Development of MIL-STD for ZnNi Plating, Low Hydrogen Embrittlement Electrodeposition

ASETSD\nDefense Workshop 2018

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Parts on the Shelf and Contracts in Place
Agenda

- Timeline
- SBIR Phases
  - Feasibility
  - Qualification
  - Implementation
- Process Control
  - USAF Drawing
  - MIL-STD
Timeline

- SBIR (Small Business Innovation Research) Project
  - SBIR is a Three Phase Project
    - Phase I: Feasibility (2007)
    - Phase II: Qualification (2008 - 2010)
    - Phase III: Implementation (2010 - Present)
      - ESTCP – Environmental Security Technology Certification Program
      - CSAG – Consolidated Sustainment Activity Group (Landing Gear Funding)
      - GSD – General Support Division (Landing Gear Funding)
      - P2 – Pollution Prevention
      - DMAG – Overhaul Shop
Phase I: Feasibility (2007)

- Selected Coating to Replace Cadmium
  - Required to protect Steel
  - Galvanic Potential is close to steel and has good corrosion properties
  - Low Hydrogen Embrittlement for High Strength Steel
  - Used supplier developed technical data
  - Bench top tank (8 gal)

<table>
<thead>
<tr>
<th>Metal or Plating</th>
<th>Galvanic Series Measurements in 3.5% NaCl</th>
<th>$\Delta$ mV from Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>IZ-C17+ Zn-Ni with IZ-264 Tri-Cr CC</td>
<td></td>
<td>-30</td>
</tr>
<tr>
<td>IZ-C17+ Zn-Ni with No CC</td>
<td></td>
<td>-40</td>
</tr>
<tr>
<td>LHE Ti-Cd with No CC</td>
<td></td>
<td>-90</td>
</tr>
<tr>
<td>LHE Ti-Cd with Hex-Chrome CC</td>
<td></td>
<td>-80</td>
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<tr>
<td>LHE Cd with Hex-Chrome CC</td>
<td></td>
<td>-80</td>
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<tr>
<td>LHE Cd with No CC</td>
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<td>-70</td>
</tr>
<tr>
<td>Zn</td>
<td></td>
<td>-380</td>
</tr>
<tr>
<td>Zn-Ni (Low Ni)</td>
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<td>-480</td>
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<tr>
<td>Hot Dip Zn</td>
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<td>-525</td>
</tr>
</tbody>
</table>

- Identified Required Testing for Acceptance and Qualification
  - Based on testing required for other electroplating processes such as Cadmium
- Developed parameters for chemical maintenance, coating composition, etc.
- Scaled up prototype plating tank (325 gal)
Phase II: Qualification

- Testing performed to validate process/coating integrity
  - Corrosion (Salt Fog and Environmental)
  - Base Metal Adhesion
  - Paint Adhesion
  - Hydrogen Embrittlement
  - DeZincification
  - Reembrittlement
  - Fatigue

- Open Circuit Potential
- Galvanic Potential
- Repairability (Brush Plating)
- Compatibility on Other Metals
- Compatibility with Other Coatings
- Liquid Metal and Solid Metal Embrittlement
- Coating Removal
- Waste Treatment
- Chemical Controls/Maintenance
- Process Control
- Anode Development
Phase III: Implementation (2010 – Present)

- Reviewed AMS 2417 Specification for ZnNi plating – This spec was too broad (lessons learned from QQ-P-416 and Mil-Std-870)
- Developed USAF Drawing 201027456 for process control and Source Control Drawing 201027457
- Installation of Prototype Production Tank (3200 gal) – Converted to full production August 2013
- Development of Conformal Anodes for Component Plating
Conversion of USAF Drawing to MIL-STD (2016 – Present)

- Need for a MIL-STD was identified as landing gear spares procurement started requesting LHE ZnNi on landing gear. Job shops were not able or reluctant to convert without a more available standard.
- Initiated steps of publishing MIL-STD
- Developed format and verbiage for MIL-STD

- Completed internal USAF review of MIL-STD – Engineering, Plating Shop
- Collaborated with industry partners to maintain similar parameters
- Submitted MIL-STD draft to Hill AFB Data Acquisition & Defense Standardization Office
MIL-STD Publication (TBD)

- MIL-STD for LHE ZnNi Electrodeposition to be sent out to DOD offices for review, comment and approval
Questions?

LHE ZnNi

ASTM B117 4000 hours

LHE Cd

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