



**IPC J-STD-003C-WAM1&2
with Amendments 1 & 2**

Solderability Tests for Printed Boards

Developed by the Printed Circuit Board Solderability Specifications Task Group (5-23a) of the Assembly and Joining Committee (5-20) of IPC

Supersedes:

J-STD-003C-WAM1 - May 2014
J-STD-003C - September 2013
J-STD-003B - March 2007
J-STD-003A - February 2003
J-STD-003 - April 1992
IPC-S-804A - January 1987
IPC-S-803
IPC-S-801

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

Contact:
IPC

Table of Contents

1 GENERAL	1	3.3.5 Timing Equipment	7
1.1 Scope	1	3.4 Preparation for Testing	7
1.2 Purpose	1	3.4.1 Test Specimen Preparation and Conditioning for Test	7
1.3 Objective	1	3.4.2 Pretest Conditioning	7
1.3.1 Definition of Requirements	1	3.4.3 Steam Preconditioning Apparatus	7
1.3.2 Document Hierarchy	1	3.4.4 Steam Conditioning	8
1.4 Classification	1	3.4.5 Baking	8
1.5 Test Method Classification	2	3.5 Solder Bath Requirements	8
1.5.1 Visual Acceptance Criteria Tests	2	3.5.1 Solder Temperatures	8
1.5.2 Force Measurement Criteria Tests	2	3.5.2 Solder Contamination Control	8
1.6 Test Method Selection	2	4 TEST PROCEDURES	9
1.6.1 New Surface Finishes Not Covered in 6010 or by 4500 Series Documents	2	4.1 Test Procedure Limitations	9
1.7 Test Specimen Requirements	2	4.1.1 Application of Flux	9
1.8 Coating Durability – SnPb Containing (HASL and Plated and Reflowed SnPb) Surface Finishes	3	4.1.2 Dwell Times	9
1.9 Coating Durability – Non-SnPb Surface Finishes	4	4.2 Tests with Established Accept/Reject Criteria ...	10
2 APPLICABLE DOCUMENTS	5	4.2.1 Edge Dip Test	10
2.1 Industry	5	4.2.2 Wave Solder Test:	13
2.1.1 IPC	5	4.2.3 Surface Mount Simulation Test	14
2.2 Joint Industry Standards	5	4.3 Tests with Force Measurement Criteria	15
3 REQUIREMENTS	5	4.3.1 Wetting Balance Test	15
3.1 Terms and Definitions	5	4.4 6010 Solder Float Test	19
3.1.1 Contact Angle, Soldering*	5	4.4.1 Solder Float Test Tin/Lead Solder	19
3.1.2 Dewetting*	5	4.4.2 Apparatus	19
3.1.3 Dissolution of Component Metallization (Leaching)*	5	4.4.3 Evaluation	19
3.1.4 Equilibrium Wetting	5	5 EVALUATION AIDS	20
3.1.5 Nonwetting, Solder*	5	5.1 Evaluation Aids – Surface	20
3.1.6 Pinhole*	5	5.2 Evaluation Aids – For Class 3 PTHs	21
3.1.7 Solderability*	5	6 NOTES	22
3.1.8 Solder Connection Pinhole*	5	6.1 Correction for Buoyancy	22
3.1.9 Wetting, Solder*	5	6.2 Preheat	22
3.2 Materials	6	6.3 Prebaking	22
3.2.1 Solder	6	6.4 Safety Note	22
3.2.2 Flux	6	6.5 Use of Nonactivated Flux	22
3.2.3 Flux Removal	6	6.6 Solder Contact	22
3.3 Equipment	6	APPENDIX A Calculation of Maximum Theoretical Force for a Rectangular Cross-Section	23
3.3.1 Pre-Conditioning Equipment	6	APPENDIX B Calculation of Area under the Wetting Curve	25
3.3.2 Solder Pot/Bath	6	APPENDIX C Informative Annex	26
3.3.3 Optical Inspection Equipment	7		
3.3.4 Dipping Equipment	7		

APPENDIX D Test Protocol for Wetting Balance Gauge Repeatability and Reproducibility (G R&R) Using Copper Foil Coupons 28

APPENDIX E J-STD-002/J-STD-003 Activated Solderability Test Flux Rationale Committee Letter 30

