SOLDERABILITY SPECIFICATIONS

1.0 SCOPE

This standard covers solderability test methods and evaluation criteria for both the dip coated, using either a solder pot or meniscograph, and process simulation. Performance requirements of pre plated materials used in the fabrication of terminals and pre plated and post plated terminals intended for soldering into plated or etched circuits by automated equipment are defined.

2.0 PURPOSE

To establish standard test method and evaluation procedures for determining the ability of plated surfaces to accept molten solder. An accelerated aging sequence is included to simulate a minimum of 6 months natural aging under a combination of various storage conditions that have different deleterious effects.

3.0 REFERENCE DOCUMENTS

3.1 DOCUMENTS

- ASTM D-465 Standard Test Methods for Acid Number of Naval Store Products including Tall Oil and other related products.
- IPC/EIA/JEDEC J-STD-002 Solderability Tests for Component Leads, Terminations, Lugs, Terminals and Wires.
- IPC/EIA/JEDEC J-STD-004 Requirements for Soldering Fluxes
- IPC/EIA/JEDEC J-STD-005 Requirements for Soldering Pastes
- IPD/EIA/JEDEC J-STD-006 Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications
- IPC-6013 Qualification and Performance Specification for Flexible Printed Boards
- ASTM B-678 Solderability
- EIA-364 TP-18 Visual and Dimensional Inspection for Electrical Connector
- EIA-364 TP-52 Test Procedures for Solderability of Contact Terminations used in Connector/ Sockets.
- IEC-68-2-20 Basic Environment Testing Procedures Part 2: Tests Part T: Soldering
- JEDEC JESD22-B102 Solderability
- JIS-C-0050 Basic Environmental Testing Procedures Part 2: Tests Part T: Soldering
- MIL-STD-202 Method 208 Solderability
- MIL-STD-883 Method 2003 Solderability
- MIL-STD-883 Method 2022 Meniscograph Solderability

[A summary comparison of worldwide solderability specifications appears in Appendix.]

4.0 DEFINITIONS

4.1 DEWETTING

A condition whereby the molten solder has coated the surface tested and then receded leaving irregularity shaped mounds of solder separated by areas covered with a thin solder film; base metal is not exposed. See Figure 5.

4.2 FLUX

A chemically and physically active compound that, when heated, promotes the wetting of a base metal surface by molten solder by removing minor surface oxidation and other surface films and by protecting the surface from reoxidation during a soldering process.

4.3 FOREIGN MATERIAL

A Lumpy, irregular coating which has covered, or partially covered, particles of material located on, but different than, the specimen material or coating. See Figure 6.

4.4 NON WETTING

A condition whereby a surface has contacted molten solder, but the solder has not adhered to all of the surface; surface tested remains exposed. See figure 3.

4.5 PIN HOLES

Small holes occurring as imperfections that penetrates entirely through the solder layer. See Figure 4.

4.6 POROSITY

A condition of solder coating with a spongy and uneven surface appearance that may contain concentrations of small pinholes and pits. See Figure 2.

4.7 PRINTED CIRCUIT BOARD FOOTPRINT

The mounting pattern specified to terminate the connector assembly terminals to the printed circuit board holes and or surface mount patterns.

4.8 PRINTED CIRCUIT BOARD (PC BOARD)

A substrate used to interconnect components electrically and acts as the primary structure to support those components. Also known as printed wiring board.

4.9 PROCESS COMPATIBILITY

A component's ability to withstand the manufacturing process from a stabilized temperature and humidity condition.

4.10 ROSIN FLUX

Primarily composed of natural rosin, extracted from the oleoresin of pine trees and refined. Consists of one or more of the following types: gum rosin, wood rosin, tall oil rosin, modified or natural rosin.

4.11 SOLDERABILITY

The property of metal to be wetted by solder

4.12 SPECIMEN

Component under evaluation.

4.13 WETTING

A condition whereby a relatively uniform, smooth, unbroken and adherent film of solder has formed to the surface tested.

5.0 REQUIREMENTS

5.1 EQUIPMENT

5.1.1 CONTAINER AND COVER (AGING)

A nonmetallic container of sufficient size to allow the suspension of the specimens 38mm (1.5 inches) above the boiling distilled water **shall** be used (a 2,000ml beaker is one size that has been used satisfactorily for smaller components). The cover **shall** be one or more stainless steel plates and shall be capable of covering approximately 7/8ths (88%) of the open area of the container so that a more constant temperature may be obtained. A suitable method of suspending the specimens **shall** be improvised. Perforations or slots in the plates **shall** be permitted for this purpose.

5.1.2 DIPPING DEVICE (DIP COATED)

A mechanical dipping device capable of controlling the rates and angle of immersion of the specimen, and providing a dwell time (time of total immersion to the required depth) in the solder bath as specified in 5.3.4 **shall** be used.

A mechanical dipping device is incorporated in the meniscograph, and is preset to produce an immersion and removal rate as specified in 5.3.4. The specimen dwell time is operator controlled to the time specified in 5.3.4.

