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Director, EPTAC



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Understanding Solderability Testing for Printed Circuit Boards and Components



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Solderability What is IT?

According to IPC-T-50

- **Base Solderability**
 - Is the ease with which a metal or metal alloy surface can be wetted by molten solder under minimum realistic conditions.
- **Solderability**
 - The ability of a metal to be wetted by molten solder.



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Purpose

- Solderability evaluations are made to verify the components will meet the requirements of the standards and determine that storage has no adverse effect on the ability to solder components to boards



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New Program

- EPTAC is introducing a new program which will go in detail with these 2 documents and will enhance your knowledge when conversing with your suppliers and contract manufacturers.



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Goals

- Be knowledgeable of the J-STD-002 and 003 documents
- Differentiate different surface conditions
- Determine acceptability requirements of the testing
- Be able to apply the specifications requirements



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Overview

- Interpretation of solderability results is a difficult task
- Discriminative criteria and skills set will be reviewed
- Similar methods between wire/terminals and pcbs
 - Unique J-STD-003 information will be listed within ()
- **The primary criteria for solderability**
 - is the ability for solder to sufficiently wet



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Concerns in determining solderability

The question is:

When it doesn't solder, do we
know why?

- Is it a Solderability issue?
 - Is the solder oxidizing
 - Is there an increase in the intermetallic layer?



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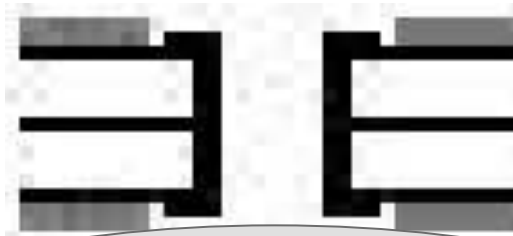
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Concerns in determining solderability

A Soldering Ability issue

- Solder Ability = the ability of an item to be soldered
 - With a through hole lead, the solder would wick up into the pth.

Multi-layered
Through-hole
pcb



Solder mask





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Visual Method Classification

1.3.1 (1.5.1) Visual Acceptance Criteria

- **Leaded applications:**
 - Test A, B, C, D, S [smt]
 - (003) Test A, B, C, D, E [smt]
- **Lead-Free applications:**
 - Test A1, B1, C1, D1, S1
 - (003) Test A1, C1, D1, E1 [smt]



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Force Measurement Tests

1.3.2 (1.5.2) Force Measurement Tests

- **Leaded Applications:**
 - Test E, F, G
 - (003) Test F
- **Lead Free applications:**
 - Test E1, F1, G1
 - (003) Test F1



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Upcoming Changes

1.4 (1.8) Coating Durability

- ~~Durability of the coating:
 - **Category 1:** surfaces that will be soldered within a short period of time (< 6 months) from the time of testing and are likely to experience a minimum of thermal exposures before soldering.
 - **Category 2:** surfaces that will be soldered after an extended time from the time of testing, and which may see limited thermal exposures before soldering
 - This is the default coating for PCB's
 - **Category 3:** surfaces whose solderability may be come degraded from storage (> 6 months) or from multiple thermal exposures.
 - This is the default coating for "tin" based surfaces~~



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General Material Requirements

Solder

- Tin/lead testing, the solder **shall** be
 - Sn60Pb40, (SN62/Pb36/2/Ag) or Sn63Pb37
 - Test S and (E) **shall** be Sn60Pb40 or Sn63Pb37, mesh size of -325/+500, and flux ROL1
 - Other solder paste may be used upon agreement between user and supplier
- Lead-Free testing the solder **shall** be
 - Sn96.5Ag3.0Cu0.5 (SAC305)
 - Test S1 and (E1) **shall** be SAC305, mesh size of -325/+500, and flux type to be agreed upon between user and supplier



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General Material Requirements

Flux

- Tin/lead testing the flux **shall** be an activated rosin flux #1
- Lead free testing the flux **shall** a activated rosin flux #2
- Flux used in preparation of the standard copper wrapping wires for tests C and C1 **shall** conform to ROL1, and **shall** be used for preparation, and **shall not** be used in performing the solderability tests

Table 3-1 Flux Compositions

Constituent	Composition by weight percent	
	Flux #1	Flux #2
Colophony	25 +/- 5	25 +/- 5
Diethylammonium hydrochloride	0.15 +/- 0.01	0.39 +/- 0.01
Isopropyl Alcohol (IPA)	Balance	Balance
Weight of Chlorine as % of solids	0.2	0.5



