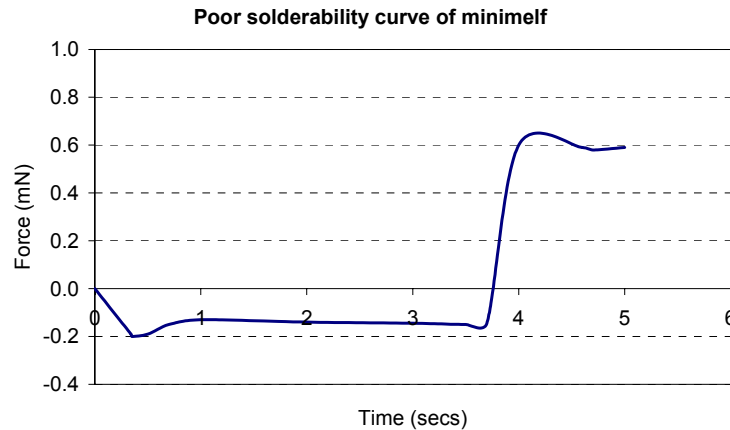Wetting Time: Less than 2 seconds.

Wetting Force at 2 seconds: Greater or equal to 0.2 mN

Examples of Solderability:

Good Solderability: Example of good solderability

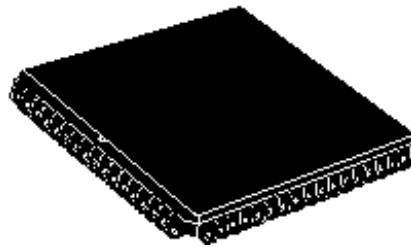Poor Solderability: Example of poor solderability

Poor solderability curve of minimelf

5.4 PLCC

Methodology: For all multi-pin devices.

Apparatus: Wetting Balance, in solder globule mode, 200mg pellet.
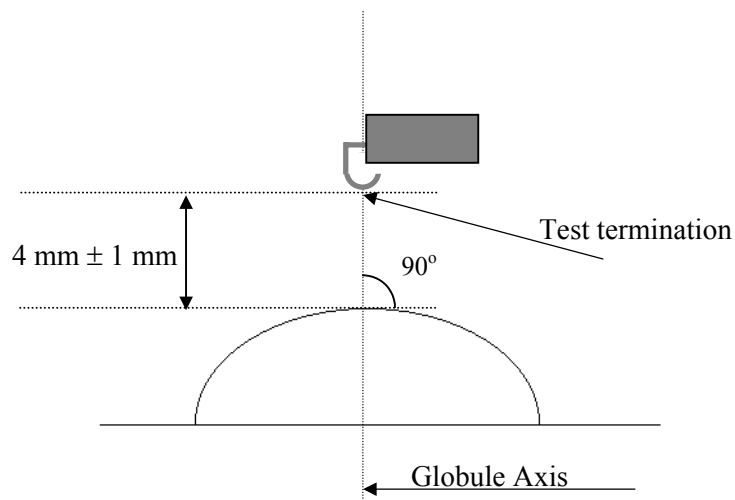
Schematic view of component:

Test Conditions:

Component preconditioning: None, test on as received components.

Special Preparation: Some terminations need to be removed to allow adequate space between the leads to be tested. This must be done at regular intervals as this is a step and repeat test. For PLCC 32s and 44s remove every other pin, for PLCC 68s and 84s remove two pins and leave one, repeat along one side.

Test termination number: Typically 5 terminations per component, test 2 components.

Solder Alloy: Sn/Pb 60/40 (according to ISO 9453).
SnAgCu 95.5/3.8/0.7 (according to EN 29453).

Flux for the Component Termination: Rosin based, 0.5 % activated flux (according to IEC 68-2-20).

Solder Temperature: 235 ^{O}C ± 3 ^{O}C for SnPb solder alloys, for lead-free alloys with a melting point equal to or greater than 215 ^{O}C, a superheat temperature of +40 ^{O}C is used.