5.1.3. DIMENSIONAL

The dimensional inspection tools, gages and equipment **shall** be capable of verifying the dimensions specified on the Molex Sales Drawing.

5.1.4 OPTICAL EQUIPMENT

An optical system capable of providing magnification between 10x and 20x **shall** be used. Lighting **shall** provide a uniform non-glare, non-directional illumination of the specimen.

5.1.5 PASTE APPLICATION TOOL (PROCESS SIMULATION)

A rubber or metal squeegee device **shall** be used to distribute the paste across the stencil/screen

5.1.6 REFLOW EQUIPMENT (PROCESS SIMULATION)

5.1.6.1 CONVECTION REFLOW SYSTEM

A test chamber using convection heating **shall** be of an appropriate size to accommodate all test specimens under evaluation. The chamber **shall** be capable of operating and maintaining the specified temperature profile within the defined time period.

5.1.6.2 INFRARED/CONVECTION SYSTEM

A test chamber using infrared(IR)/convection heating **shall** be of an appropriate size to accommodate all test specimens under evaluation. The chamber **shall** be capable of operating and maintaining the specified temperature profile within the defined time period. The chamber shall use IR to heat only the air and not directly impinge upon the test specimens.

5.1.7 SCREEN OR STENCIL (PROCESS SIMULATION)

A stencil or screen with pad geometry opening that is appropriate for the specimen being tested **shall** be used to print the solder paste. Unless otherwise specified, the nominal stencil thickness **should** be 0.102mm (.004 inch) for terminals less than 0.508mm (.020 inch) component lead pitch, 0.152mm (.006 inch) for a component with a lead pitch between 0.508mm (.020 inch) to 0.635mm (.025 inch) and 0.203mm (.008 inch) for a component with a lead pitch greater than 0.635mm (.025 inch).

5.1.8 SOLDER POT (DIP COATED)

A solder pot of sufficient size to contain at least 1 kilogram (2.2 pounds) of solder **shall** be used. Its dimensions **shall** allow immersion of the leads to a depth specified in 5.3.4 without touching the bottom of the pot. The apparatus **shall** be capable of maintaining the solder at the specified temperature.

5.1.9 SOLDER MENISCUS FORCE MEASURING DEVICE (MENISCOGRAPH)

A solder meniscus force measuring device, meniscograph, which includes a temperature controlled solder pot containing approximately 750 grams of solder **shall** be used. This apparatus **shall** be capable of maintaining the solder at the temperature specified in 5.3.4. The meniscograph apparatus **should** also include a strip chart recorder, which records the force curve for the specimen tested.

5.1.10 TEMPERATURE CHAMBER (AGING AND PROCESS SIMULATION)

Chamber **shall** be of an appropriate size to accommodate all test specimens under evaluation and **shall** be capable of operating and maintaining the specified test environment temperature with an accuracy of ± 2° C.

5.2 MATERALS

5.2.1 FLUX

The rosin flux **shall** conform to **IPC/EIA/JEDEC J-STD-004.** The rosin used **shall** have a minimum acid value of 130 as determined by **ASTM D-465**.

5.2.1.1 FLUX TYPE ROL0 (LOW OR NO FLUX/FLUX RESIDUE ACTIVITY)

ROL0 type flux with 0.0% percentage halide by weight **shall** be used for post-plated product for lead free alloy Process Simulation test method.

5.2.1.2 FLUX TYPE ROL1 (LOW OR NO FLUX/FLUX RESIDUE ACTIVITY)

ROL1 type flux with <0.5% percentage halide by weight **shall** be used for post-plated product Dip Coat and tin lead alloy Process Simulation test methods.

5.2.1.3 FLUX TYPE ROM0 (MODERATE FLUX/FLUX RESIDUE ACTIVITY)

ROM0 type flux with 0.0% percentage halide by weight **shall** be used for pre-plated product with bare edges for Dip Coat test method.

5.2.1.4 FLUX TYPE ROH0 (HIGH FLUX/FLUX RESIDUE ACTIVITY)

ROH0 type flux with 0.0% percentage halide by weight **shall not** be used unless specified.

5.2.2 FLUX REMOVAL SOLVENT

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

5.2.3 SOLDER

Solder **shall** conform to **IPC/EIA/JEDEC J-STD-006**.

Solder paste **shall** conform to **IPC/EIA/JEDEC J-STD-005** having a mesh size of –325/+500 and a flux type of ROL1. The solder paste **shall** meet the storage and shelf life requirements of the manufacturer's specification.

Except where otherwise indicated, the component elements in each alloy **shall not** deviate by more then 0.20% of the alloy mass when their nominal percentage is equal to or less than 5.0% or by more than 0.50% when their nominal percentage is greater than 5.0%.

5.2.3.1 TIN LEAD ALLOY COMPOSITION

The tin lead alloy solder **shall** conform to composition Sn60Pb40 or Sn63Pb37.

The composition of the solder including contamination levels **shall** be maintained during the testing.

