Low Temperature Powder Coating
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ASETSDefense Conference
New Orleans, La

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**Low Temperature Powder Coating**

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<th>1. REPORT DATE</th>
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Ogden Air Logistics Center, Hill AFB, UT, 84056

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**Abstract:**

**Subject Terms:**

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- Same as Report (SAR)

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**Name of Responsible Person:**
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**Standard Form 298 (Rev. 8-98)**
Prescribed by ANSI Std Z39-18
Overview

• Current wet coating processes present environmental risks
  • Results in the release of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs)
  • Legacy primers contain hexavalent chrome

• Conventional powder coatings result in an alternative highly durable coating
  • Results in the release of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs)
  • Conventional powders cure at temperatures detrimental to some alloys

• Low Temperature Cure Powder Coating (LTCPC) is an alternative to conventional powder coating
  • Cures at < 300 F
  • Still HAP/VOC free
  • Possibly formulated with corrosion inhibitors so chromated primers are not required
## Project Team

<table>
<thead>
<tr>
<th>Wayne Patterson</th>
<th>Warren Assink</th>
<th>David Piatkowski, Chris Mahendra</th>
<th>James Davila, Chris Geib</th>
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<tr>
<td><strong>OOGDEN ALC</strong></td>
<td><strong>AFRL</strong></td>
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<td><strong>Hill AFB, UT</strong></td>
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Demonstration Sites

**Validation Phase**
- Hill AFB, UT
- NAVAIR Pax River, MD
- CTC, Johnstown, PA
- NASA, Kennedy Space Center, FL

**Evaluation Phase**
- OO-ALC, Hill AFB, UT
- OC-ALC, Tinker AFB, OK
- WR-ALC, Robins AFB, GA
- NAS Whidbey Island, WA
- FRC Southwest, North Island, CA
Technical Objectives

The LTCPC Program was initiated with the following performance objectives:

• Demonstrate that LTCPC can show performance comparable to wet paint coatings in laboratory testing

• Demonstrate that the LTCTC, as applied by trained coating personnel can withstand operational conditions as well as, or better than, wet paint coatings

• Determine whether the use of LTCPC can result in process and/or environmental cost savings
**TECHNICAL APPROACH**

**Powder Coating Technology**

- Low Temperature Cure Powder Coating
  - Developed under SERDP Project WP-1268
  - Addressed deficiencies of conventional powder coatings
    - High curing temperatures
    - Long-term (>1000hrs) corrosion resistance

**Equipment**

- Corona Gun with adjustable voltage
  - Addresses limitation of conventional Corona Guns (Faraday Cage)
  - Improves uniformity of powder coverage within tight corners and recessed areas
TECHNICAL APPROACH

Current Wet Coating Process

- Solvent
- Part A
- Part B
- Mix/Thin
- Primer Application
- Spray primer
- Wait 8-12 hours
- Topcoat Application
- Spray topcoat
- Wait 12 hours
- Done

Proposed LTCPC

- Powder
- Hopper
- Spray component
- Bake 30 minutes 250 F
- Done

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Pros
- Storage / Shelf Life
- Single Component
- Quick
- Durable
- No VOC
- Transfer Efficiency 95%
- Waste is recyclable

Cons
- Small Parts (limited to booth & oven size)
- Geometries
- Must be cured at Temperature/Time
- Gas or Electric Oven
JTP Results

Filiform Corrosion Resistance

- LTCPC met requirements of MIL-PRF-23377 on two panels
- Third panel exhibited a single filament extending slightly beyond allowable tolerance

LTCPC on 2024 T-3 Clad

LTCPC on 2024 T-3 Clad
JTP Results

Neutral Salt Spray

- LTCPC performance similar or better than wet coating
JTP Results

Flexibility / Impact Resistance

- LTCPC met requirements of MIL-PRF-23377 and MIL-PRF-85285

Back – LTCPC on 2024, 0 Temper Al

Front – LTCPC on 2024, 0 Temper Al
JTP Results

Adhesion Testing

- LTCPC with pretreatment passed all adhesion testing

19. MIL-PRF-23377/MIL-PRF-85285 w/DOW 7 Pretreatment
20. LTCPC w/DOW 7 Pretreatment
21. LTCPC w/No Pretreatment (3b adhesion rating)
22. LTCPC w/DOW 7 and Prekote Pretreatment

(Magnesium Substrate, AZ31B)
JTP Results

Gravelometer

MIL-PRF-23377/85285

Powder Coat
## JTP Results

### Summary

**WP-0614 LTCPC JTP Test Results**

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Appearance</th>
<th>Salt Spray</th>
<th>SO2</th>
<th>Cyclic</th>
<th>Filiform</th>
<th>Adhesion</th>
<th>Impact</th>
<th>Strip</th>
<th>Immersion</th>
<th>Humidity</th>
<th>Gravel</th>
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**Legend:**
- LESS = Less than control
- SAME = Same as control
- BETTR = Better than control

**Notes:**
1. Two of three LTCPC panels passed. One panel exceeded limit by 1/32 in.
2. Met requirements in the MIL Standards (MIL-PRF-23377, MIL-PRF-85285, MIL-PRF-24712)
3. Non methylene chloride stripper effective.
4. Exceeded 3300 hrs in salt spray
Demonstration Testing

- USAF & USN Demonstration Sites & Test Articles
  - NAS Whidbey Island, WA
    - Depot for majority of the LTCPC Navy Demo GSE
    - Engine Yokes
    - Partial results collected on tow bars, pod cradles, and bomb hoists, but coating was stripped early due to NDE requirements
  - NAS North Island, CA
    - Maintenance facility for GSE deployed on the USS Ronald Reagan
      - Nitrogen Carts
  - OO-ALC, Hill AFB, UT
    - C-130 forward landing gear doors
    - C-130 Throttle Quads
Results - Demonstration Testing

- Navy Ground Support Equipment Field Service Evaluation – NAN-4 Nitrogen Servicing Cart
Results - Demonstration Testing

Results - Demonstration Testing

- Air Force Field Service Evaluation – C-130 Nose Landing Gear Doors (Interior Surfaces)

Chromate CC LTC Powder
C-130 Throttle Quads

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Conclusions and Summary

• Low Temperature Cure Powder Coatings performs comparably to conventional wet coatings both in laboratory and field service evaluations

• LTCPC allows environmental cost reductions through VOC/HAP elimination and hexavalent chrome reduction.

• The LTCPC process greatly shortens the coating operation (LTCPC cures much more rapidly then conventional wet coatings) resulting in labor savings and improved part processing rates.
Conclusions and Summary

• Powder Coatings are not a total replacement for wet paints…However they are a viable replacement for quite a few back shop processes
  • Be observant and cognoscente of processes
  • Don’t be afraid to try it…Use the Correct Procedure…get authorizations
  • Document successes and failures

• New Powders are being Developed as Industry sees the Need and possibilities of use.