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1.6 (1.9) Limitations

1.6 (1.9) Limitations

- This standard is not a pre-tinning exercise, but rather a destructive solderability test.
 - Components after such solderability test **shall** only be used with agreement between the user and supplier



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General Requirements

3.3.3.1 Referee Magnification

- Referee magnification **shall** be 70X for fine pitch components (0.5 mm [0.020 in]) and, 30X for all other lead sizes

3.3.4 (3.3.4) Dipping Equipment

- The equipment used **shall** be capable of
 - Controlling the emersion rate
 - Dwell time
 - Dwell depth
 - Sample holding fixtures **shall** avoid heat loss and assure consistent test results



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General Requirements

3.4.1 (3.4.1) Specimen Preparation and Surface Condition

- All solderable surfaces **shall** be tested in the condition that they would normally be during assembly
- They **shall** be handled without creating contamination,
- The leads **shall** not be wiped, cleaned, scraped or abraded
- Any lead forming **shall** be specified in applicable procurement documentation, and be completed before testing
- Any removal of insulation **shall** be completed before testing and such that there is no strand separation or wire damage



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General Requirements

3.5.2 (3.5.2) Solder Contamination Control

- The solder used for solderability testing **shall** be chemically or spectrographically analyzed and replaced depending on the contamination levels, see *Table 3-4 Maximum Limits of Solder Bath Contaminant*



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Table 3-4 Maximum Limits of Solder Bath Contaminant

Contaminant	Maximum Contaminant Weight Percentage Limit Sn Pb Alloys ^(1,2)	Maximum Contamination Weight Percentage Limit Lead-free Alloys ^(3,4)
Copper	0.300	0.800
Gold	0.200	0.200
Cadmium	0.005	0.005
Zinc	0.005	0.005
Aluminum	0.006	0.006
Antimony	0.500	0.500
Iron	0.020	0.020
Arsenic	0.030	0.030
Bismuth	0.250	0.250
Silver	0.100	4.000
Nickel	0.010	0.010
Lead	N/A	0.100

Notes:

1. The tin content of the solder **shall** be maintained within $\pm 1\%$ 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%. Not applicable to lead-free alloys.
3. The tin content of the solder **shall** be maintained within $\pm 1\%$ of the nominal alloy being used. Tin content **shall** be tested at the same frequency as testing for copper/silver concentration. The balance of the bath **shall** be the items listed above.
4. Maximum contamination limits are applicable for Sn96.5Ag3.0Cu0.5 (SAC305) per J-STD-006. Other Lead-free solder alloy contamination limits may be used upon agreement between user and vendor.



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Test A/A1: Solder Dip and Look Test, (Edge Dip Test)