	Tin Lead Alloy	Sn60Pb40 or Sn63Pb37
Maximum Contaminant Weight Percentage (wt %) Limit	Copper (Cu)	Not Applicable
	Gold (Au)	0.200
	Cadmium (Cd)	0.005
	Zinc (Zn)	0.005
	Aluminum (Al)	0.006
	Antimony (Sb)	0.500
	Iron (Fe)	0.020
	Arsenic (As)	0.030
	Bismuth (Bi)	0.250
	Silver (Ag)	Not Applicable
	Nickel (Ni)	0.010
	Lead (Pb)	0.100
	Sum total of the Aluminum, Copper, Gold, Cadmium and Zinc	0.400

5.2.3.2 LEAD FREE ALLOY COMPOSITION

The lead free alloy solder **shall** conform to 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. %.

The composition of the solder including contamination levels **shall** be maintained during the testing.

	Lead Free Alloy	Sn95.5Ag3.9Cu0.6
Maximum Contaminant Weight Percentage (wt %) Limit	Copper (Cu)	0.300
	Gold (Au)	0.200
	Cadmium (Cd)	0.005
	Zinc (Zn)	0.005
	Aluminum (Al)	0.006
	Antimony (Sb)	0.500
	Iron (Fe)	0.020
	Arsenic (As)	0.030
	Bismuth (Bi)	0.250
	Silver (Ag)	0.100
	Nickel (Ni)	0.010
	Lead (Pb)	Not Applicable
	Sum total of the Aluminum, Copper, Gold, Cadmium and Zinc	0.400

5.2.4 TEST BOARDS

The test printed circuit boards **shall** meet the requirements per **IPC-6013**. Test Boards **should** be glass epoxy FR4 without copper cladding.

5.3 PROCEDURE

5.3.1 SPECIMENS

The test procedure **shall** be performed on a number of specimen terminations. The specimens **shall** be representative of current production product available for sale.

5.3.2 PREPARATION OF TERMINATIONS

No wiping, cleaning, scraping or abrasive cleaning **shall** be performed. During handling, care **shall** be exercised to prevent the surface to be tested from being contaminated by grease, perspirants, etc. Any special preparation of the terminations, such as bending or re-orientation prior to the test, **shall** be specified.

5.3.3 AGING

5.3.3.1 STEAM

Prior to the application of flux and subsequent solder dips, specimens assigned to Categories 2 or 3 **shall** be subjected to aging exposure of the surfaces to steam in the container specified in 5.1.1. The specimens shall be suspended so that no portion of the specimen is less than 38mm (1.5 inches) above the boiling distilled water with the cover specified in 5.1.1. See Table 1 for categories and duration of steam exposure. If necessary, additional hot distilled water **shall** be gradually added in small quantities so that the water will continue to boil and the temperature will remain essentially constant.

5.3.3.2 DRY HEAT

Prior to the application of flux and subsequent solder dips, specimens assigned to Category 4 **shall** be subjected to aging exposure in at 155 ± 5° C dry heat. See Table 1 for duration of dry heat exposure.

TABLE 1: AGING CATEGORIES FOR COMPONENT LEADS AND TERMINATIONS	
CATEGORY	**REQUIREMENTS**
1	**No Steam Aging Requirements.** (Minimum Coating Durability) Intended for surfaces which will be soldered within a short period of time (e.g. up to 6 months) from the time of testing and are likely to experience a minimum of thermal exposures prior to soldering (see Note below).
2	**1 Hour ± 5 Minutes Steam Aging** Typical Coating Durability (for non-tin and non-tin lead finishes) Intended for surfaces finished with other than Lead free or Sn/Pb coatings which will be soldered after an extended time from the time of testing and which may see limited thermal exposures prior to soldering (see Note below).
3	**8 Hours ± 15 Minutes Steam Aging** Typical Coating Durability (default for tin and tin-lead finishes) Intended for surfaces finished with Lead Free or Sn/Pb coatings which will be soldered after an extended storage (e.g. greater than 4 months) from the time of testing and/or which see multiple thermal exposures prior to soldering (see Note below).
4	**16 Hours ± 15 Minutes Dry Heat** Intended for surfaces finished with Sn or Sn/Pb coatings which will be soldered after an extended time from the time of testing and which may see limited thermal exposure prior to soldering.

NOTE:

The accelerated steam aging of solderable coatings has been, and continues to be, the subject of intense investigation. Compared to other aging methods, steam aging satisfactorily accelerates the degradation of tin and tin/lead surfaces in a manner similar to natural aging. The degradation mechanisms of surface oxidation and Cu-Sn intermetallic growth are both enhanced by the heat and humidity of steam. Properly applied tin and tin-lead coatings can withstand the steam aging environment well beyond the 8 hours specified and may survive natural aging well beyond 12 months. Due to the combined effects of specific geometry, storage environment, and material systems, it is not possible to accurately predict storage life. As a result, this specification indicates a storage life overlap for coating durability Category 1 and Category 3, and an open-ended limit for coating durability Category 3. For coatings other than tin or tin-lead, Category 2 data does not exist to support steam aging longer than the 1-hour specified.

