



ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES®



IPC/ECA J-STD-002C

Solderability Tests for Component Leads, Terminations, Lugs, Terminals and Wires

A joint standard developed by IPC Component and Wire Solderability Specification Task Group (5-23b) of the Assembly and Joining Processes Committee (5-20) and the Electronic Components, Assemblies and Materials Association (ECA) Soldering Technology Committee (STC)

Supersedes:

J-STD-002B - February 2003
J-STD-002A - October 1998
J-STD-002 - April 1992

Users of this publication are encouraged to participate in the development of future revisions.

Contact:

ECA

2500 Wilson Boulevard
Arlington, VA 22201
Phone (703) 907-8024
Fax (703) 875-8908

IPC

3000 Lakeside Drive, Suite 309S
Bannockburn, IL 60015-1249
Phone (847) 615-7100
Fax (847) 615-7105

Table of Contents

1 SCOPE	1	4 TEST PROCEDURES	6
1.1 Scope	1	4.1 Application of Flux	6
1.2 Purpose	1	4.2 Visual Acceptance Criteria Tests	8
1.2.1 Shall and Should	1	4.2.1 Test A – Tin/Lead Solder – Solder Bath/Dip and Look Test (Leads, Wires, etc.)	8
1.2.2 Document Hierarchy	1	4.2.1.1 Apparatus	8
1.3 Method Classification	1	4.2.1.1.1 Solder Pot/Bath	8
1.3.1 Visual Acceptance Criteria Tests	1	4.2.1.1.2 Dipping Device	8
1.3.2 Force Measurement Tests	1	4.2.1.2 Preparation	8
1.4 Coating Durability	2	4.2.1.3 Procedure	8
1.5 Referee Verification Solder Dip for Tests A, B, C, A1, B1, C1	2	4.2.1.4 Evaluation	8
1.6 Limitations	2	4.2.1.4.1 Magnification	8
1.7 Contractual Agreement	2	4.2.1.4.2 Accept/Reject Criteria	9
2 APPLICABLE DOCUMENTS	2	4.2.2 Test B – Tin/Lead Solder – Solder Bath/Dip and Look Test (Leadless Components)	10
2.1 Industry	2	4.2.2.1 Apparatus	10
2.1.1 IPC	2	4.2.2.1.1 Solder Pot/Bath	10
2.1.2 International Electrotechnical Commission	2	4.2.2.1.2 Vertical Dipping Device	10
2.2 Government	2	4.2.2.2 Preparation	10
2.2.1 Federal	2	4.2.2.3 Procedure	10
3 REQUIREMENTS	2	4.2.2.4 Evaluation	10
3.1 Terms and Definitions	2	4.2.2.4.1 Magnification	10
3.2 Materials	3	4.2.2.4.2 Accept/Reject Criteria	10
3.2.1 Solder	3	4.2.3 Test C – Tin/Lead Solder – Wrapped Wires Test (Lugs, Tabs, Terminals, Large Stranded Wires)	11
3.2.2 Flux	3	4.2.3.1 Apparatus	11
3.2.2.1 Flux Maintenance	3	4.2.3.1.1 Solder Pot/Bath	11
3.2.3 Flux Removal	3	4.2.3.1.2 Dipping Device	11
3.2.4 Standard Copper Wrapping Wires	3	4.2.3.2 Preparation	11
3.2.5 Water	4	4.2.3.3 Procedure	11
3.3 Equipment	4	4.2.3.4 Evaluation	12
3.3.1 Steam Conditioning Apparatus	4	4.2.3.4.1 Magnification	12
3.3.2 Solder Vessel	4	4.2.3.4.2 Accept/Reject Criteria	12
3.3.3 Optical Inspection Equipment	4	4.2.4 Test D – Tin/Lead or Lead-Free Solder – Resis- tance to Dissolution of Metallization Test	13
3.3.3.1 Referee Magnification	5	4.2.4.1 Apparatus	13
3.3.4 Dipping Equipment	5	4.2.4.1.1 Solder Pot/Bath	13
3.3.5 Timing Equipment	5	4.2.4.1.2 Dipping Device	13
3.4 Preparation for Testing	5	4.2.4.1.3 Attitude (Angle of Immersion)	13
3.4.1 Specimen Preparation and Surface Condition	5	4.2.4.2 Preparation	13
3.4.1.1 Steam Conditioning Categories	5	4.2.4.3 Procedure	13
3.4.2 Steam Conditioning	5	4.2.4.4 Evaluation	13
3.4.2.1 Post Conditioning Drying	6	4.2.4.4.1 Magnification	13
3.4.2.2 Equipment Maintenance	6	4.2.4.4.2 Accept/Reject Criteria	13
3.4.3 Surfaces to be Tested	6	4.2.5 Test S – Tin/Lead Solder – Surface Mount Process Simulation Test	14
3.5 Solder Bath Requirements	6	4.2.5.1 Apparatus	14
3.5.1 Solder Temperatures	6		
3.5.2 Solder Contamination Control	6		