Immersion Speed: 1.0 mm/s

Duration of Immersion: 5 seconds

Immersion Depth Termination: 0.1 mm

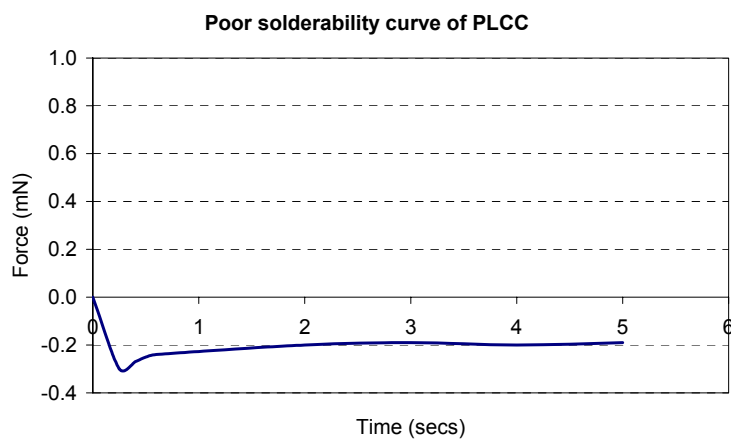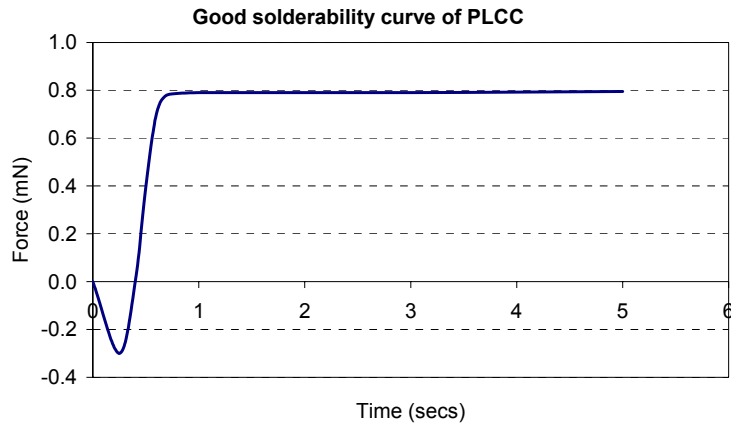Preheat: No preheat.

Component Position above Solder Globule:

Pass/Fail Criteria:

Wetting Time: Less than 2 seconds.

Wetting Force at 2 seconds: Greater or equal to 0.2 mN/mm (permeter of termination)

Examples of Solderability:

Good Solderability: Example of good solderability

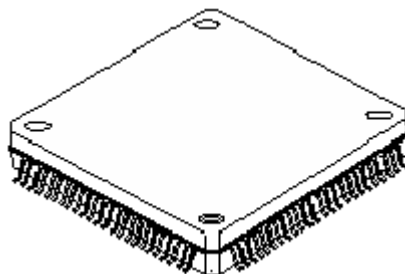Poor Solderability: Example of poor solderability

Good solderability curve of PLCC

Poor solderability curve of PLCC

5.5   QFP

Methodology: For all multi-pin devices.

Apparatus: Wetting Balance, in solder globule mode, 200mg pellet.

Schematic view of component:

Test Conditions:

Component preconditioning:	None, test on as received components.
Special Preparation:	As the leads are close together, a number are bent back at regular intervals to allow adequate space for solderabilty testing. The spacing between leads must be regular as testing is carried out in the step and repeat mode for QFPs.
Test termination number:	Typically 5 terminations per component, test 2 componnets
Solder Alloy:	Sn/Pb 60/40 (according to ISO 9453). SnAgCu 95.5/3.8/0.7 (according to EN 29453).
Flux for the Component Termination:	Rosin based, 0.5 % activated flux (according to IEC 68-2-20).
Solder Temperature:	235 ^{O}C $\pm$ 3 ^{O}C for SnPb solder alloys, for lead-free alloys with a melting point equal to or greater than 215 ^{O}C, a superheat temperature of +40 ^{O}C is used.
Immersion Speed:	1.0 mm/s
Duration of Immersion:	5 seconds
Immersion Depth Termination:	0.2 mm
Preheat:	No preheat.