Humidity aged samples experience a primary aging mechanism of both oxidation of the Sn/Pb surface and $Cu_6 Sn_5$ intermetallic growth. The primary aging mechanism for dry aged samples tends to be only intermetallic growth.

5.3.4 SOLDERABILITY – DIP COATED

5.3.4.1 FLUX APPLICATION

Flux type ROL1 or ROM0 **shall** be used as specified in 5.2.1. Specimens **shall** be immersed in the flux that is at room ambient temperature, to the minimum depth necessary to cover the surface to be tested. The specimens **shall** be immersed in the flux for a period of 5 to 10 seconds.

5.3.4.2 SPECIMEN IMMERSION

The dross and burned flux **shall** be skimmed from the surface of the molten solder as specified in 5.2.3 (may not require a separate operation in wave flow pots). The molten solder **shall** be maintained at a uniform temperature of:

Tin Lead Alloy	230 °C ± 5 °C
Lead Free Alloy	245 °C ± 5 °C

The surface of the molten solder **shall** be skimmed again just prior to immersing the specimens in the solder. The parts **shall** be attached to a dipping device (see 5.1.2 or 5.1.9) and the flux-covered specimen immersed ONCE in molten solder to the same depth.

The immersion and removal rates **shall** be 25 ± 6mm/sec (1 ± .25 inch per second) and the dwell time in the solder bath **shall** be 5 ± 0.5 seconds, unless otherwise specified. After the dipping process, the part **shall** be allowed to cool in air. Residual flux **shall** be removed from the specimen by rinsing in isopropyl alcohol or other suitable solution, see 5.2.2. If necessary, a soft damp cloth or cotton swab moistened with clean 91% isopropyl alcohol or suitable solution **shall** be used to remove all remaining flux.

5.3.4.3 EXAMINATION OF SPECIMENS

After testing, the entire specimen **shall** be examined using a magnification between 10X and 20X in the critical solder area, per **EIA-364 TP 18**. See 5.4.1.

5.3.5 SOLDERABILITY – PROCESS SIMULATION

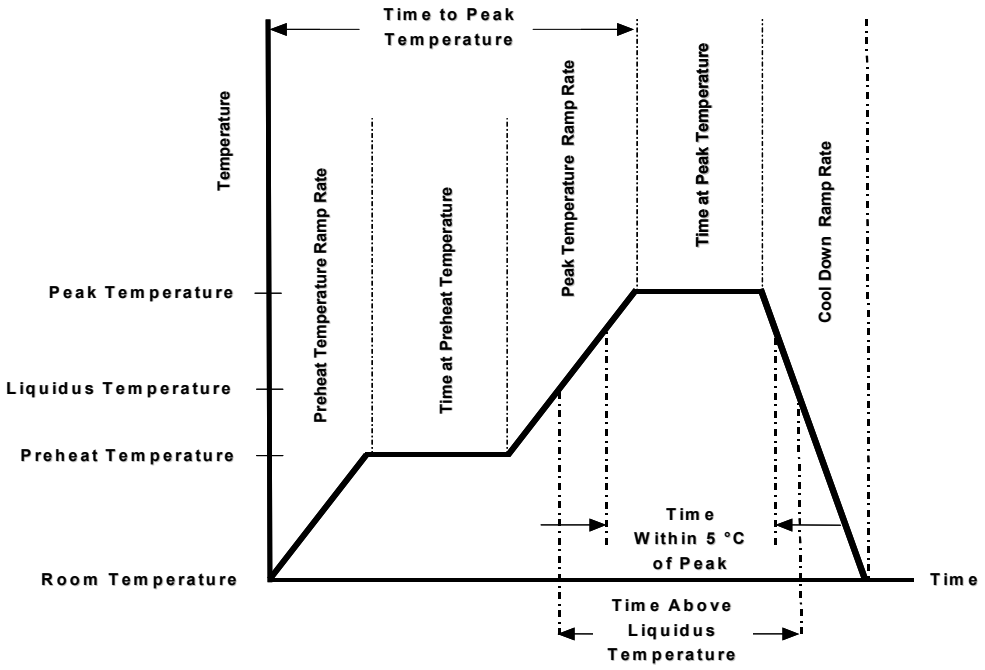
5.3.5.1 PASTE PRINTING

Solder paste **shall** be applied using the appropriate stencil or screen and the stencil or screen **shall** be carefully removed to avoid smearing of the paste print. The print paste geometry **shall** be verified to the PC Board footprint dimensional requirements of the specimen under test.

5.3.5.2 PLACEMENT OF SPECIMEN

The specimen **shall** be placed on the solder print paste using suitable tools to prevent contamination and assure alignment. The proper placement of the specimen on the solder print paste **shall** be verified prior to solder reflow processing.