4.2.5.1.1 Stencil/Screen	14	4.2.9.4.1 Magnification	18
4.2.5.1.2 Paste Application Tool	14	4.2.9.4.2 Accept/Reject Criteria	18
4.2.5.1.3 Test Substrate	14	4.3 Force Measurement Tests	19
4.2.5.1.4 Tin/lead Reflow Equipment	14	4.3.1 Test E – Tin/Lead Solder – Wetting Balance Solder Pot Test (Leaded Components)	19
4.2.5.2 Preparation	14	4.3.1.1 Apparatus	19
4.2.5.3 Procedure	14	4.3.1.1.1 Dipping Device	19
4.2.5.4 Evaluation	14	4.3.1.2 Preparation	19
4.2.5.4.1 Magnification	14	4.3.1.3 Procedure	19
4.2.5.4.2 Accept/Reject Criteria	14	4.3.1.4 Evaluation	19
4.2.6 Test A1 – Lead-free Solder – Solder Bath/Dip and Look Test (Leads, Wires, etc.)	15	4.3.1.4.1 Magnification	19
4.2.6.1 Apparatus	15	4.3.1.4.2 Accept/Reject Criteria	19
4.2.6.1.1 Solder Pot/Bath	15	4.3.2 Test F – Tin/Lead Solder – Wetting Balance Solder Pot Test (Leadless Components)	22
4.2.6.1.2 Dipping Device	15	4.3.2.1 Apparatus	22
4.2.6.2 Preparation	15	4.3.2.1.1 Dipping Device	22
4.2.6.3 Procedure	15	4.3.2.2 Preparation	22
4.2.6.4 Evaluation	15	4.3.2.3 Procedure	22
4.2.6.4.1 Magnification	15	4.3.2.4 Evaluation	22
4.2.6.4.2 Accept/Reject Criteria	15	4.3.2.4.1 Magnification	22
4.2.7 Test B1 – Lead-free Solder – Solder Bath/Dip and Look Test (Leadless Components)	16	4.3.2.4.2 Accept/Reject Criteria	22
4.2.7.1 Apparatus	16	4.3.3 Test G – Tin/Lead Solder – Wetting Balance Globule Test	23
4.2.7.1.1 Solder Pot/Bath	16	4.3.3.1 Apparatus	23
4.2.7.1.2 Vertical Dipping Device	16	4.3.3.1.1 Dipping Device	23
4.2.7.2 Preparation	16	4.3.3.2 Materials	23
4.2.7.3 Procedure	16	4.3.3.2.1 Flux	23
4.2.7.4 Evaluation	16	4.3.3.2.2 Solder	23
4.2.7.4.1 Magnification	16	4.3.3.2.3 Test Specimen	23
4.2.7.4.2 Accept/Reject Criteria	16	4.3.3.3 Procedure	23
4.2.8 Test C1 – Lead-free Solder – Wrapped Wires Test (Lugs, Tabs, Terminals, Large Stranded Wires)	17	4.3.3.3.1 Temperature of the Solder	23
4.2.8.1 Apparatus	17	4.3.3.3.2 Fluxing	23
4.2.8.1.1 Solder Pot/Bath	17	4.3.3.3.3 Dipping Angle, Immersion Depth, and Immersion Rates	23
4.2.8.1.2 Dipping Device	17	4.3.3.3.4 Preheat	23
4.2.8.2 Preparation	17	4.3.3.4 Evaluation	23
4.2.8.3 Procedure	17	4.3.3.4.1 Magnification	23
4.2.8.4 Evaluation	17	4.3.3.4.2 Suggested Criteria	23
4.2.8.4.1 Magnification	17	4.3.4 Test E1 – Lead-free Solder – Wetting Balance Solder Pot Test (Leaded Components)	26
4.2.8.4.2 Accept/Reject Criteria	17	4.3.4.1 Apparatus	26
4.2.9 Test S1 – Lead-free Solder – Surface Mount Process Simulation Test	18	4.3.4.1.1 Dipping Device	26
4.2.9.1 Apparatus	18	4.3.4.2 Preparation	26
4.2.9.1.1 Stencil/Screen	18	4.3.4.3 Procedure	26
4.2.9.1.2 Paste Application Tool	18	4.3.4.4 Evaluation	26
4.2.9.1.3 Test Substrate	18	4.3.4.4.1 Magnification	26
4.2.9.1.4 Lead-Free Reflow Equipment	18	4.3.4.4.2 Accept/Reject Criteria	26
4.2.9.2 Preparation	18	4.3.5 Test F1 – Lead-free Solder – Wetting Balance Solder Pot Test (Leadless Components)	27
4.2.9.3 Procedure	18	4.3.5.1 Apparatus	27
4.2.9.4 Evaluation	18	4.3.5.1.1 Dipping Device	27