Component Position above Solder Globule:
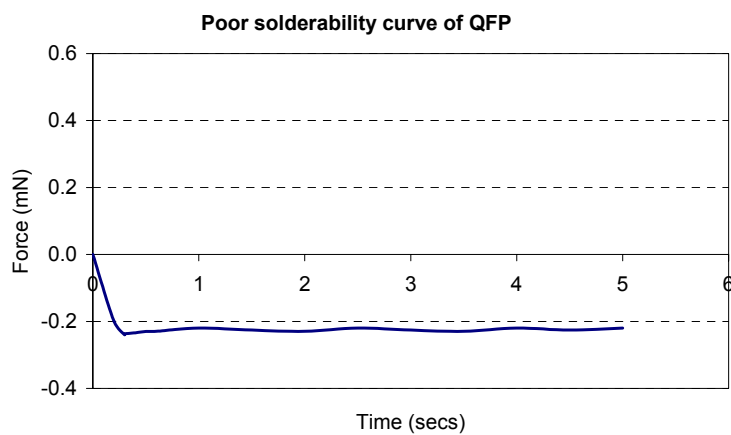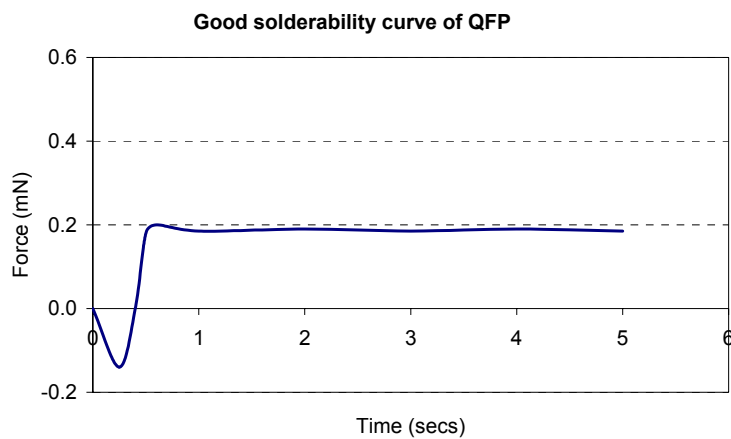
Pass/Fail Criteria:

      Wetting Time: Less than 2 seconds.

      Wetting Force at 2 seconds: Greater or equal to 0.2 mN/mm (permeter of termination)

Examples of Solderability:

      Good Solderability: Example of good solderability

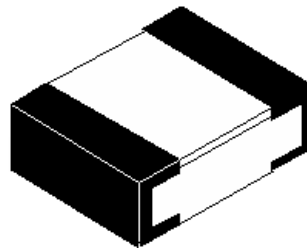   Poor Solderability: Example of poor solderability

Good solderability curve of QFP

Poor solderability curve of QFP

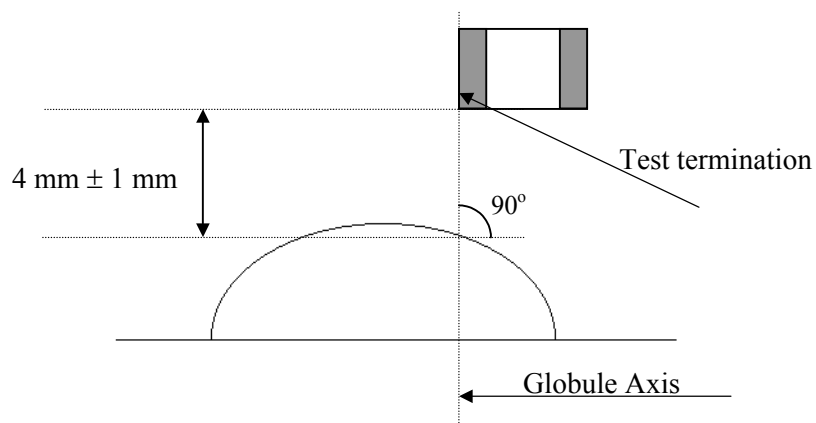## 5.6   Chip Resistor

Methodology: 0402, 0603, 0805, 1206.

