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

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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.

Contact:

IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

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Fabrication Processes Committee

Co-Chairs
George Milad
Uyemura International Corp.

Gerard A. O'Brien
Solderability Testing & Solutions, Inc.

Plating Processes Subcommittee

Co-Chairs
George Milad
Uyemura International Corp.

Gerard A. O'Brien
Solderability Testing & Solutions, Inc.

Technical Liaison of the IPC Board of Directors

Bob Neves
Microtek Laboratories

Dongkai Shangguan
Flextronics International

Plating Processes Subcommittee

Wallace Ables, Dell Inc.
Martin Anselm, Universal Instruments Corporation
Craig Bachman, Molex Copper Flex Products
Tina Barclay, TAS Consulting
Bill Barthel, Plexus Manufacturing Solutions
Martin W. Bayes, Ph.D., Dow Electronic Materials
Luc Beauvillier, Isola Group SARL
Elizabeth Benedetto, Hewlett-Packard Company
Jon Bengston, Uyemura International Corp.
Wendi Boger, Viasystems Group, Inc.
Jim Bogert, Fischer Technology Inc.
Mumtaz Y. Bora, Peregrine Semiconductor
William C. Bowerman, OMG Electronic Chemicals
Trevor S. Bowers, Adtran Inc.
Peter Bratin, Ph.D., ECI Technology, Inc.
Jerry Brewer, Atotech USA Inc.
Dock Brown, Medtronic
Lee Burger, OMG Electronic Chemicals
Matthew J. Byrne, BAE Systems Platform Solutions
Mike V. Carano, OMG Electronic Chemicals
Srinivas Chada, Ph.D., Power-One Renewable Energies Inc.
Alex Chen, Celestica
Peter Chiang, MSI (Micro-Star International Co., Inc.)
Joshua Civiello, Defense Supply Center Columbus
Horst Clauberg, Kulicke & Soffa Industries Inc.
Christine R. Coapman, C2 Consulting
David J. Corbett, Defense Supply Center Columbus
G. Sidney Cox, Ph.D., DuPont
Donald Cullen, MacDermid, Inc.
Richard Davidson, Honeywell Aerospace
Michael F. DiCicco, Northrop Grumman Corporation
Karl H. Dietz, Ph.D., Karl Dietz Consulting LLC
Steven Dunford, Schlumberger Well Services
Gene Dunn, Plexus Corporation
C. Don Dupriest, Lockheed Martin Missiles & Fire Control
Patricia S. Dupuis, Raytheon Company
Richard M. Edgar, Tec-Line Inc.
Theodore Edwards
Steven R. Etheridge, Dell Inc.
John J. Fendrock, Raytheon Missile Systems
Ellen Finch, Anaren Microwave Inc.
Sandra M. Fortune, Northrop Grumman Corporation
Dennis Fritz, MacDermid, Inc.
Hiroyuki Fukuda, Shikoku Chemicals Corporation
Lionel Fullwood, WKK Distribution Ltd.
Gerald Gagnon, Extech Instruments Corporation
Thomas Gahagan, Anaren Microwave Inc.
Andrew Glendening, Northrop Grumman ESSD
Robert Gordon, Amonix, Inc.
Michael R. Green, Lockheed Martin Space Systems Company
Albin Gruenwald, Uyemura International Corp.
Donald Gudeczauskas, Uyemura International Corp.
Michael Haller, Fischer Technology Inc.
Philip M. Henault, Raytheon Company
David D. Hillman, Rockwell Collins
Charles Hirbour, Technic Inc.
Joanne Hohman, Lockheed Martin Missiles & Fire Control
Helen Holder, Hewlett-Packard Company
Michelle Hong, Wistron Corporation
Jay Huang, Wistron Corp.
Werner Huegel, Ph.D., Robert Bosch GmbH
Jim Huff, Dell Inc.
Joseph Jacobi, Lockheed Martin Missiles & Fire Control

Kuldip Johal, Atotech USA Inc.

William Johannes, Sandia National Labs Albuquerque

Patrick A. Jones, Northrop Grumman Corporation

James B. Kenny, Enthone Inc. - Cookson Electronics

John Konrad, Endicott Interconnect Technologies Inc.

Rajesh C. Kumar, Viasystems North America, Inc.