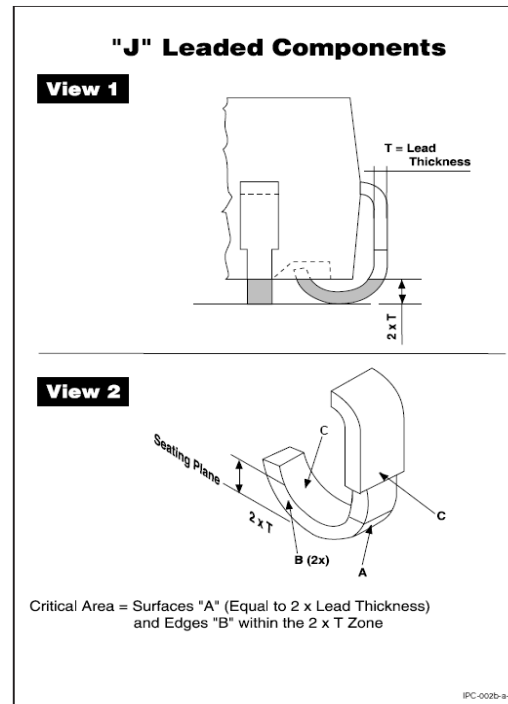


Figure A-1

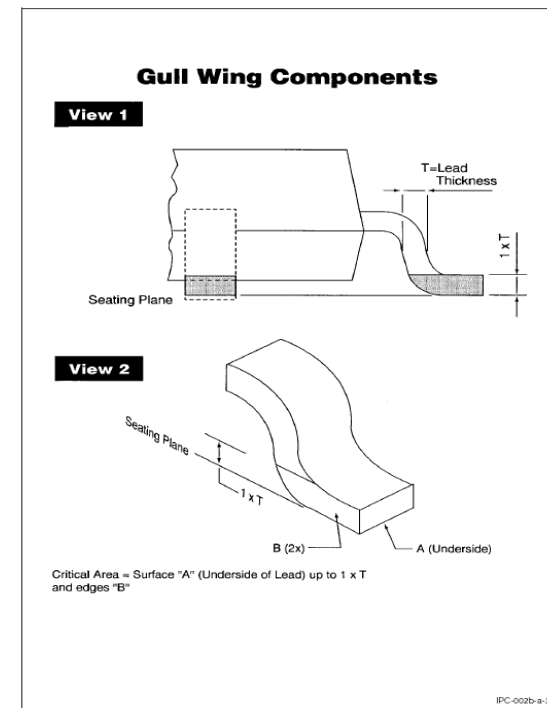


Figure A-3



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Test A/A1: Solder Dip and Look Test, (Edge Dip Test)

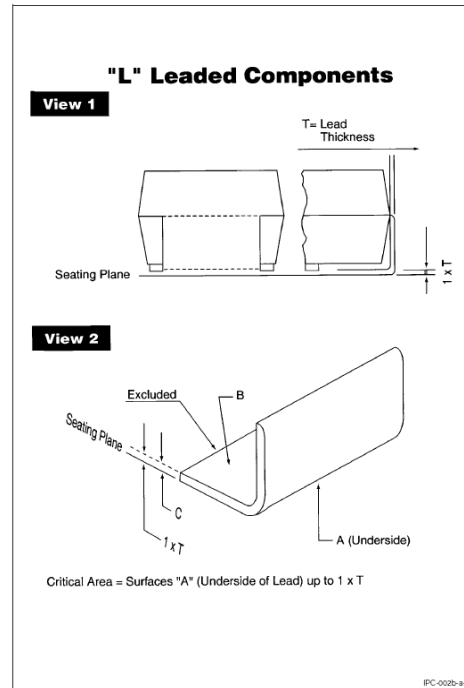


Figure A-5

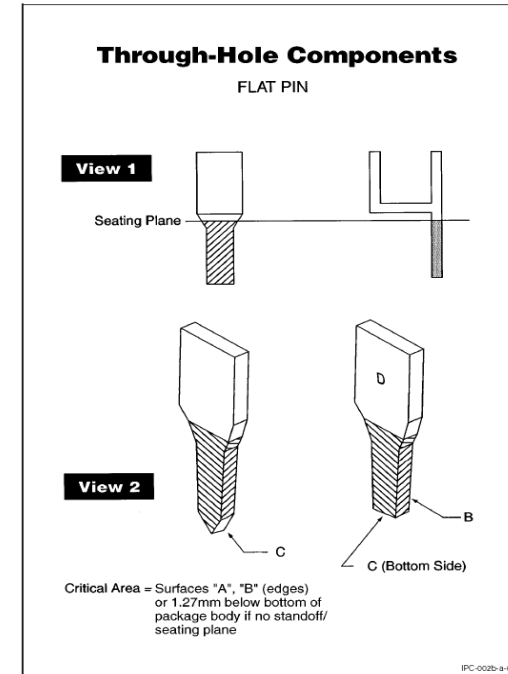


Figure A-6



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Test A/A1: Solder Dip and Look Test, (Edge Dip Test)