5.3.5.3 PROCESS TIME AND TEMPERATURE PROFILE



TIN LEAD ALLOY

DESCRIPTION	REQUIREMENT
Solder Type	60 Sn 40Pb or 63 Sn 37Pb
Solder Flux Type	ROL1
Past Flux Type	ROL1
Average Ramp Rate	3 °C/second maximum
Preheat Temperature	150 °C minimum; 200 °C maximum
Preheat Time	60 to 180 seconds
Ramp to Peak	3 °C/second maximum
Time over Liquidus (183 °C)	60 to 150 seconds
Peak Temperature	230 °C +0/-5 °C @ PCB
Time within 5 °C of peak	20 to 40 seconds
Ramp – Cool Down	6 °C/second maximum
Time 25 °C to Peak	8 minutes maximum

LEAD FREE ALLOY

DESCRIPTION	REQUIREMENT
Solder Type	Sn 95.5 Ag 3.9Cu 0.6
Solder Flux Type	ROL0 or ROL1
Paste Flux Type	ROL1
Average Preheat Ramp Rate	3 °C/second maximum
Preheat Temperature	150 °C minimum; 200 °C maximum
Preheat Time	60 to 180 seconds
Ramp to Peak	3 °C/second maximum
Time over Liquidus (217 °C)	60 to 150 seconds
Peak Temperature	245 °C +0/-5 °C @ PCB
Time within 5 °C of peak	20 to 40 seconds
Ramp – Cool Down	6 °C/second maximum
Time 25 °C to Peak	8 minutes maximum

5.4 FAILURE CRITERIA

5.4.1 SOLDERABILITY – DIP COATED METHOD

The criteria for acceptable solderability of the specimen are:

a. The total surface area of the dipped part of the specimen **shall** be at least 95% wetted.

b. That pinholes, voids, porosity, nonwetting or dewetting **shall** not be concentrated in one area and do not exceed 5% of the total metallized area. In case of dispute, the percentage of coverage with pinholes or voids **shall** be determined by actual measurement of these areas, as compared to the total area.

c. That there **shall** be no solder bridging between any metallized area and any other metallized area not connected to it by design. In the event that the solder dipping has caused bridging, the test **shall** be considered a failure provided that a local application of heat (i.e. gas, soldering iron or redipping) results in solder pullback and no wetting of the dielectric area as indicated by microscope examinations at a magnification of between 10X and 20X. The area of the surface to be tested as specified in 5.3.4 **shall** include all sides of the specimen surface.

d. New solder **shall** not be easily lifted nor peeled from the surface of the tested specimen with a razor blade.

5.4.2 SOLDERABILITY – DIP COATED METHOD BY MENISCOGRAPH

The criteria for acceptable solderability using the Meniscograph has not been established. This method **should** be used for evaluation only.

The criteria for acceptable solderability during evaluation of the recordings are subject to much debate. Possible interpretations of the Meniscograph Curves are shown in figure 1.

Visual inspection **shall** be used in conjunction with the meniscograph or **shall** only be used if the meniscograph wetting curve was not generated, see figures 2 through 6.

