IPC-4556

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

1 SCOPE

1.1 Statement of Scope This specification sets the requirements for the use of Electroless Nickel/Electroless Palladium/ Immersion Gold (ENEPIG) as a surface finish for printed boards. This specification sets requirements for ENEPIG deposit thicknesses for applications including soldering, wire bonding and as a contact finish. It is intended for use by chemical suppliers, printed board manufacturers, electronics manufacturing services (EMS) and original equipment manufacturers (OEM).

1.2 Description ENEPIG is a tertiary layered surface finish plated over copper as the basis metal. ENEPIG consists of an electroless nickel base layer over which is plated an electroless palladium barrier layer followed by a deposit of a thin immersion gold as the final outer layer. For deposition process details, see APPENDIX 1 of this specification. It is a multi-functional surface finish, applicable to soldering and to gold, aluminum and copper wire bonding. It is also suitable as the mating surface for soft membrane and steel dome contacts. Additional applications include use in Low Insertion Force (LIF) and Zero Insertion Force (ZIF) edge connectors and for press-fit applications. The electroless palladium layer forms a diffusion barrier that impedes nickel diffusion to the gold surface. The immersion gold protects the palladium layer from reacting with contaminants prior to processing that might otherwise affect joining processes, such as wire bonding and soldering.

1.2.1 Electroless Nickel Reducing Agents - Phosphorus Content Phosphorus-containing, reducing agents are typically used for the reduction of the electroless nickel during the deposition process and phosphorus is incorporated in the nickel deposit. The level of this co-deposited element should be controlled within the suppliers specified process limits. Variation of phosphorus levels outside the specified process limits may have adverse effects on the performance of the finish.

1.2.2 Electroless Palladium Reducing Agents There are two distinct classes of reducing agents used in electroless palladium baths currently available for use in the ENEPIG process, those that produce deposits that contain a co-deposited element such as phosphorus, and those that produce an essentially pure palladium deposit. The level of the co-deposited elements should be controlled within the specified process limits. Examples of electroless palladium deposit from both these classes have been evaluated during the development of this specification and no perceivable differences in performance were observed in the tests of solderability or wire bondability

1.3 Objective This specification sets the requirements for ENEPIG as a surface finish (see Table 3-1 for a summary of these requirements). As additional surface finishes require specifications, they will be addressed by the IPC Plating Processes Subcommittee as part of the IPC-455X specification family. This and other surface finish specifications are under continuous review. The 4-14 subcommittee will make appropriate amendments or revisions to these documents as required. The 4-14 Plating Processes Subcommittee undertook a ''Round Robin'' study to generate data to support the recommendations sited for the various aspects of this specification. For an outline of the study, refer to APPENDIX 2.

1.3.1 Order of Precedence In the event of conflict, the following order of precedence **shall** apply:

1. The purchase order. This includes AABUS exceptions to this specification.
2. The master drawing. This includes AABUS exceptions to this specification.
3. This specification.
4. Applicable documents as detailed in Section 2 of this document.

1.3.1.1 Appendices This specification contains eleven Appendices provided for information which are included after the main body of this document. Be aware that none of the content of these appendices are binding requirements unless separately and specifically specified herein, or as required by purchase order, master drawing, other applicable documents, or as established AABUS.

1.4 Performance Functions

1.4.1 Solderability One of the two primary functions of ENEPIG is to provide a solderable surface finish capable of providing IPC Category 3 shelf life (minimum 12 months) per IPC-J-STD-003 testing. This shelf life is suitable for all surface mount, hybrid and through-hole assembly applications. The use of electroless palladium as a diffusion barrier between the