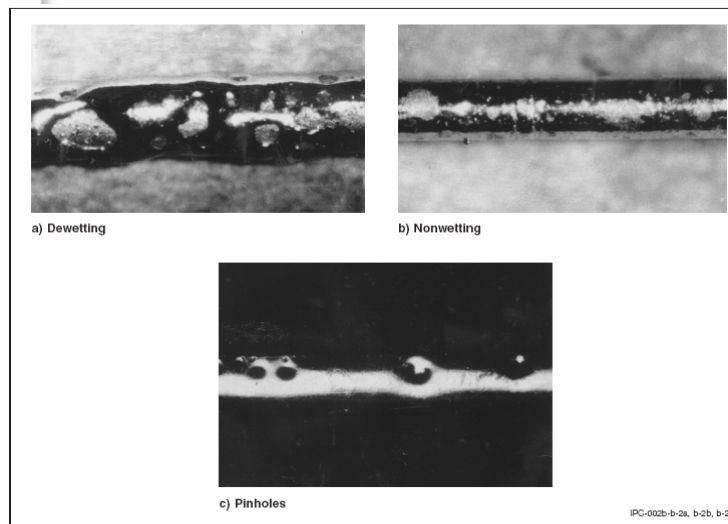


Figure B-2

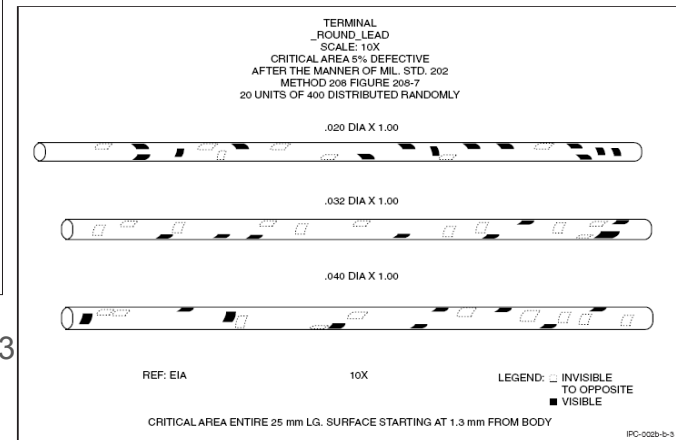


Figure B-3



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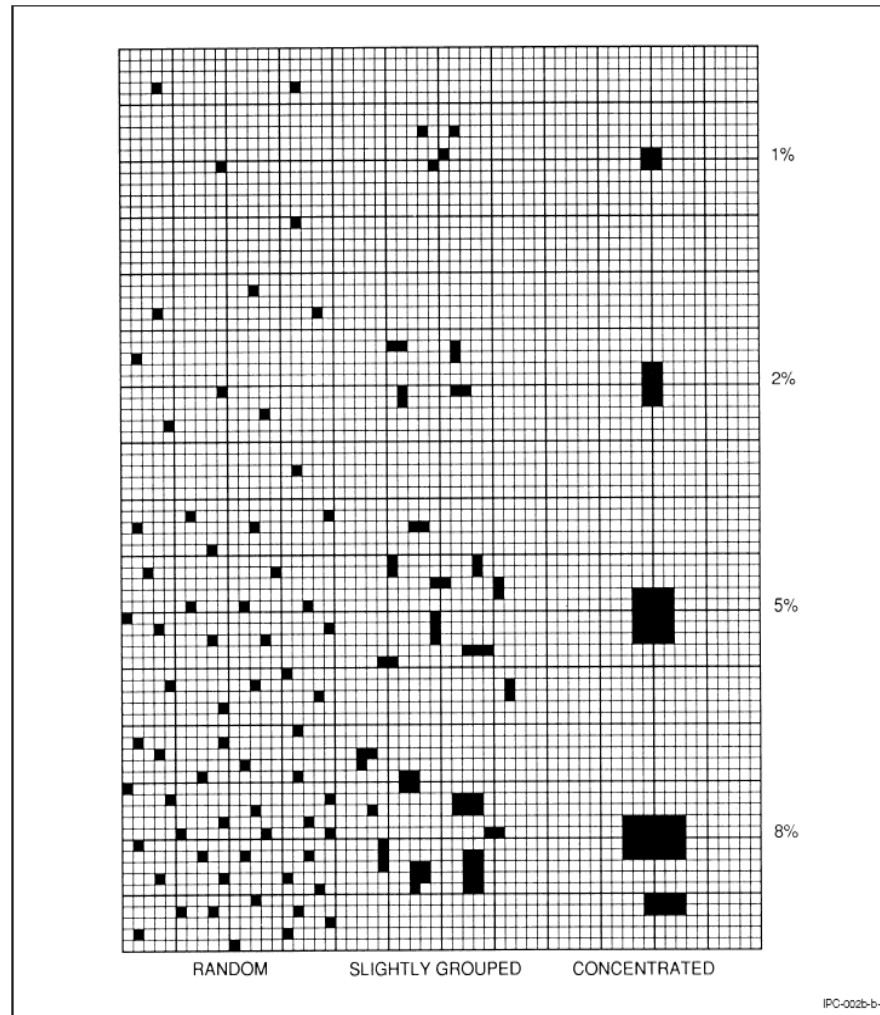