Figures

Figure 3-1 Contact Angle 5
 Figure 3-2 Example Reticle 7
 Figure 4-1 Edge Dip Solderability Test 10
 Figure 4-2 Legacy S-Coupon Test Specimen for PTHs 11
 Figure 4-3 New S-Coupon Layout (mm [in]) 11
 Figure 4-4 Suggested Test Specimen for Surface Mount Features 12
 Figure 4-5 Effectiveness of Solder Wetting of Plated-Through Holes – Class 3 below 3.0 mm 14
 Figure 4-6 Examples of Solder Wetting of PTHs – Class 3 below 3.0 mm 14
 Figure 4-7 Arrangement for the Test Apparatus (Solder Bath Wetting Balance Method) 16
 Figure 4-8 Arrangement for the Test Apparatus (Solder Globule Wetting Balance Method) 16
 Figure 4-9 Suggested Wetting Balance and Soldering Immersion Test Specimens 16
 Figure 4-10 Wetting Balance Test Soldering Immersion at 90° for Double Sided Finishes 17
 Figure 4-11 Wetting Balance Test Soldering Immersion at 20° to 40° for Single Sided Coupons/ Samples Removed from Printed Boards 17
 Figure 4-12 Set A Wetting Curve 18
 Figure 4-13 Set B Wetting Curve 18

Figure 5-1 I Sn Surface Finish Showing Uniform Wetting 20
 Figure 5-2 I Sn Surface Finish Showing Chronic Dewetting 20
 Figure 5-3 ENIG Exhibiting Nonwetting 20
 Figure 5-4 ENIG Exhibiting Nonwetting 20
 Figure 5-5 ENIG Exhibiting Dewetting 21
 Figure 5-6 ENIG Exhibiting Dewetting 21
 Figure 5-7 HASL Surface Finish after Wetting Balance Testing, showing Excellent Wetting and Positive Advancement of Solder 21

Tables

Table 1-1 Solderability Test Method Selection 3
 Table 1-2 Final Finish Conditioning/Stress Testing for Category 3/Category B Coating Durability 4
 Table 3-1 Flux Composition 6
 Table 3-2 Steam Temperature Requirements 7
 Table 3-3 Maximum Limits of Solder Bath Contaminant ... 9
 Table 4a Summary of Solder Float Dwell Times as Function of Printed Board Design Characteristics 10
 Table 4-1 Stencil Thickness Requirements 15
 Table 4-2 Reflow Parameter Requirements – SnPb 15
 Table 4-3 Lead-Free Reflow Parameter Requirements ... 15
 Table 4-4 Pass/Fail Criteria for Specific Surface Finishes Using Eutectic SnPb 17
 Table 4-5 Pass/Fail Criteria for Specific Surface Finishes Using SAC305 Solder 18
 Table 4-6 Wetting Balance Parameter and Suggested Criteria 18
 Table E-1 Flux Compositions 30

Solderability Tests for Printed Boards

1 GENERAL

1.1 Scope This standard prescribes test methods, defect definitions, and illustrations for assessing the solderability of printed wiring board surface conductors, attachment lands, and plated-through holes (PTHs). This standard is intended for use by both user and supplier.

This standard is not intended to verify the potential of successful processing at assembly or to evaluate design impact on wettability. This standard describes procedures or methods to determine the acceptable wettability of a surface finish. Wettability can be affected by handling, finish application, and environmental conditions.

1.2 Purpose This standard describes solderability determinations that are made to verify that the printed board fabrication processes and subsequent storage have had no adverse effect on the solderability of those portions of the printed board intended to be soldered. Reference coupons or representative portions of a printed board may be used. Solderability is determined by evaluation of a test specimen which has been processed as part of a panel of boards and subsequently removed for testing per the method selected.

1.3 Objective To provide solderability test methods to determine the acceptance of printed board surface conductors, attachment lands, and PTHs to wet easily with solder, and to withstand the rigors of the printed board assembly processes.

1.3.1 Definition of Requirements 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 “best processing techniques” and is used to reflect general industry practices and a suggestion for guidance only.

1.3.2 Document Hierarchy In the event of conflict, the following descending order of precedence applies:

- a. Procurement documentation AABUS, which should include expected shelf life requirements if stored and handled properly.
- b. Master drawing or master assembly drawing reflecting the user’s detailed requirements.
- c. When required by the customer or per contractual agreement, this document, J-STD-003.
- d. Other documents, to the extent specified by the customer.

1.4 Classification Three general classes have been established to reflect progressive increases in sophistication, functional performance requirements, and testing/ inspection frequency as defined in the IPC-6010 series of documents.

The user is responsible for defining the product class. The product class should be stated in the procurement documentation package.

CLASS 1 General Electronic Products

Includes products suitable for applications where the major requirement is function of the completed assembly.

CLASS 2 Dedicated Service Electronic Products

Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically, the end-use environment would not cause failures.

CLASS 3 High Performance Electronic Products

Includes products where continued high performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems.

Printed board performance classes do not dictate the surface finish durability rating that may be specified. Category 2/ Category A durability is the default coating durability rating.

This standard relies on input from the 4-14 plating process subcommittee and the 4500 series of printed board surface finish documents generated in that subcommittee to determine the durability rating potential for each specified finish. This document and the appropriate 4500 series document should be considered complimentary to one another.