4.3.5.2	Preparation	27	Figure 4-5	Illustration of Acceptable Solderable Terminal	11
4.3.5.3	Procedure	27	Figure 4-6	Illustration of Unsolderable Terminal	11
4.3.5.4	Evaluation	27	Figure 4-7	Illustration of Acceptable Solderable Stranded Wire	11
4.3.5.4.1	Magnification	27	Figure 4-8	Illustration of Partially Solderable Stranded Wire Showing Incomplete Fillet	12
4.3.5.4.2	Accept/Reject Criteria	27	Figure 4-9	Wetting Balance Apparatus	19
4.3.6	Test G1 – Lead-free Solder – Wetting Balance Globule Test	28	Figure 4-10	Set A Wetting Curve	20
4.3.6.1	Apparatus	28	Figure 4-11	Set B Wetting Curve	21
4.3.6.1.1	Dipping Device	28	Figure 4-12	Component and Dipping Angle (Directly from IEC 60068-2-69)	25
4.3.6.2	Materials	28	Figure A-1	“J” Leded Components	30
4.3.6.2.1	Flux	28	Figure A-2	Passive Components	31
4.3.6.2.2	Solder	28	Figure A-3	Gull Wing Components	32
4.3.6.2.3	Test Specimen	28	Figure A-4	Leadless Chip Carrier	33
4.3.6.3	Procedure	28	Figure A-5	“L” Leded Components	34
4.3.6.3.1	Temperature of the Solder	28	Figure A-6	Through-Hole Components – Flat Pin	35
4.3.6.3.2	Fluxing	28	Figure A-7	Through-Hole Components – Round Pin	36
4.3.6.3.3	Dipping Angle, Immersion Depth, and Immersion Rates	28	Figure A-8	Exposed Pad Package	37
4.3.6.3.4	Preheat	28	Figure A-9	Bottom-Only Termination Component	37
4.3.6.4	Evaluation	28	Figure A-10	Area Array Component Critical Surface	38
4.3.6.4.1	Magnification	28	Figure B-1	Defect Size Aid	39
4.3.6.4.2	Suggested Criteria	28	Figure B-2	Types of Solderability Defects	40
5	NOTES	29	Figure B-3	Aids in Evaluation of 5% Allowable Area of Pin Holes	
5.1	Use of Activated Flux	29	Figure B-4	Aid in Evaluation of 5% Allowable Area of Pin Holes	
5.2	Massive Components	29	Figure B-5	Solderability Coverage Guide	43
5.3	Sampling Plans	29	Figure C-1	Lead Periphery and Volume for a 132 I/O PQFP	45
5.4	Safety Notes	29			
5.5	Correction for Buoyancy	29			
5.6	Accelerated Steam Conditioning Limitations	29			
Appendix A	.....	30			
Appendix B	.....	39			
Appendix C	.....	44			
Appendix D	.....	46			
Appendix E	.....	47			
Appendix F	.....	48			
Appendix G	.....	50			

Figures

Figure 3-1	Example Reticle	4
Figure 4-1	Dipping Schematic	8
Figure 4-2	Solder Dipping Angle for Surface Mount Leded Components	9
Figure 4-3	Solder Dipping Depth for Through-Hole Components	9
Figure 4-4	Leadless Component Immersion Depth	10

