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# IPC-4552

## Amendment 1

Specification for Electroless  
Nickel/Immersion Gold  
(ENIG) Plating for Printed  
Circuit Boards

**IPC-4552**  
**Amendment 1**  
June 2012

A standard developed by IPC

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- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

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- Keep people out
- Increase cycle time
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## Specification for Electroless Nickel/Immersion Gold (ENIG) Plating for Printed Circuit Boards

Replace Table 3-1 and footnote with the following:

**Table 3-1 Requirements of Electroless Nickel/Immersion Gold Plating**

Tests	Test Method	Requirement Paragraph	Class 1	Class 2	Class 3
<b>General</b>					
Visual	Visual	3.1	Uniform plating and complete coverage of surface to be plated		
Electroless Nickel Thickness	APPENDIX 4	3.2.1	3 to 6 $\mu\text{m}$ [118.1 to 236.2 $\mu\text{in}$ ]		
Immersion Gold Thickness <b>(Default for this IPC standard)</b>	APPENDIX 4	3.2.2.1	The minimum immersion gold deposit thickness <b>shall</b> be 0.05 $\mu\text{m}$ [1.97 $\mu\text{in}$ ] at -4 sigma from the mean as measured on a pad size of 1.5 mm x 1.5 mm [0.060 in x 0.060 in] or equivalent area.		
Immersion Gold Thickness <b>(Exception required on procurement documentation)</b>	APPENDIX 4	3.2.2.2	The minimum immersion gold deposit thickness <b>shall</b> be 0.04 $\mu\text{m}$ [1.58 $\mu\text{in}$ ] at -4 sigma from the mean as measured on a pad size of 1.5 mm x 1.5 mm [0.060 in x 0.060 in] or equivalent area.		
Porosity	N/A	3.3	N/A		
<b>Physical</b>					
Adhesion/Tape Test	IPC-TM-650, TM 2.4.1	3.4	No evidence of plating removed		
Solderability <sup>(2)</sup>	J-STD-003	3.5	Meet solderability requirements of Category 3 durability with 6 months shelf life.		
<b>Chemical</b>					
Phosphorous/Boron Content	ASTM B733-97 & ASTM B607-91(1998)	1.2.1	(Reference Only; Supplier Dependent - No Testing Required)		
Chemical Resistance	N/A	3.7	N/A		
<b>Electrical</b>					
High Frequency Signal Loss <sup>(1)</sup>		3.8	TBD		
Contact Resistance <sup>(1)</sup>		1.4.2	TBD		
<b>Environmental</b>					
Cleanliness	IPC-TM-650, TM 2.3.25	3.6	Max. 1.56 $\mu\text{g}/\text{cm}^2$		

<sup>(1)</sup> An appropriate IPC-TM-650 test method used to generate data for this electrical property is not available at the time of this writing.

<sup>(2)</sup> This applies to the default Immersion Au thickness, only.

**Replace Section 3.2.1 with the following:**

**3.2.1 Electroless Nickel Thickness** The electroless nickel thickness **shall** be 3 µm to 6 µm [118 µin to 236 µin] as measured on a nominal pad size of 1.5 mm x 1.5 mm [0.060 in x 0.060 in] or equivalent area, where standard feature size tolerances as expressed in the IPC-6010 standard series, apply.

NOTE: Some designs may not have feature sizes of this specified pad area and will require the use of alternate pad sizes. The XRF collimator used **shall** always be smaller than the pad used for measurement; and specifically, the collimator **shall not** exceed 30% of the feature pad size being measured. For smaller sized pads, the measurement time will need to increase proportionately as a function of collimator size reduction. Consistency of pad size measurement is of primary concern in order to obtain a statistically valid result due to the general plating deposit variation seen as a function of pad size. That is, smaller features will plate thicker than larger features. The use of fiducial pads for this measurement is suggested for designs not having the specified pad feature areas, as above.

**Replace Section 3.2.2 with the following:****3.2.2 Immersion Gold Thickness**

**3.2.2.1 ENIG – Category 3 Coating Durability per IPC J-STD-003 – (This is the Default Gold Thickness)** The minimum immersion gold thickness **shall** be 0.05 µm [1.97 µin] at -4 sigma (standard deviation) from the mean as measured on a pad size of 1.5 mm x 1.5 mm [0.060 in x 0.060 in] or equivalent area, where standard feature size tolerances as expressed in the IPC-6010 standard series, apply.

The typical gold thickness range is 0.075 µm to 0.125 µm [2.95 µin to 4.92 µin]. Thicker gold than the upper end of the typical range would normally require extended solution dwell time and/or increased solution temperature. Either of these two process changes can increase the risk of compromising the integrity of the nickel undercoat due to excessive corrosion during the deposition of the immersion gold.

Setup and measurement methodologies are crucial for accuracy (see APPENDIX 4 for recommended measurement techniques).

NOTE: The same considerations apply for gold thickness measurements and their relationship to pad size as applied to the electroless nickel deposition thickness. Due to the importance of control of immersion gold deposit thickness, it is imperative to have all parties measure the same feature size which may likely require discussion and agreement between user and supplier.

**3.2.2.2 ENIG – Category 2 Coating Durability per IPC J-STD-003 – (This is for Soldering Applications ONLY)**

The minimum immersion gold deposit thickness **shall** be 0.04 µm (1.58 µin) at -4 sigma from the process mean as measured on a pad size of 1.5 mm x 1.5 mm [0.060 in x 0.060 in] or equivalent area, where standard feature size tolerances as expressed in the IPC-6010 standard series, apply. The use of this reduced gold thickness **shall** require the following specific notation on the procurement documentation: **“The gold thickness to be per Amendment 1 to IPC-4552, section 3.2.2.2.”**

NOTE: Pad size concerns apply here as in 3.2.1 and 3.2.2.1.

The following four provisions **shall** be met for “Soldering Applications ONLY” before the ENIG plating reduction is allowed to be implemented:

1. Due to the reduced gold thickness, the printed boards **shall** be used within six months of date of manufacture.
2. Immersion gold plating thickness process capability **shall** be demonstrated.
3. Demonstrated measurement capability - A Gauge Repeatability and Reproducibility (GR&R) test **shall** be run showing acceptable values for the plating thickness ranges in this specification. This should be run annually or AABUS.
4. The deposit **shall** pass J-STD-003 solderability testing with the appropriate stressing condition of 8 hours at 72 °C ± 5 °C [162 °F ± 9 °F] and 85% ± 3% R.H. Printed boards **shall** show evidence of proper wetting.