Apparatus: Wetting Balance, in solder globule mode, 25mg pellet for 0402s and 0603s, 200mg pellet for 0805s, 1206s.

Schematic view of component:

Test Conditions:

Component preconditioning:	None, test on as received components.
Special Preparation:	None.
Test termination number:	One termination per component.
Solder Alloy:	Sn/Pb 60/40 (according to ISO 9453). SnAgCu 95.5/3.8/0.7 (according to EN 29453).
Flux for the Component Termination:	Rosin based, 0.5 % activated flux (according to IEC 68-2-20).
Solder Temperature:	235 ^{O}C $\pm$ 3 ^{O}C for SnPb solder alloys, for lead-free alloys with a melting point equal to or greater than 215 ^{O}C, a superheat temperature of +40 ^{O}C is used.
Immersion Speed:	1.0 mm/s
Duration of Immersion:	5 seconds
Immersion Depth Termination:	0.1 mm
Preheat:	No preheat.

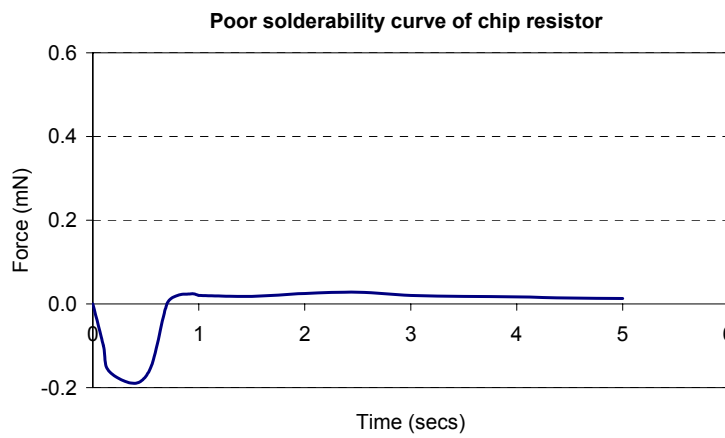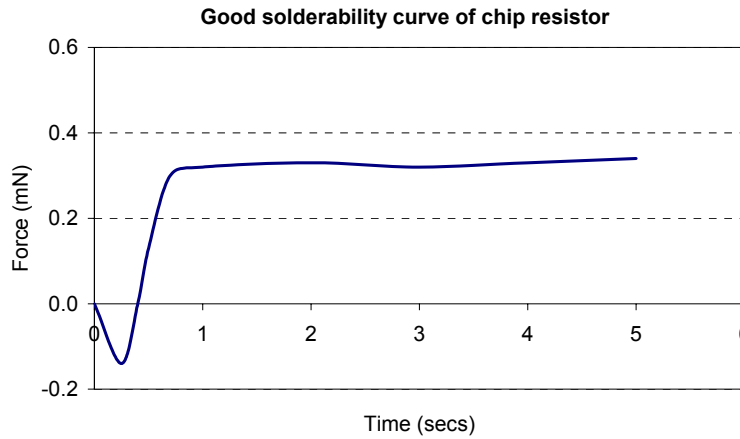Component Position above Solder Globule:

Pass/Fail Criteria

Wetting Time: Less than 2 seconds.

Examples of Solderability:

Good Solderability: Example of good solderability
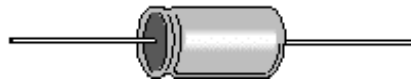
Poor Solderability: Example of poor solderability

Good solderability curve of chip resistor

Poor solderability curve of chip resistor

5.7 Wire

**Methodology:** 0.8, 0.9, 1.0, 1.2, 1.6 mm in diameter

Apparatus: Wetting Balance, in the solder bath mode. A 200 mg solder alloy pellet is desirable for use in the solder globule mode when testing copper wire with copper containing lead-free alloys. This is to avoid contamination of the solder bath from copper dissolution.