Henry Lajoie, OMG Electronic Chemicals Inc.

Joseph R. LaRoche, BAE Systems

Brigitte Lawrence, Brigitflex Inc.

Paul Lomax, Fischer Technology Inc.

Anne Lomonte, Draeger Medical Systems, Inc.

Gary Long, Intel Corporation

Clifford R. Maddox, Boeing Company

Brian D. Madsen, Ph.D., Continental Automotive Systems

Chris Mahanna, Robisan Laboratory Inc.

Guenther Mayr, AT&S Austria Technologie & Systemtechnik AG

Martin McDaniel, NSWC Crane

Joe McGurran, Atotech USA Inc.

Coleen McKirryher, MacDermid, Inc.

Tim Mckliget, Holaday Circuits Inc.

Stephen Meeks, St. Jude Medical

Peter Menuez, L-3 Communications - Cincinnati Electronics

Renee J. Michalkiewicz, Trace Laboratories - Baltimore

William Miller, Panasonic Automotive Systems Company of America

James J. Monarchio, TTM Technologies, Inc.

Alton Moore, Raytheon Company

Ted F. Myers, ECI Technology, Inc.

David Nelson, Adtran Inc.

Keith Newman, Hewlett-Packard Company

Thi Nguyen, Lockheed Martin Missile & Fire Control

Gary Nicholls, Metalor Technologies USA

Mustafa Oezkoek, Atotech Deutschland GmbH

Sean Oflaherty, Oxford Instruments

Patrick O'Keefe, Holaday Circuits Inc.

Wim Ongenae, MEC Europe

Mario Orduz, Cookson Electronics

William A. Ortloff, Raytheon Company

Michael W. Paddack, Boeing Company

J. Lee Parker, Ph.D., JLP

Dan Parquet, Viasystems Group, Inc.

Michael Pavlov, ECI Technology, Inc.

Anders Pedersen, Harris Corporation, GCSD

Marybeth Perrino, Endicott Interconnect Technologies Inc.

Robert Peterson, Alternate Finishing Inc.

Michah Pledger, Semblant Ltd.

Gnyaneshwar Ramakrishna, Cisco Systems Inc.

Gustavo Ramos, Atotech Deutschland GmbH

Randy R. Reed, Viasystems Group, Inc.

Robert Reid, Technic Inc.

Henry J. Rekers, Schneider Electric

Jose A. Rios, Endicott Interconnect Technologies Inc.

Hugh Roberts, Atotech USA Inc.

Gary C. Roper, Roper Resources, Inc.

Stan Sappington, S/G Electronics Inc.

Daryl Sato, Intel Corporation

Karl A. Sauter, Oracle America, Inc.

Thomas C. Saven, Ticer Technologies

Stefan Schmitz, Fraunhofer IZM Branch Lab Microsystem Engineering

Michael Schneider, ECI Technology, Inc.

Randy Schueller, Ph.D., DfR Solutions

Michael Schwaemmlein, Atotech Deutschland GmbH

Martin Scionti, Raytheon Missile Systems

Jeff Seekatz, Raytheon Company

Tom Selby, Optimum Design Associates

Gordon Simmons, Superior Processing

Atamjit Singh, Unitech Industries Inc.

Polina Snugovsky, Ph.D., Celestica

David Sommervold, The Bergquist Company, Prescott

Eric J. Stafstrom, Technic Inc.

William Starmann, Raytheon Company

Donald Susan, Ph.D., Sandia National Labs Albuquerque

John Swanson, MacDermid, Inc.

Jeff Taylor, IBM Corporation

Matthew Taylor, Fischer Technology Inc.

Royce Taylor, Raytheon Company

Stephen L. Tisdale, Intel Corporation

Michael Toben, Dow Electronic Materials

Lenora M. Toscano, MacDermid, Inc.

James Trainor, OMG Electronic Chemicals Inc.

Kristen Troxel, Hewlett-Packard Company

Paul Vianco, Ph.D., Sandia National Labs Albuquerque

Joe Vo, Broadcom Corporation

Donald Walsh, Uyemura International Corp.

