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IPC-4553

Specification for Immersion Silver Plating for Printed Circuit Boards

Developed by the Plating Processes Subcommittee (4-14) of the
Fabrication Processes Committee (4-10) of IPC



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

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Table of Contents

1 SCOPE	1	APPENDIX 1 Chemical Definitions	7
1.1 Statement of Scope	1	APPENDIX 2 Process Sequence (Generic)	8
1.2 Description	1	APPENDIX 3 Qualification of IAg Process by the Board Supplier	9
1.3 Objective	1	APPENDIX 4 Standard Developments Efforts of Immersion Silver	10
1.4 Performance Functions	1	APPENDIX 5 X-Ray Fluorescence (XRF) Spectroscopy	25
1.4.1 Solderability	1		
1.4.2 Contact Surface	1		
1.4.2.1 Membrane Switches	1		
1.4.2.2 Metallic Dome Contacts	1		
1.4.3 EMI Shielding	1		
1.4.4 Aluminum Wire Bonding	1		
1.5 Definition of Terms	2		
2 APPLICABLE DOCUMENTS	2		
2.1 IPC	2		
2.2 Mil-Standards	2		
2.3 Telcordia™	2		
3 REQUIREMENTS	2		
3.1 Visual	2		
3.2 Finish Thickness	2		
3.2.1 Immersion Silver (IAg) Thickness	4		
3.3 Porosity	4		
3.4 Adhesion	4		
3.5 Solderability	5		
3.6 Cleanliness	5		
3.7 Electrochemical Migration Testing	5		
3.8 Packing and Storage	6		
3.9 Chemical Resistance	6		
3.10 High Frequency Signal Loss	6		
4 QUALITY ASSURANCE PROVISIONS	6		
4.1 Qualification	6		
4.1.1 Sample Test Coupons	6		
4.2 Acceptance Tests	6		
4.3 Quality Conformance Testing	6		
		Figures	
		Figure 3-1 Example of Uniform Plating	2
		Figure 3-2 Example of Staining of the Silver	3
		Figure 3-3 Another Example of Surface Staining	3
		Figure 3-4 Additional Staining Example	3
		Figure 3-5 Additional Staining Example	3
		Figure 3-6 IPC-2221 Test Speciman M, Surface Mount Solderability Testing, mm [in]	5
		Figure 3-7 Improper Packing or Storage Can Result in the Immersion Silver Corroding	6
		Figure 1 Immersion Silver Industry Survey Results	11
		Figure 2 Comparison of Thin Versus Thick Silver Solderability Performance Using Real Time Shelf Life	12
		Figure 3 XRF Results of Thin IAg Deposit	12
		Figure 4 XRF Results of Thick IAg Deposit	13
		Figure 5 Wetting Balance Coupon	13
		Figure 6 Supplied Immersion Silver Deposit for Wetting Balance Testing	14
		Figure 7 Solderability Performance Vendor A - Real Time Storage	15
		Figure 8 Solderability Performance Vendor D - Real Time Storage	15
		Figure 9 Solderability Performance Vendor E - Real Time Storage	16
		Figure 10 Comparison of Vendor D Protected vs Unprotected - Day 709	16
		Figure 11 Comparison of Vendor A Protected vs Unprotected - Day 763	17

Figure 12	Comparison of Vendor E Protected vs Unprotected - Day 709	17	Figure 17	Comb Test Pattern and UL Parallel Pattern Used for Testing	21
Figure 13	I _{Ag} Deposit Thickness for TM-650, 2.6.14.1, as Measured by "Micron X" XRF Unit	18	Figure 18	SIR Values for the Test at 96 Hours - 35°C/87.5% R.H. All Five I _{Ag} Suppliers' Data are Combined	21
Figure 13A	SEM Image of Vendor A's 3X Sample Confirming XRF Measurements	19	Figure 19	Resistance Values at 596 Hours - All Groups Included - Different Spaces/ Bias Voltages	22
Figure 14	Final Readings in Chamber of First Round of Electrolytic Corrosion Testing at 35°C/92% R.H., Post 500 Hours of 10 Volt DC Bias. NO FAILURES PRODUCED	19	Figure 20	Resistance Readings at 1344 Hours for I _{Ag} as a Function of Applied Volts/mil	22
Figure 15	Final Readings in Chamber of First Round of Electrolytic Corrosion Testing at 65°C/87% R.H., Post 500 Hours of 10 Volt DC Bias - NO FAILURES PRODUCED	20	Figure 21	Evidence of Dendritic Growth on the Electrolytic Silver Sample	23
Figure 15A	Comb Patterns After 596 Hours in 65°C/87% R.H. with 10 Volt Bias Applied - No Failures for Dendritic Growth but Water Spotting Clearly Evident	20	Figure 22	SEM/EDX Analysis of Figure 14, Above	23
Figure 16	Test Protocol Applied Voltages Used for 3-11G Testing	20	Figure 23	Contact Resistance for I _{Ag} Supplier A	24
Tables					
	Table 3-1	Requirements of I _{Ag}	4		
	Table 4-1	Qualification Test Coupons	6		