Figure B-4



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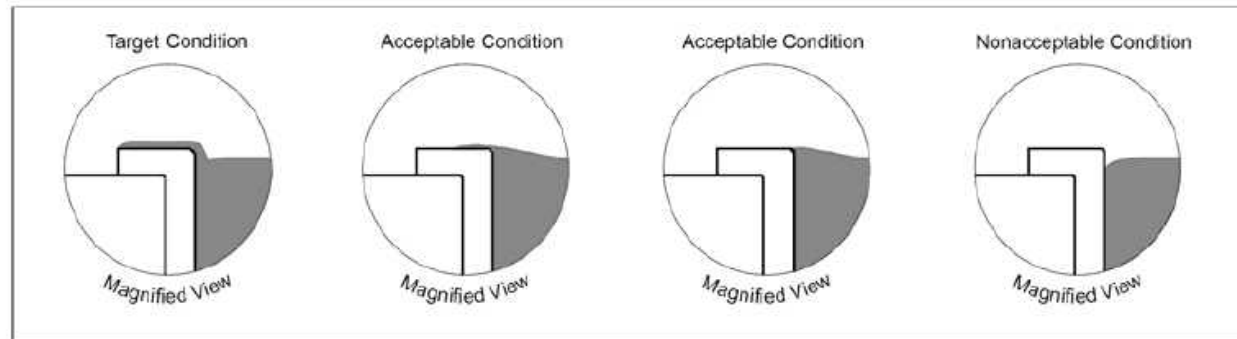
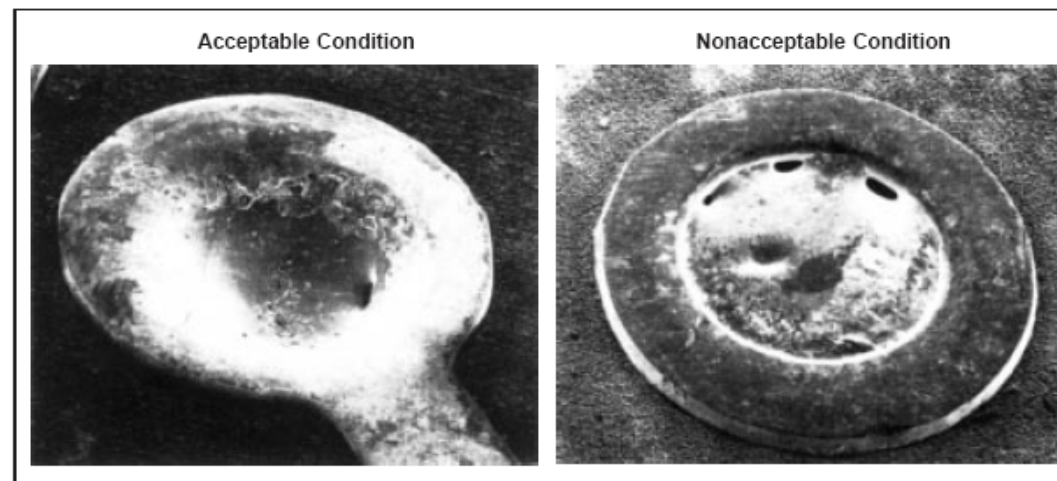


Figure 4-5 Effectiveness of Solder Wetting of Plated-Through Holes - Class 3



(Figure 4-6)



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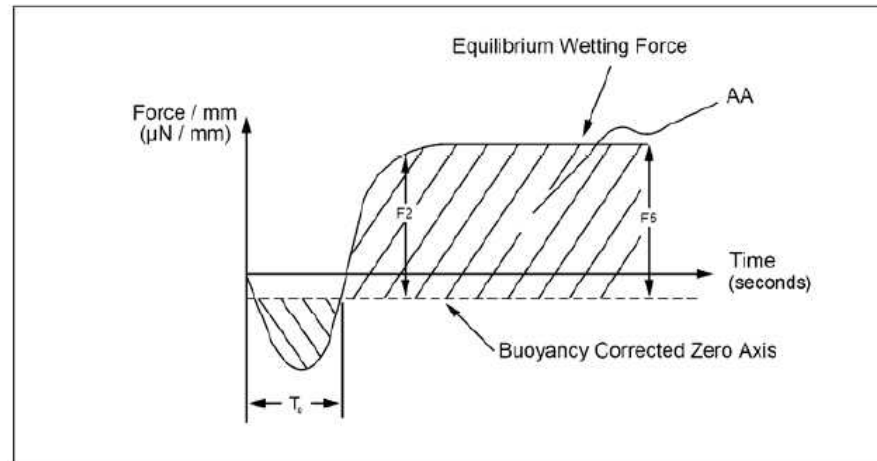