Tables

Table 1-1	Steam Conditioning Categories for Component Leads and Terminations	2
Table 3-1	Flux Compositions	3
Table 3-2	Steam Temperature Requirements	4
Table 3-3	Solderability Test Selection Component Type	5
Table 3-4	Maximum Limits of Solder Bath Contaminant ..	6
Table 4-1	Stencil Thickness Requirements	14
Table 4-2	Reflow Parameter Requirements	14
Table 4-3	Stencil Thickness Requirements	18
Table 4-4	Lead-free Reflow Parameter Requirements	18
Table 4-5	Wetting Balance Parameter and Suggested Evaluation Criteria	20
Table 4-6	Dipping Angle and Immersion Depth for Components (Directly from IEC 60068-2-69)	24
Table 4-7	Wetting Parameters and Suggested Evaluation Criteria	25
Table 3-1	Flux Compositions	48

Solderability Tests for Component Leads, Terminations, Lugs, Terminals and Wires

1 SCOPE

1.1 Scope This standard prescribes test methods, defect definitions, acceptance criteria, and illustrations for assessing the solderability of electronic component leads, terminations, solid wires, stranded wires, lugs, and tabs. This standard also includes a test method for the Resistance to Dissolution/Dewetting of Metallization. This standard is intended for use by both vendor and user.

1.2 Purpose Solderability evaluations are made to verify that the solderability of component leads and terminations meets the requirements established in this standard and to determine that storage has had no adverse effect on the ability to solder components to an interconnecting substrate. Determination of solderability can be made at the time of manufacture, at receipt of the components by the user, or just before assembly and soldering.

The resistance to dissolution of metallization determination is made to verify that metallized terminations will remain intact throughout the assembly soldering processes.

1.2.1 Shall and Should The word “**shall**” is used in the text of this document wherever there is a requirement for materials, preparation, process control or acceptance of a soldered connection or a test method. The word “**should**” reflects recommendations and is used to reflect general industry practices and procedures for guidance only.

1.2.2 Document Hierarchy In the event of conflict, the following decreasing order of precedence applies:

1. Procurement as agreed between user and supplier.
2. Master drawing or master assembly drawing reflecting the user’s detailed requirements.
3. When invoked by the customer or per contractual agreement, this document, J-STD-002.
4. Other documents to extent specified by the customer.

1.3 Method Classification This standard describes methods by which component leads or terminations may be evaluated for solderability. Test A, Test B, Test C, Test D and Test S for tin/lead solder processes and Test A1, Test B1, Test C1, Test D and Test S1 for lead-free solder processes, unless otherwise agreed upon between vendor and user, are to be used for each application as a default.

1.3.1 Visual Acceptance Criteria Tests

Test A – Solder Bath/Dip and Look Test (Leaded Components and Stranded Wires) Tin/Lead Solder (paragraph 4.2.1)

Test B – Solder Bath/Dip and Look Test (Leadless Components) Tin/Lead Solder (paragraph 4.2.2)

Test C – Wrapped Wires Test (Lugs, Tabs, Hooked Leads, and Turrets) Tin/Lead Solder (paragraph 4.2.3)

Test D – Resistance to Dissolution/Dewetting of Metallization Test Tin/Lead Solder and Lead-free Solder (paragraph 4.2.4)

Test S – Surface Mount Process Simulation Test Tin/Lead Solder (paragraph 4.2.5)

Test A1 – Solder Bath/Dip and Look Test (Leaded Components and Stranded Wires) Lead-free Solder (paragraph 4.2.6)

Test B1 – Solder Bath/Dip and Look Test (Leadless Components) Lead-free Solder (paragraph 4.2.7)

Test C1 – Wrapped Wires Test (Lugs, Tabs, Hooked Leads, and Turrets) Lead-free Solder (paragraph 4.2.8)

Test S1 – Surface Mount Process Simulation Test Lead-free Solder (paragraph 4.2.9)

1.3.2 Force Measurement Tests

Test E – Wetting Balance Solder Pot Test (Leaded Components) Tin/Lead Solder (paragraph 4.3.1)

Test F – Wetting Balance Solder Pot Test (Leadless Components) Tin/Lead Solder (paragraph 4.3.2)

Test G – Wetting Balance Globule Test Tin/Lead Solder (paragraph 4.3.3)

Test E1 – Wetting Balance Solder Pot Test (Leaded Components) Lead-free Solder (paragraph 4.3.4)

Test F1 – Wetting Balance Solder Pot Test (Leadless Components) Lead-free Solder (paragraph 4.3.5)

Test G1 – Wetting Balance Globule Test Lead-free Solder (paragraph 4.3.6)

These methods (1.3.2) are included for evaluation purposes only. Data collected should be submitted to the IPC Wetting Balance Task Group for correlation and analysis. Tests E, F, G, E1, F1 and G1 **shall** not be used for acceptance/rejection without user and vendor agreement.