Karl Wengenroth, Enthone Inc. - Cookson Electronics

Vicka White, Honeywell Inc. Air Transport Systems

Andreas Wippel, AT&S Austria Technologie & Systemtechnik AG

Wesley M. Wolverton, Raytheon Systems Company

Chen Xu, Ph.D., Alcatel-Lucent

Yung-Herng Yau, Enthone Inc. - Cookson Electronics

Joshua Young, Maxwell Technologies Inc.

Table of Contents

1 **SCOPE** 1
1.1 Statement of Scope 1
1.2 Description 1
1.2.1 Electroless Nickel Reducing Agents - Phosphorus Content 1
1.2.2 Electroless Palladium Reducing Agents 1
1.3 Objective 1
1.3.1 Order of Precedence 1
1.3.1.1 Appendices 1
1.4 Performance Functions 1
1.4.1 Solderability 1
1.4.2 Wire Bonding 2
1.4.3 Contact Surface 2
1.4.3.1 Membrane Switches 2
1.4.3.2 Metallic Dome Contacts 2
1.4.4 EMI Shielding 2
1.4.5 Interface for Conductive and/or Anisotropic Adhesives 2
1.4.6 Connectors 2
1.4.6.1 Press-Fit Applications 2
1.4.6.2 Edge Tab Contact Applications 2
1.4.7 Limitations of ENEPIG 2
1.4.7.1 Creep Corrosion/Chemical Resistance 2
1.4.7.2 High Frequency Signal Loss 3

2 **APPLICABLE DOCUMENTS AND TERMS AND DEFINITIONS** 3
2.1 IPC 3
2.2 American Society for Testing and Materials (ASTM International) 3
2.3 JEDEC 3
2.4 Defense Standardization Program 3
2.5 Telcordia Technologies, Inc. 3
2.6 International Organization for Standardization (ISO) 3
2.7 Terms, Definitions and Acronyms 4

3 **REQUIREMENTS** 4
3.1 Visual 5
3.1.1 High Magnification Reference Images 6
3.2 Finish Thickness 7
3.2.1 Electroless Nickel Thickness 7
3.2.2 Electroless Palladium Thickness 7
3.2.3 Immersion Gold Thickness 7
3.2.4 XRF Calibration Standards 8
3.2.5 Use of Non-Statistical Thickness Specification 8
3.2.6 Production Overruns and/or Inventory Items 8
3.3 Porosity 8
3.4 Adhesion 8
3.5 Solderability 9
3.5.1 Force Measurement Testing (Wetting Balance Testing) 9
3.6 Cleanliness 9
3.7 Electrolytic Corrosion 9

4 **QUALITY ASSURANCE PROVISIONS** 9
4.1 General Quality Assurance Provisions 9
4.1.1 Qualification Recommendations 9
4.1.2 Sample Test Coupons 10
4.2 Quality Conformance Testing 11
4.2.1 Thickness Measurements 11
4.2.2 Qualified Processes 11

APPENDIX 1 Chemical Definitions and Process Sequence 12

APPENDIX 2 Round Robin Test Summary 14

APPENDIX 3 ENEPIG PWB Surface Finish XRF Round Robin Testing 16

APPENDIX 4 Factors Affecting Measurement Accuracy of ENEPIG Coatings by XRF 23

APPENDIX 5 ENEPIG PWB Surface Finish Wetting Balance Testing 32

APPENDIX 6 Solder Spread Testing 40

APPENDIX 7 ENEPIG PWB Surface Finish Shear Test Project 48

APPENDIX 8 Gold Wire Bonding 58

APPENDIX 9 XRF Thickness Measurements of thin Au and Pd (ENEPIG): Recommendations for Instrumentation (Detectors) and their Limitations 64

