Field Demonstration of Alternative Coatings for High Strength Steel (HSS)
**Field Demonstration of Alternative Coatings for High Strength Steel (HSS)**

**Army Aviation and Missile Life Cycle Management Command, AMSAM-EN-EV, Redstone Arsenal, AL, 35898**

26th Replacement of Hard Chrome and Cadmium Plating Program Review Meeting, January 24-26, 2006, San Diego, CA. Sponsored by SERDP/ESTCP.
Overview

• Background
• Purpose
• Objective
• Test Protocol
• Firing Demo
• Results
• Summary
Background

- Cadmium
  - Toxicity
  - Exposure
- Environmental Impact
- Weapon Systems
Weapon Systems

Multi-Launch Rocket System (MLRS)

Army Tactical Missile System (ATACMS)
The purpose of this field demonstration is to determine corrosion protection imparted by various alternative coatings for high strength steel (HSS) fasteners.

Natural and severe environments experienced on rocket motor launchers.
Objective

• Identify a coating or coatings that perform as well or better than cadmium for applicability on high strength fasteners utilized by Army rocket motor launchers
Test Protocol

- Coatings
- Coupons
- Configuration
- Primer
- Topcoat
- Test Fixture
Alternative Coatings

- Cadmium
  - electrodeposited
- Zinc
  - electrodeposited
- Elisha
  - mineralization
- Dacromet
  - coating
- Geomet
  - coating
- Zinc-Nickel
  - electrodeposited
Coated Fasteners
Torque values were based upon:
• 90% yield strength
• Manufacturer’s recommended value
Installed Fasteners
Primed Coupons and Fasteners
Coupons and Fasteners w/ Topcoat
UNITED STATES ARMY AVIATION AND MISSILE
Lifecycle Management Command

Test Fixture
Results

- Visual Inspection
  - 6 month exposure
  - 12 month exposure
- Torque and Breakaway torque
- Tensile testing
6 Months
12 Months

Steel Substrate
Coupon C
12 Months Exposure
Uninstalled Fasteners
## Torque Value

<table>
<thead>
<tr>
<th>Coating</th>
<th>$\mu$</th>
<th>Torque Value</th>
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<tbody>
<tr>
<td>Cadmium</td>
<td>0.08</td>
<td>50 ft lbs</td>
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<tr>
<td>Zinc</td>
<td>0.11</td>
<td>46 ft lbs</td>
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<tr>
<td>Elisha</td>
<td>0.13</td>
<td>53 ft lbs</td>
</tr>
<tr>
<td>Dacromet</td>
<td>0.11</td>
<td>46 ft lbs</td>
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<tr>
<td>Geomet</td>
<td>0.11</td>
<td>46 ft lbs</td>
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<tr>
<td>Zinc-Nickel</td>
<td>0.08</td>
<td>70 ft lbs</td>
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Breakaway Torque

Steel Coupon

Breakaway (ft-lbs) vs. Coating

- Cd
- Zn
- Elisha
- Dacromet
- Geomet
- Zn-Ni

Torque value
6 months
12 months
Tensile Strength

Aluminum Coupon

MAX Load (ksi)

Coating

Control
6 months
12 months

Cd
Zn
Elisha
Dacromet
Geomet
Zn-Ni
Tensile Strength

Steel Coupon

- MAX Load (ksi)
- Coating: Cd, Zn, Elisha, Dacromet, Geomet, Zn-Ni

Control
- 6 months
- 12 months
Summary

• Scheduling
• Points of Contact
## Field Demonstration of Cadmium Alternatives on HSS Fasteners

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Qtr 1</th>
<th>Qtr 2</th>
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<td>Fabricate Test Stand and Install Coups</td>
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<td>Install Test Fixture at Test Stand E</td>
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<td>Perform Evaluation of Tensile Strength</td>
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Points of Contact

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