Specification for Immersion Silver Plating for Printed Circuit Boards

1 SCOPE

1.1 Statement of Scope This specification sets the requirements for the use of Immersion Silver (IAg) as a surface finish for printed circuit boards. This specification is intended to set requirements for IAg deposit thickness based on performance criteria. It is intended for use by supplier, printed circuit manufacturer, electronics manufacturing services (EMS) and original equipment manufacturer (OEM).

1.2 Description IAg is a thin immersion deposit over copper. It is a multifunctional surface finish, applicable to soldering, press fit connections and as a contact surface. It has the potential to be suitable for aluminum wire bonding. The immersion silver protects the underlying copper from oxidation over its intended shelf life. Exposure to moisture and air contaminants, such as sulfur and chlorine, may negatively impact the useful life of the deposit. The impact can range from a slight discoloration of the deposit to the pads turning completely black. Proper packaging is a requirement.

1.3 Objective This specification sets the requirements specific to IAg as a surface finish. As other finishes require specifications, they will be addressed by the IPC Plating Processes Subcommittee as part of the IPC-4550 specification family. As this and other applicable specifications are under continuous review, the subcommittee will add appropriate amendments and make necessary revisions to these documents.

1.4 Performance Functions

1.4.1 Solderability This primary function of IAg is to provide a solderable surface finish, suitable for all surface mount and through-hole assembly applications and with an appropriate shelf life. The deposit has demonstrated the ability to meet a shelf life of 12 months per J-STD-003 and industry data, when handled per this specification's requirements.

Similar to Gold, Silver forms a brittle intermetallic compound Ag_3Sn with Tin. For the recommended deposit thickness the possibility of silver embrittlement is negligible, especially when the assembly solder alloy is a Sn/Pb composition.

Excessive thickness of Immersion silver combined with lead free silver bearing solder, have the potential to create an embrittled solder joint. The committee is working to

define the upper wt% silver content in a solder joint at which the long term reliability remains acceptable.

1.4.2 Contact Surface There is a possibility for using IAg for the following applications. The use of Immersion Silver is acceptable for the IPC-6010 series Class 1 and Class 2 applications but is NOT currently recommended for the IPC-6010 series Class 3 applications which are for High Reliability Electronic Products where equipment downtime cannot be tolerated, and the circuitry must function, when required. Examples of such applications are for life support items and critical weapons systems.

1.4.2.1 Membrane Switches The IAg surface with as little as $0.1\ \mu\text{m}$ [$4\ \mu\text{in}$] of immersion silver has demonstrated that it is suitable for one million actuations with negligible resistance change. However the end use atmosphere (temperature/humidity/contaminants) may degrade this performance. The end user **shall** determine the impact of use environments on the IAg deposit.

1.4.2.2 Metallic Dome Contacts *Data on this topic should be submitted to the IPC 4-14 Plating Processes Subcommittee to be considered for inclusion in upcoming revisions of this standard.*

1.4.3 EMI Shielding IAg is one of the surface finishes that may be used as an interface between electromagnetic interference (EMI) shielding and the printed wiring board (PWB). A key characteristic for this application is a consistent metal interface between the PWB metallization and the shield material. The formation of a highly conductive interface between the two surfaces will ensure excellent EMI shielding capability, which should also provide resistance to atmospheric influences on the IAg deposit. The end user **shall** determine the impact of the end use environment on the reliability of the shield interface. Tarnish of surrounding areas not in contact directly with the shield is NOT a reason to reject the PWB/deposit but rather an indication of the impact of the atmosphere on an active metal.

1.4.4 Aluminum Wire Bonding IAg meets the requirements of MIL-STD-883, Method 2011.7. Variables that affect performance include cleanliness, substrate materials, wire thickness and surface topography. IAg is not a surface leveler; the surface topography largely depends on the conditions of the underlying copper surface. While producing acceptable wire bonds, silver, unlike the other Noble metals used for this application, is potentially not stable due to