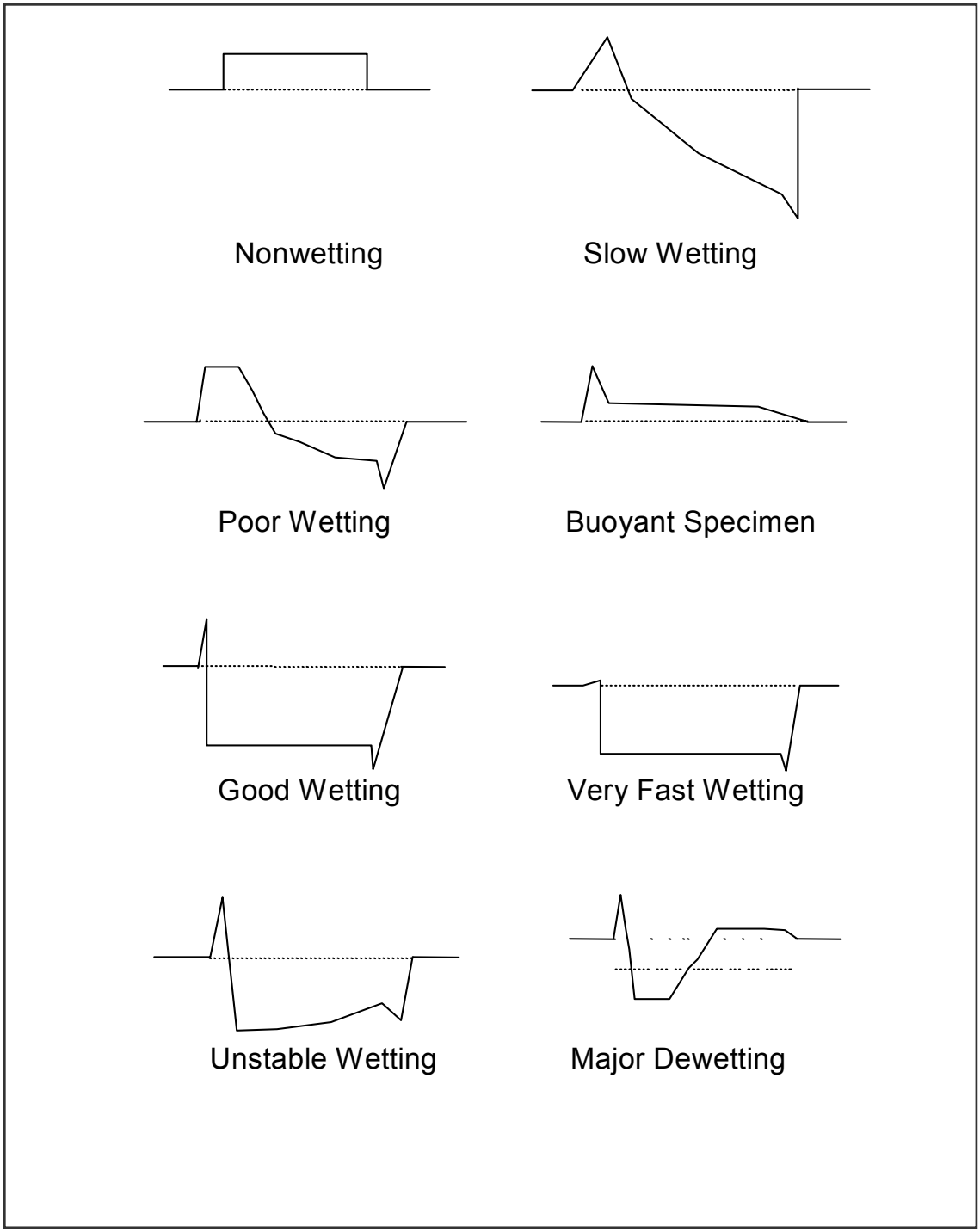


FIGURE 1: TYPICAL WETTING CURVES

5.4.3 PROCESS SIMULATION

The criteria for acceptable solderability using Process Simulation has not been established. This method **should** be used for evaluation only due to the significant process and product application variable type.

6.0 DETAILS TO BE SPECIFIED

6.1 DIP COATED METHOD

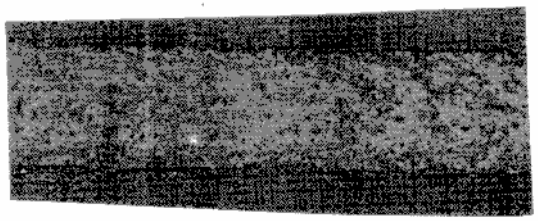
The following information **should** be specified in the test report:

- Material Number, description, Sales Drawing Number and Revision
- Evaluation Method: (Dip and Look or Meniscograph)
- Aging Category: (if other than Category 1)
- Solder used: (Tin Lead alloy or Lead Free alloy composition)
- Flux type used: (if other than ROL0 or ROM0)
- Immersion Time in Solder: (if other than 5.0 ± 0.5 seconds)
- Solder Temperature: (if other than 245° ± 5° C)
- Area of Examination:
- Number of Terminations of Each Specimen Evaluated:
- Pass/Fail Criteria: (if other than specifications listed in 5.4.1 or 5.4.2)
- Test Results

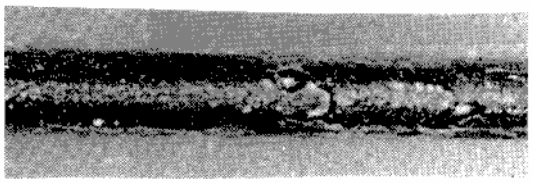
6.2 PROCESS SIMULATION METHOD

The following information **should** be specified in the test report:

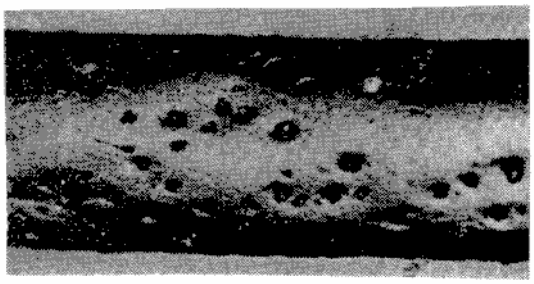
- Material Number, description, Sales Drawing Number and Revision
- Evaluation Method: (IR or Convection or Storage Oven)
- Aging Category: (if other than category 1)
- Solder used: (Tin Lead alloy or Lead Free alloy composition)
- Flux type used: (if other than ROL0 or ROL1)
- Process Equipment
- Process Time and Temperature Profile: (If other than specifications listed in 5.3.5.3)
- Area of Examination:
- Number of Terminations of Each Specimen Evaluated:
- Pass/Fail Criteria: (if other than specifications listed in 5.4.3)
- Test Results



