ELECTROCOAT PROCESS FOR NON-CHROMATE PRIMERS IN DOD MANUFACTURING

Project Number: WP-201010

ASETSDefense
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# Report Documentation Page

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<td>PPG Industries Inc., One PPG Place, Pittsburgh, PA, 15272</td>
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*Standard Form 298 (Rev. 8-98)*
*Prescribed by ANSI Std Z39-18*
Technical Approach

Task 1
- **Laboratory validation**
  - Test to MIL-PRF-23377 and MIL-PRF-32239.
  - *Goal: Electrocoat to meet MIL specifications and to equal performance of qualified spray primer.*

Task 2
- **Tank Installation at Military Depot**
  - Pilot tank to demonstrate electrocoat application
  - Application on aircraft parts

Task 3
- **Track performance relative to qualified controls**
  - Field performance on military aircraft
  - Determine life cycle benefits
Electrocoat Basics

An application method which uses direct electrical current to deposit the coating

- Waterborne coating
- Chromium-free (no heavy metals)
- Lower temperature cure: 30 minutes metal at 200°F
- Chemistry and cure requirements are uniquely suited for aerospace aluminum
Electrocoat Basics

The electrocoat system - Four stages:
- Electrocoat tank - primer application
- Two rinse tanks
- Oven (thermal cure)

From Pretreatment

Electrocoat

1st Rinse

DI or RO Rinse

30 min @ 200°F metal temp

To Oven

Ready to fly
Electrocoat Benefits

Productivity & Efficiency
- Virtually 100% materials utilization
- Immediate part handling after thermal cure (30 minutes metal @ 200 °F)
  - Do not have “dry to touch”, “dry to tape”, “dry to fly” restrictions

Application & Performance
- Uniform film across entire surface including recessed areas and complex shapes
- Excellent barrier / corrosion resistance properties
Benefits of Electrocoat

Environmental, Health, and Safety Considerations

• Aqueous based
• Minimal waste discharge - closed loop process
• Minimal exposure of workers to coating components

<table>
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<tr>
<th>VOC (EPA Method 24)</th>
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<tr>
<td>Ecoat</td>
<td>~260 g/L</td>
</tr>
<tr>
<td>NC spray primer</td>
<td>340 g/L</td>
</tr>
<tr>
<td>Cr spray primer #1</td>
<td>350 g/L</td>
</tr>
<tr>
<td>Cr spray primer #2</td>
<td>340 g/L</td>
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Task 1- Laboratory Validation

• 2024 and 7075 aluminum alloys

• Four surface treatments
  – Cr(IV) Alodine 1200s (NAVAIR and PPG applied)
  – Sulfuric Acid Anodize (Type II) with dichromate seal
  – TCP
  – Prekote

• Comparison of five primers
  – Ecoat #1 and Ecoat #2 with two levels of corrosion inhibitor
  – MIL-PRF-23377N Cr-free spray primer
  – MIL-PRF-23377C Solvent Cr spray primer
  – MIL-PRF-85582C Water Cr spray primer

• Primer-only and with MIL-PRF-85285 Type I Gloss white topcoat
Performance Tests

• Corrosion
  – B117 Neutral salt spray
  – Filiform
  – SO₂ salt fog
  – GM9540P
  – Beach Exposure (Kennedy Space Center)
  – Galvanic assemblies
    • Neutral salt spray
    • SO₂ salt fog
    • Beach Exposure
Performance Tests

- Fluid Resistance
  - MIL-PRF-23699 lubricating oil
  - MIL-PRF-83282 hydraulic fluid
  - JP-8 + 100 jet fuel
  - Skydrol LD-4
  - Water
  - JP-5 jet fuel

- Adhesion
  - Wet
  - Dry

- Flexibility
  - Mandrel bend
  - GE impact
## Results summary

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<tr>
<th>Test</th>
<th>Comments</th>
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<tr>
<td>Salt spray</td>
<td>Better than/ equal to NC spray primer</td>
<td>✓</td>
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<tr>
<td>Filiform</td>
<td>Better than/ equal to Cr spray primer</td>
<td>✓</td>
</tr>
<tr>
<td>9540P</td>
<td>Better than/ equal to Cr spray primer</td>
<td>NR</td>
</tr>
<tr>
<td>SO₂</td>
<td>Equal to controls</td>
<td>NR</td>
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<tr>
<td>Flexibility</td>
<td>Equal to controls</td>
<td>✓</td>
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<tr>
<td>Wet/ Dry Adhesion</td>
<td>Better than/ equal to controls</td>
<td>✓</td>
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<td>Impact</td>
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<tr>
<td>Water Resistance</td>
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<tr>
<td>Exposure Galvanic</td>
<td>Equal to controls</td>
<td>NR</td>
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<tr>
<td>Salt spray Galvanic</td>
<td>Mixed results</td>
<td>NR</td>
</tr>
<tr>
<td>SO₂ Galvanic</td>
<td>Mixed results</td>
<td>NR</td>
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• AA2024-T3 & AA7075-T6
• Alodine 1200s, TCP, Prekote
• Testing:
  – ASTM B117 (500 hrs/3 weeks)
  – ASTM G85.A4 (336 hrs/2 weeks)
  – Beach exposure (still in testing- 9 months)
• Corrosion testing- 3 weeks SO\textsubscript{2} (ASTM G85. Annex 4)
Corrosion mechanism different between Electrocoat and spray primers

- Electrocoat has larger area of blistering; all surface corrosion
- Spray primers have more localized, but deeper corrosion

Scribe near fastener hole

Residual coating

End of scribe

Ecoat

Cr spray primer

NC spray primer
Task 2- Tank installation at Military Depot

• Potential parts
Task 2- Tank installation at Military Depot (Option 1)

- Technology demonstration using 100 gallon, self-contained electrocoat system
Task 2- Tank installation at Military Depot (Option 2)

• Utilization/ modification of existing equipment

~ 200 gallon tanks

~ 2000 gallon tanks
Project Team

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**Julia Russell:** PI (Aug 2010- September 2012)
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USAF CPCO/WRAFB

**CWO Randall Langley:** Co-performer
USCG Airworthiness Sustainment Branch –Corrosion Program Manager

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