APPENDIX 10 Gage Capability. Gage R&R Type 1 Study 66

APPENDIX 11 Solderability Testing Helps Select Surface Finishes 69

Figures

Figure 3-1 Uniform Plating 5
Figure 3-2 Extraneous Plating or Nickel Foot 5
Figure 3-3 Edge Pull Back 5
Figure 3-4 Skip Plating 5
Figure 3-5 Skip Plating of Gold Over Palladium 6
Figure 3-6 Skip Plating of Gold Over a Palladium Deposit 6
Figure 3-7 1000X SEM Image of a Normal ENEPIG Surface 6
Figure 3-8 4000X SEM Image of a Normal ENEPIG Surface 6
Figure 3-9 2500X FIB Image of a Normal ENEPIG Deposit 6
Figure 3-10 100,000X FIB Image of a Normal ENEPIG Deposit 6
Figure 3-11 TEM Image of a Normal ENEPIG Deposit 7
Figure 3-12 2500X Image of Nickel that is Hyper-Corroded 7
Figure 3-13 The Standard IPC Force Measurement Coupon 9
Figure A3-1 Test Coupon Used for XRF Round Robin Measurements 16
Figure A3-2 Immersion Gold Thickness Readings in Microinches for the Sixteen Test Pads Where C Is the Reference XRF 18
Figure A3-3 Electroless Palladium Thickness Readings in Microinches for the Sixteen Test Pads Where C Is the Reference XRF 19
Figure A3-4 Electroless Nickel Thickness Readings in Microinches for the Sixteen Test Pads Where C Is the Reference XRF 20
Figure A3-5 The Impact of Feature Size on Electroless Palladium and Immersion Gold Deposition Thickness Plated on the Same PB 22
Figure A4-SS1 XRF Spectra of 1/2 oz Cu/Epoxy vs. 1 oz Cu/Epoxy 28
Figure A4-SS2 XRF Spectra of ENEPIG Plated on Cu (No Epoxy) vs. 1/2 oz Cu/Epoxy 29
Figure A4-SS3 XRF Spectra of ENEPIG Plated on Cu (No Epoxy) vs. ENEPIG Plated on 1 oz Cu/Epoxy 30
Figure A4-SS4 XRF Spectrum of ENEPIG Plated on 1 oz Cu/Epoxy 31
Figure A5-1 Example of the Wetting Balance Coupon Used for the Testing of ENEPIG 32
Figure A5-2 XRF Measurements of Gold and Palladium Thicknesses Supplied as Nominal 0.1 micron Electroless Palladium 33
Figure A5-3 XRF Measurements of Gold and Palladium Thicknesses Supplied as Nominal 0.2 micron Electroless Palladium 33
Figure A5-4 XRF Measurements of Gold and Palladium Thicknesses Supplied as Nominal 0.3 micron Electroless Palladium 33
Figure A5-5 Metronelec ST88 Wetting Balance Used for the Testing 33
Figure A5-6 Example of the Wetting Performance for a Nominal 4 µin Electroless Palladium Tested with SnPb Solder 34
Figure A5-7 Example of the Wetting Performance for a Nominal 8 µin Electroless Palladium Tested with SnPb Solder 34
Figure A5-8 Example of the Wetting Performance for a Nominal 20 µin Electroless Palladium Tested with SnPb Solder 35
Figure A5-9 Example of the Wetting Performance for a Nominal 4 µin Electroless Palladium Tested with SAC305 Solder 35
Figure A5-10 Example of the Wetting Performance for a Nominal 8 µin Electroless Palladium Tested with SAC305 Solder 36
Figure A5-11 Example of the Wetting Performance for a Nominal 12 µin Palladium Tested with SAC305 Solder 36
Figure A5-12 Example of a Nominal 4 µin Electroless Palladium ENEPIG Post Temperature and Humidity Stressing, Tested with SnPb - Showing Excellent Robustness 37
Figure A5-13 Example of a Nominal 4 µin Electroless Palladium ENEPIG, with Very Thin Immersion Gold after Temperature and Humidity Stressing & Tested with SnPb 38
Figure A5-14 Example of a Nominal 6 µin ENEPIG Deposit Tested with SAC305 Post Stressing – Showing Excellent Robustness of Deposit 38
Figure A5-15 Performance of Sample Group 20 (with thin gold) with SAC305 Post Stressing 39
Figure A6-1 Layout of Test Board Used for Solder Spread and Wetting Balance Testing 41
Figure A6-2 Solder Spread Pattern and Paste Stencil 41
Figure A6-3 An Actual Solder Spread Result Showing the Deposits Counted for Each Line of the Pattern 42
Figure A6-4 Solder Spread Results Using an ROL1 Sn/Pb/Ag Solder Paste on ENEPIG Deposits 43
Figure A6-5 Solder Spread Results Using an ROL0 Pb-free Solder Paste of the SAC 300 Family on ENEPIG Deposits 44
Figure A6-6 Solder Spread for Lowest Spread ENEPIG Sample Showing Evidence of High Contact Angle and Dewetting for Some Areas of the Printed Board 45
Figure A6-7 Solder Spread Results for Pb-free Solder Paste as a Function of the EN Layer Thickness in the ENEPIG Deposit 46
Figure A7-1 Shear Test Coupon 48
Figure A7-2 DAGE 5000 Shear Test System 49
Figure A7-3 Solderball Shear Results 49
Figure A7-4 Sn63Pb37 Test Coupon 19 52
Figure A7-5 Sn63Pb37 Test Coupons 1 & 2 52
Figure A7-6 Sn63Pb37 Test Coupons 3 & 4 52