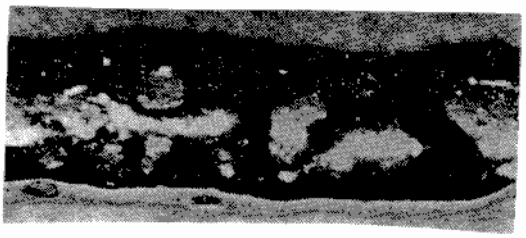
POROSITY
FIGURE 2



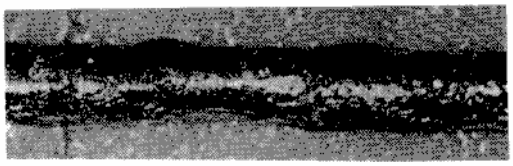
NON-WETTING
FIGURE 3



PINHOLES
FIGURE 4



DEWETTING
FIGURE 5



FOREIGN MATTER
FIGURE 6

APPENDIX

COMPARISON OF SOLDERABILITY METHODS

Dip Coated Comparison		
Description	**SMES-152 Solderability Rev. D**	
Solder Type	Tin Lead Alloy Sn60Pb40 or Sn63Pb37 J-STD-006	Lead FreeAlloy Sn95.5Ag3.9Cu0.6 J-STD-006
Solder Process	None	None
Flux Type	Type ROL1 (Optional: ROM0) J-STD-004	Type ROL0 J-STD-004
Flux Dwell	5-10 seconds	5-10 seconds
Flux Drain	5-20 seconds	10-20 seconds
Solder Temperature	230° ± 5° C	245° ± 5°C
Solder Dwell	5.0 ± 0.5 seconds	5.0 ± 0.5 seconds
Immersion Rate	25 ± 6 mm/sec	25 ± 6 mm/sec
Aging	Category1: None; Category 2: 1 hr ± 5 minutes; Category 3: 8 hr ± 15 minutes; Category 4: 16 hr dry heat	
Failure Criteria	95% minimum new coverage; 5% maximum pin holes and voids (not in one concentrated area)	
Rinse	Isopropyl alcohol or suitable flux removal solvent	

Dip Coated Comparison			
Description	**JEDEC JESD22-B102D Solderability Revision SEP 2004**		
Solder Type	Tin Lead Alloy Sn60Pb40 Or Sn63Pb37 J-STD-006	Tin Lead Alloy Sn60Pb40 Or Sn63Pb37 J-STD-006	Lead FreeAlloy Sn95.5Ag3.9Cu0.6 J-STD-006
Solder Process	Wave Soldering	Reflow Soldering	Wave and Reflow Soldering
Flux Type	Type ROL1 J-STD-004	Type ROL1 J-STD-004	Type ROL1 J-STD-004
Flux Dwell	5-10 seconds	5-10 seconds	5-10 seconds
Flux Drain	5-20 seconds	5-20 seconds	5-20 seconds
Solder Temperature	245° ± 5°C	215° ± 5°	245° ± 5°C
Solder Dwell	5.0 ± 0.5 seconds	5.0 ± 0.5 seconds	5.0 ± 0.5 seconds
Immersion Rate	25.4 ± 6.4 mm/sec	25.4 ± 6.4 mm/sec	25.4 ± 6.4 mm/sec
Aging	Category A: Steam 1 hr ± 5 minutes; Category B: Steam 4 hr ± 10 minutes; Category C: Steam 8 hr ± 15 minutes; Category C: Steam 16 hr ± 30 minutes; Category E: Dry Bake 16 hr ± 0.5 hr at 150 °C ± 5 °C		
Failure Criteria	95% minimum new coverage (pin holes acceptable but not concentrated in an area); 5% maximum area acceptable for pin holes, dewetting, and nonwetting		
Rinse	Suitable flux removal solvent		

Dip Coated Comparison				
Description	**MIL-STD-202 Method 208 Rev. G 93/7/12**	**IPC/EIA/JEDEC J-STD-002B Rev. FEB 2003**	**IEC-68-2-20 Solderability Rev. 1992**	**ASTM B-678-86 Solderability Rev. 2001**
Solder Type	Sn60 or Sn63 Type S Fed Spec QQ-S-571	Sn60Pb40 or Sn63Pb37 J-STD-006	Tin Lead Alloy 60 ± 1% Sn (Contaminant list)	Tin Lead Alloy 60% Sn / 40% Pb (Alloy grade 60A)
Solder Process	None	None	None	None
Flux Type	Type R MIL-F-14256 (RMA optional)	Type ROL1 per J-STD-004	25% Rosin in 75% Isopropanol (or ethyl alcohol); non-activated flux (up to 0.5% chloride added).	25±5% WW rosin in 99% Isopropyl alcohol (mildly activated if specified)
Flux Dwell	5-10 seconds	5-10 seconds	Not specified	Not specified
Flux Drain	10-60 seconds	5-20 seconds	60 ± 5 seconds	30-60 seconds
Solder Temperature	245° ± 5°C	245° ± 5°C	230° ± 5°C	245° ± 5°C
Solder Dwell	5.0 ± 0.5 seconds or 7.0 ± 0.5 seconds	5.0 +0/-0.5 seconds	2.0 ± 0.5 seconds or 5.0 ± 0.5 seconds (or longer based on thermal capacity)	5.0 ± 0.5 seconds
Immersion Rate	25 ± 5 mm/sec	25 ± 6 mm/sec	25 ± 2.5 mm/sec	25 ± 5 mm/sec
Aging	8.0 ± 0.5 hr	Category 1:None; Category 2: 1 hr ± 5 minutes; Category 3: 8 hr ± 15 minutes; Category 4: N/A	Category 1: None; Category 1a: 1 hr; Category 1b: 4 hr; Category 2: 10day SS humidity; Category 3: 16hr dry heat;	24 hr
Failure Criteria	5% maximum dewetted, nonwetted, or with pin holes	95% minimum new coverage; anomalies other than pin holes, dewetting, and nonwetting are not cause for rejection	Smooth and bright solder with no more than small amounts of pin holes, nonwetted, or dewetted areas (not in one concentrated area)	Adherent, bright, smooth, and uniform over 95% minimum tested area; 5% may contain pin holes, dewetted areas, and roughness
Rinse	Isopropyl alcohol	Isopropyl alcohol (Note on MSDS)	Isopropanol (or ethyl alcohol)	Isopropyl alcohol

