



DEFENSE LOGISTICS AGENCY
LAND AND MARITIME
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13 July 2018

MEMORANDUM FOR MILITARY/INDUSTRY DISTRIBUTION

SUBJECT: Engineering Practice Study to Review usage of Electroless Nickel
Phosphide in package plating.
Project Number 5961-2018-084

The initial draft for this subject document, dated 13 July 2018, is now available for viewing and downloading from the DLA Land and Maritime website:

<https://LandandMaritimeApps.dla.mil/Programs/MilSpec/DocSearch.aspx>

The study will review a proposal to add additional testing and a design rule disallowing direct application of electroless Nickel Phosphide over corrosion prone base metals for welded lids or packages to mitigate cracking.

Concurrence or comments are required at this Center within 45 days from the date of this letter (27 August 2018). Late comments will be held for the next coordination of the document. Comments from Military departments must be identified as either "Essential" or "Suggested". Essential comments must be justified with supporting data. Military review activities should forward comments to their custodians of this office, as applicable, in sufficient time to allow for consolidating the department reply. Since Navy-EC is the custodian for this document, all Navy review activities should forward their comments directly to this Center.

The point of contact for this document is Mr. Jason Hochstetler, DLA Land and Maritime-VAC, Post Office Box 3990, Columbus, OH 43216-3990. Mr. Hochstetler can also be reached at 614-692-7106/850-7106, or by facsimile 614-692-6939/850-6939, or by e-mail to: Jason.Hochstetler@dlamail.mil.

/signed/
Jason Hochstetler
For
Thomas M. Hess
Chief
Active Devices Team



ENGINEERING PRACTICES STUDY 1161

TITLE: STUDY TO REVIEW USAGE OF ELECTROLESS NICKEL PHOSPHIDE IN
PACKAGE PLATING.

13 Julye 2018

STUDY PROJECT

PRELIMINARY

Study Conducted by DLA LAND AND MARITIME

Prepared by:

Jason Hochstetler

I. **OBJECTIVES:** DLA Land and Maritime-VAC is conducting an EP study to Review the use of electroless Nickel Phosphide in package plating. The purpose of this EP study is to obtain input from the military services, manufacturers, and user communities concerning the proposals to mitigate cracking found in some devices coated with electroless Nickel Phosphide. The survey results will help determine if additional testing or design restrictions need to be added for packages using this plating method or if the existing conformance tests are sufficient.

II. **BACKGROUND:** Through a failure analysis a manufacturer has found that some devices that were seam welded with electroless Nickel Phosphide plated Kovar lids exhibit micro cracking near the seam weld zone. The micro cracking can lead to leaks after the device is exposed to MIL-STD-750, TM1041, salt atmosphere. The cracks allowed salts to deposit and corrode through the underlying Kovar material causing the leaks. Currently hermetic seal testing is not required directly following salt atmosphere in the conformance inspection of MIL-PRF-19500, the manufacturer performed it as an extra test as part of the failure analysis.

As a result of the findings, the manufacturer has added a layer of electrolytic Nickel between the Kovar base metal and the electroless Nickel Phosphide. Electroless nickel Phosphide that contains 10 +/-2% phosphorus is brittle and can crack during the seam weld process. The electrolytic nickel is more ductile than electroless Nickel Phosphide and will act as a barrier over the Kovar.

This could potentially affect all packages using an electroless Nickel Phosphide plating that has been seam welded.

Proposal: Based on the information provided from the manufacturer DLA has three potential changes to be considered to address this issue. One proposal is an additional Fine/Gross leak test to test for the potential cracking, and two proposals would add design rules to require or prohibit specific materials to prevent the cracking.

1. Add Fine/Gross leak testing to the following subgroups following Salt Atmosphere testing in MIL-PRF-19500:
Subgroup B1 (JAN/TX/TXV)
Subgroup B2 (JANS)
Subgroup C4

2. Add a design rule restriction in Appendix H requiring a layer (preferably Electrolytic Nickel) between Kovar and the immediate electroless Nickel Phosphide layer if applicable for seam welded lids.

3. Prohibit the direct application of electroless Nickel Phosphide over any corrosion-prone base metals for welded lids/packages.

Alternatively, a suggestion was made that too many additional variables exist in the manufacturing process that could potentially cause cracking and that the restriction of electroless Nickel Phosphide may not be the best solution for all manufacturers. So while a particular adjustment is needed / works for one manufacturer it might not be necessary and may even be detrimental to other manufacturers and require them to alter additional variables in their process. The seam seal process has many variables including, lid composition, lid thickness, plating layers, plating thickness, plating composition (phosphorus content), weld energy, weld repetition rate, electrode angle, electrode pressure, electrode material, native oxide, corner radius, over travel, etc.

Please answer the questions in **Attachment 1** to provide feedback regarding the proposals.

III. **RESULTS:** All comments on this study shall be submitted to jason.hochstetler@dla.mil. Resulting coordinated comments will provide a basis to determine which proposal is the preferred method to mitigate cracking for the affected devices or if the solution is manufacturer specific. Comments to this study shall be submitted to DLA Land and Maritime within 45 days from the date of this letter.

IV. **CONCLUSIONS:** The final comments on this study will be published in a final EP study report after all submitted comments have been resolved.

V. **RECOMMENDATIONS:** DLA Land and Maritime recommends that all military and industry representatives review the Electroless Nickel Phosphorus proposals and provide comments.

Attachment 1

- 1) Which (MIL-PRF-19500) device packages, currently manufactured, utilize electroless Nickel Phosphide plating?
 - a. If electroless Nickel Phosphide was utilized, have you had any qualification, conformance inspection, or customer concerns regarding corrosion of the base metal due to a breach of the electroless Nickel Phosphide plating?
 - b. If there was a breach of the electroless Nickel Phosphide plating was it attributed to a process control issue, or just the nature of the electroless Nickel Phosphide plating?
- 2) Out of the three proposals;
 - (1) Fine/Gross leak testing.
 - (2) Requiring an intermediate layer (preferably Electrolytic Nickel) between Kovar and the immediate electroless Nickel Phosphide layer on devices with seam welded lids.
 - (3) Prohibit the direct application of electroless Nickel Phosphide over any corrosion-prone base metals for welded lids/packages.
 - a. Are there any disadvantages in the proposed additions or prohibitions?
 - b. Would there be any negative technical impact to the manufacturing processes that would be required?