Figure A7-7 Sn63Pb37 Test Coupons 5 & 6 53
Figure A7-8 Sn63Pb37 Test Coupons 7 & 8 53
Figure A7-9 Sn63Pb37 Test Coupon 18 53
Figure A7-10 Sn63Pb37 Test Coupon 19 54
Figure A7-11 SAC305 Test Coupons 1 & 2 54
Figure A7-12 SAC305 Test Coupons 3 & 4 54
Figure A7-13 SAC305 Test Coupons 5 & 6 55
Figure A7-14 SAC305 Test Coupons 16 & 17 55
Figure A7-15 SAC305 Test Coupon 18 55
Figure A7-16 SAC305 Test Coupon 19 56
Figure A7-17 Solderball Shear Force as a Function of Palladium Plating Thickness 56
Figure A8-1 Wire Bond Test Vehicle Showing pin #1, quadrants 1, 2, 3 and 4 58
Figure A8-2 Example of 6 in x 8 in Panel Containing 1 in x 1in ENEPIG Wire Bond Coupons 60
Figure A8-3 Visual Evaluation of Wire Bonding Showing Classical Crescents Resulting in Neck Breaks 61
Figure A8-4 (Top) Summary of 1 mil Gold Wire ENEPIG Destructive Pull Test (DPT) Results and (Lower) Comparison of X-Y Directional DPT Values 62
Figure A11-1a Meniscometer 70
Figure A11-1b Wetting Balance 70
Figure A11-2 ENEPIG with Thin and Thick Pd from Vendors 1 & 2 71
Figure A11-3 Wetting Rate as a Function of Battelle Class 2 Aging 72

Tables

Table 3-1 Requirements of Electroless Nickel Electroless Palladium Immersion Gold (ENEPIG) Plating ... 4
Table 4-1 Suggested Fabricator Qualification Plan 10
Table 4-2 C=0 Sampling Plan (Sample Size for Specific Index Value[1]) 11
Table A3-1 Comparison of the Accuracy of Measurements Relative to the C Readings for All Three Deposits 21
Table A4-1 Summary of XRF Configuration Solutions Offered for Measurement of ENEPIG Plating on PCB's with Advantages and Disadvantages 27
Table A5-1 XRF Measurements of the Nominal 0.5 micron Electroless Palladium Samples 32
Table A6-S1 Preconditioning and Solder Paste Matrix Used for Solder Spread Testing for a Given ENEPIG Chemistry and Electroless Palladium Thickness 40
Table A7-1 Test Coupon Serial Number and Palladium Thickness 48
Table A7-2 Sn63Pb37 Solderball Shear Test Results Coupon Set 1 (grams) 50
Table A7-3 Sn63Pb37 Solderball Shear Test Results Coupon Set 2 (grams) 50
Table A7-4 SAC305 Solderball Shear Test Results Coupon Set 1 (grams) 51
Table A7-5 SAC305 Solderball Shear Test Results Coupon Set 2 (grams) 51
Table A8-I Twenty-one Panels Marked (a) Whole Panel, (b) Array and (c) Hand Cut 59
Table A8-II Destructive Wire Bond Pull Test Force (grams) Results for All 21 ENEPIG Test Groups 60
Table A8-III Summary of Plating Finish Thicknesses for Samples Wire Bonded 63
Table A9-1 XRF Detectors and Their Limitations at Typical Count Rates 64
Table A11-1 "Relative Wettability Guideline," Using Contact Angle (θ_C) As "General" Metric 70

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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