Dip Coated Comparison			
Description	**MIL-STD-883D Method 2003.7 JUN 01 1993**	**JIS-C-0050 Solderability Rev. APR 1992**	**EIA-364 TP-52A Solderability Rev. MAR 2003**
Solder Type	Tin Lead Alloy Sn60 or Sn63 Type S Fed Spec QQ-S-571	Tin Lead Alloy 60 ± 1% Sn contaminant list (H60A, H60S, H63A JIS-Z-3282)	Tin Lead Alloy 60/40 ± 5% SnPb
Solder Process	None	None	None
Flux Type	Type R MIL-F-14256 (RMA optional)	25% Rosin in 75% Isopropanol (or ethyl alcohol); non-activated flux (up to 0.5% chloride added).	25% WW rosin in 99% Isopropyl alcohol with a specific gravity of 0.843 ± 0.005: Class 1: Type ROL0; Class 2:Type ROM0; Class 3: Type ROH0
Flux Dwell	5-10 seconds	Not specified	5-10 seconds
Flux Drain	10-60 seconds	60 ± 5 seconds	5-20 seconds
Solder Temperature	245° ± 5°C	235° ± 5°C	245° ± 5°C
Solder Dwell	5.0 ± 0.5 seconds or 7.0 ± 0.5 seconds	2.0 ± 0.5 seconds or 5 ± 0.5 seconds (or longer based on thermal capacity)	4-5 seconds
Immersion Rate	25 ± 5 mm/sec	25 ± 2.5 mm/sec	25 ± 6 mm/sec
Aging	8.0 ± 0.5 hr	Category 1: None; Category 1a: 1 hr; Category 1b: 4 hr; Category 2: 10day SS humidity; Category 3: 16hr dry heat;	Category 1: None; Category 2: 1 hr ± 5 minutes; Category 3: 8 hr ± 15 minutes; Category 4: 16 hr ± 1hr
Failure Criteria	5% maximum dewetted, nonwetted, or with pin holes	Smooth and bright with no more than a small amount of pin holes, nonwetted, or dewetted areas not concentrated in one area	95% minimum new coverage (pin holes acceptable but not concentrated in an area); 5% maximum area acceptable for pin holes, dewetting, and nonwetting
Rinse	Isopropyl alcohol	Isopropanol (or ethyl alcohol)	Isopropyl alcohol

Process Simulation Comparison Table					
Description	**SMES 152 Solderability Rev. D.**		**JEDEC JESD22-B102D Solderability Revision SEP 2004**		
Solder Type	Tin Lead Alloy Sn60Pb40 or Sn63Pb37 J-STD-006	Lead FreeAlloy Sn95.5Ag3.9Cu0.6 J-STD-006	Tin Lead Alloy Sn60Pb40 or Sn63Pb37 J-STD-006		Lead FreeAlloy Sn95.5Ag3.9Cu0.6 J-STD-006
Flux Type	Type ROL1 J-STD-004	Type ROL1 J-STD-004	Type ROL1 J-STD-004		Type ROL1 J-STD-004
Reflow Process	Convection / IR Oven		Storage Oven	Convection / IR Oven	
Preheat Temperature (°C)	150-200	150–200	None	150-170	160–180
Preheat Time	60 ± 180 seconds		None	60 ± 10 seconds	
Reflow Temperature (°C)	225–230	240–245	215–230	215–230	230–245
Reflow Time	60 ± 150 seconds		2-5 min (Until reflow is achieved)	60 ± 10 seconds	
Aging	Category 1: None; Category 2: Steam 1 hr ± 5 minutes; Category 3: Steam 8 hr ± 15 minutes; Category 4: Dry Heat 16 hr ± 1hr at 155 °C ± 5 °C		Category A: Steam 1 hr ± 5 minutes; Category B: Steam 4 hr ± 10 minutes; Category C: Steam 8 hr ± 15 minutes; Category C: Steam 16 hr ± 30 minutes; Category E: Dry Bake 16 hr ± 0.5 hr at 150 °C ± 5 °C		
Failure Criteria	95% minimum new coverage; cooling pin holes, voids, porosity, nonwetting, or dewetting 5% maximum total area		95% minimum new coverage; cooling pin holes, voids, porosity, nonwetting, or dewetting 5% maximum total area		
Rinse	Isopropyl alcohol or suitable flux removal		Suitable flux removal solvent		