Schematic view of component:

Test Conditions:

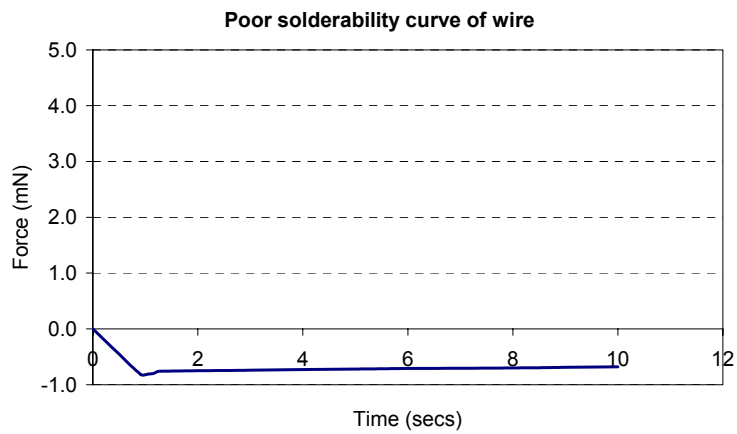|	
Component preconditioning:	None, test on as received components.
Special Preparation:	None, although it may be preferable to clip the wire from the component body
Test termination number:	One termination per component.
Solder Alloy:	Sn/Pb 60/40 (according to ISO 9453). SnAgCu 95.5/3.8/0.7 (according to EN 29453).
Flux for the Component Termination:	Rosin based, 0.5 % activated flux (according to IEC 68-2-20).
Solder Temperature:	235 ^{O}C $\pm$ 3 ^{O}C for SnPb solder alloys, for lead-free alloys with a melting point equal to or greater than 215 ^{O}C, a superheat temperature of +40 ^{O}C is used.
Immersion Speed:	20 mm/s when using a solder bath, 1 mm/s when using a solder globule
Duration of Immersion:	10 seconds
Immersion Depth Termination:	4.0 mm when using a solder bath for all wire diameters, 0.5mm when using a solder globule, 1.0 mm when using a solder globule and the wire has a diameter of 1.6 mm.
Preheat:	No preheat.
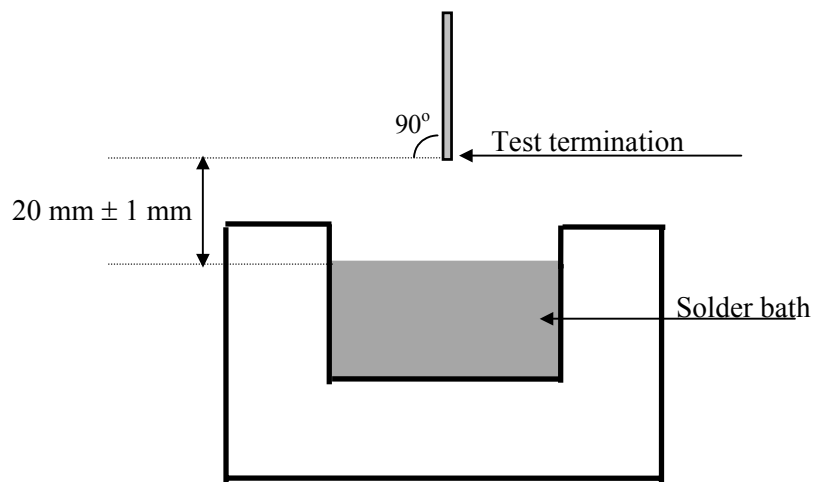
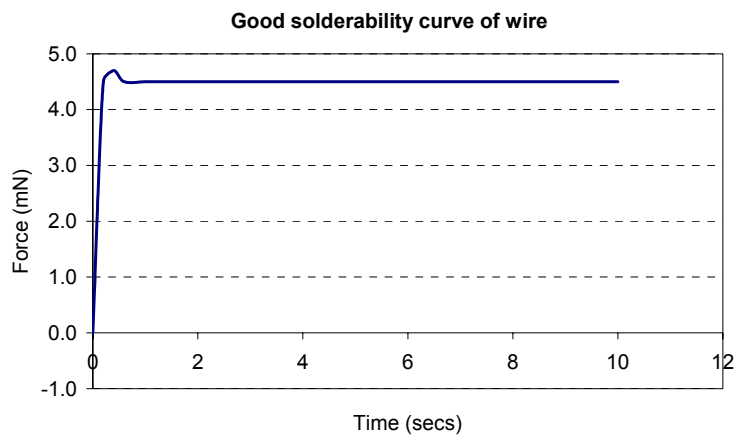Component Position above Solder Globule:

Pass/Fail Criteria:

Wetting Time: Less than 2 seconds.

Wetting Force at 2 seconds: Greater or equal to 0.2 mN/mm (perimeter of termination)

Examples of Solderability:

Good Solderability: Example of good solderability
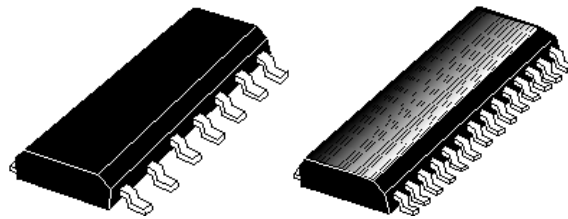
Poor Solderability: Example of poor solderability

Good solderability curve of wire

Force (mN) vs Time (secs)

Poor solderability curve of wire

Force (mN) vs Time (secs)

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5.8   SOIC

Methodology: SOIC14, SOIC28

Apparatus: Wetting Balance, in the solder globule mode. A 200 mg pellet.

Schematic view of component:

Test Conditions:

Component preconditioning:	None, test on as received components.
Special Preparation:	As the leads are close together, a number are bent back at regular intervals to allow adequate space for solderabilty testing. The spacing between leads must be regular as testing is carried out in the step and repeat mode for SOICs.
Test termination number:	Typically 3 terminations per component, test 4 componnets
Solder Alloy:	Sn/Pb 60/40 (according to ISO 9453). SnAgCu 95.5/3.8/0.7 (according to EN 29453).
Flux for the Component Termination:	Rosin based, 0.5 % activated flux (according to IEC 68-2-20).
Solder Temperature:	235 ^{O}C $\pm$ 3 ^{O}C for SnPb solder alloys, for lead-free alloys with a melting point equal to or greater than 215 ^{O}C, a superheat temperature of +40 ^{O}C is used.
Immersion Speed:	1.0 mm/s
Duration of Immersion:	5 seconds
Immersion Depth Termination:	0.2 mm
Preheat:	No preheat.

Component Position above Solder Globule:

4 mm ± 1 mm
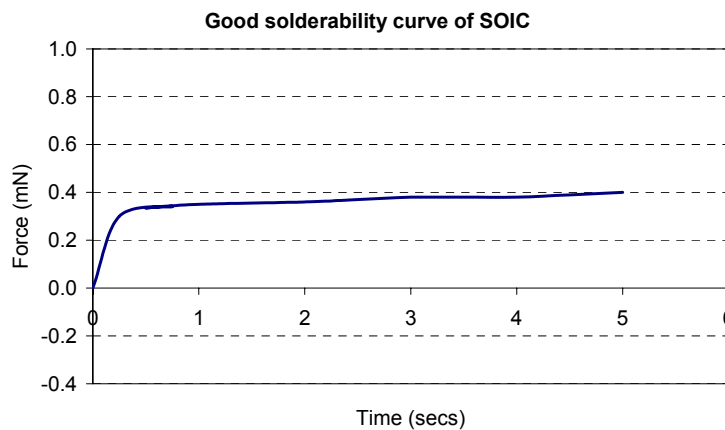
45º

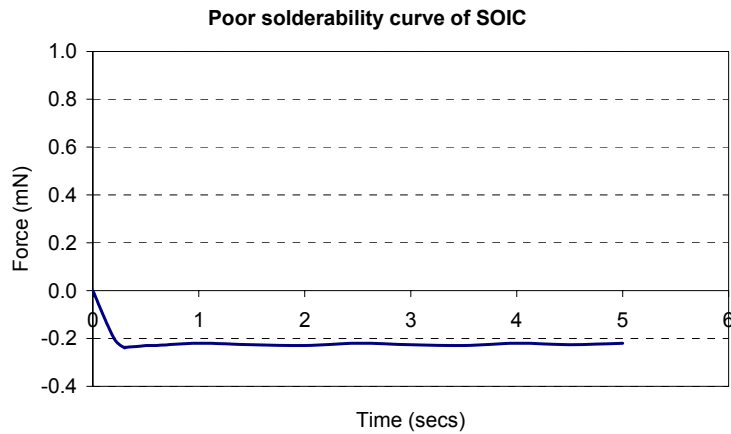Test termination

Globule Axis

Pass/Fail Criteria:

Wetting Time: Less than 2 seconds.

Wetting Force at 2 seconds: Greater or equal to 0.2 mN/mm (perimeter of termination)

Examples of Solderability:

Good Solderability: Example of good solderability
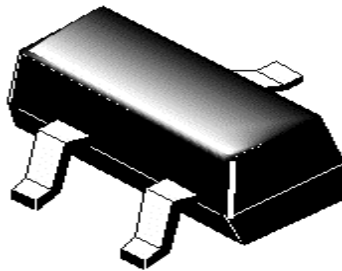
Poor Solderability: Example of poor solderability

Good solderability curve of SOIC

Poor solderability curve of SOIC

5.9   SOT

Methodology: SOT23

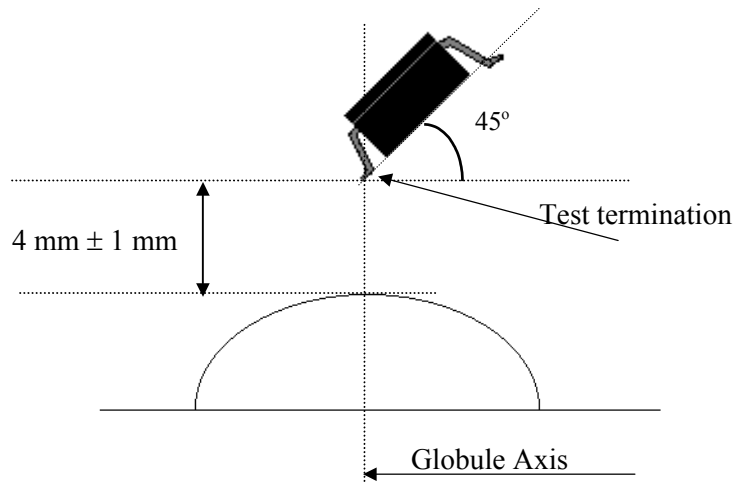**Apparatus:**   Wetting Balance, in the solder globule mode. A 200 mg pellet.

Schematic view of component:

Test Conditions:

Component preconditioning:	None, test on as received components.
Special Preparation:	None, test on as received component.
Test termination number:	One termination per componnet
Solder Alloy:	Sn/Pb 60/40 (according to ISO 9453). SnAgCu 95.5/3.8/0.7 (according to EN 29453).
Flux for the Component Termination:	Rosin based, 0.5 % activated flux (according to IEC 68-2-20).
Solder Temperature:	235 ^{O}C $\pm$ 3 ^{O}C for SnPb solder alloys, for lead-free alloys with a melting point equal to or greater than 215 ^{O}C, a superheat temperature of +40 ^{O}C is used.

Immersion Speed: 1.0 mm/s

Duration of Immersion: 5 seconds

Immersion Depth Termination: 0.1 mm

Preheat: No preheat.

Component Position above Solder Globule:

Pass/Fail Criteria:

Wetting Time: Less than 2 seconds.

Wetting Force at 2 seconds: Greater or equal to 0.2 mN/mm (perimeter of termination)

Examples of Solderability:

Good Solderability: Example of good solderability

Poor Solderability: Example of poor solderability

Good solderability curve of SOT