Figure 4-10 Set A Wetting Curve

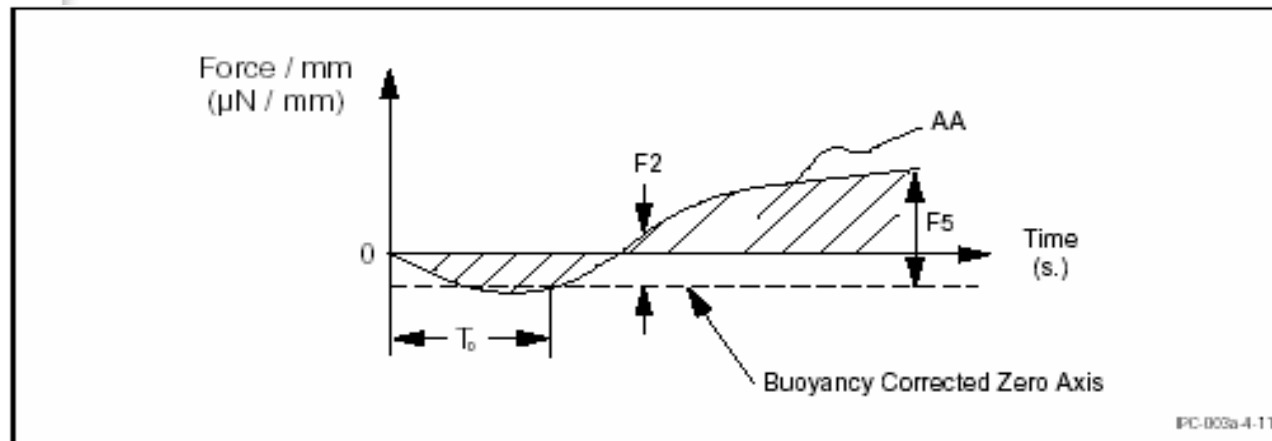


Figure 4-11



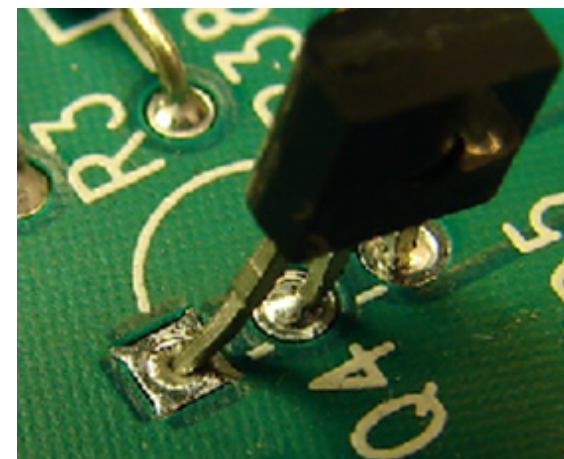
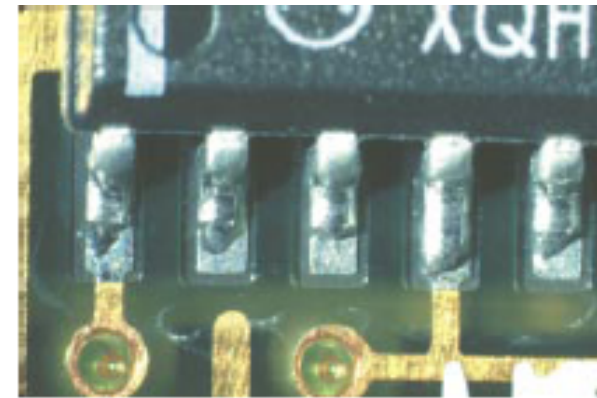
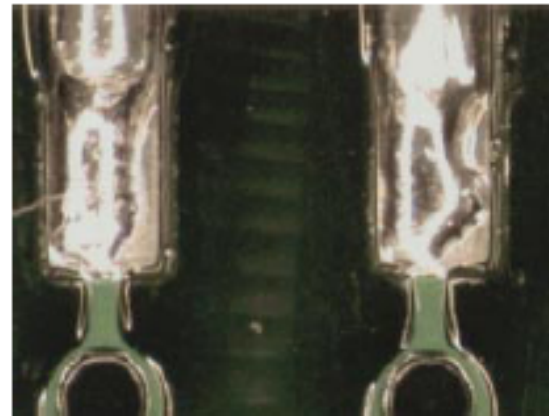
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Check for Wetting/ Dewetting





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Check for Wetting/ Dewetting

**Preferred
Wetting**



**Small
Amount of
Dewetting**



**Complete
Dewetting**



Nonwetting





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Thank You



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