Electrocoat Primers for the Aerospace Industry

PPG GOVERNMENT SOLUTIONS

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Enhanced Coating Systems for the Aerospace Industry

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The new generation of aircraft substrates combined with environmental regulations present challenges to develop new materials and/or processes for painting.

PPG has responded to the need for Cr(VI)-free coatings via two pathways:

- Elimination of Cr(VI) in conventional coating systems
  - Cr(VI)-free conversion coating
  - Cr(VI)-free sol-gel surface treatment
  - Spray primer containing novel corrosion inhibitor pigments
- New coating process
  - Electrocoat primer - Aerocron™

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Electrocoat Primers for the Aerospace Industry

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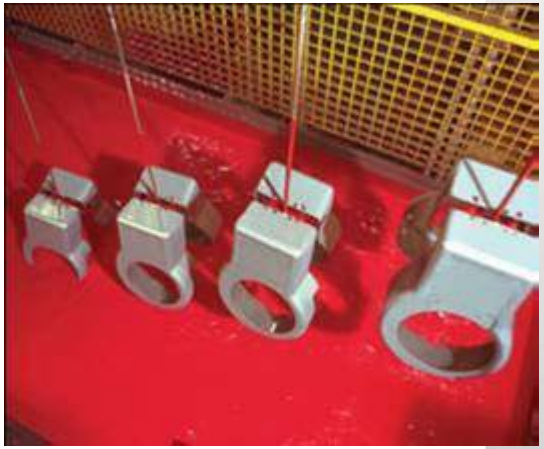
- Electrocoat Basics
- Why Electrocoat
- Electrocoat Process
- Test Results
- Conclusions



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Electrocoat Basics

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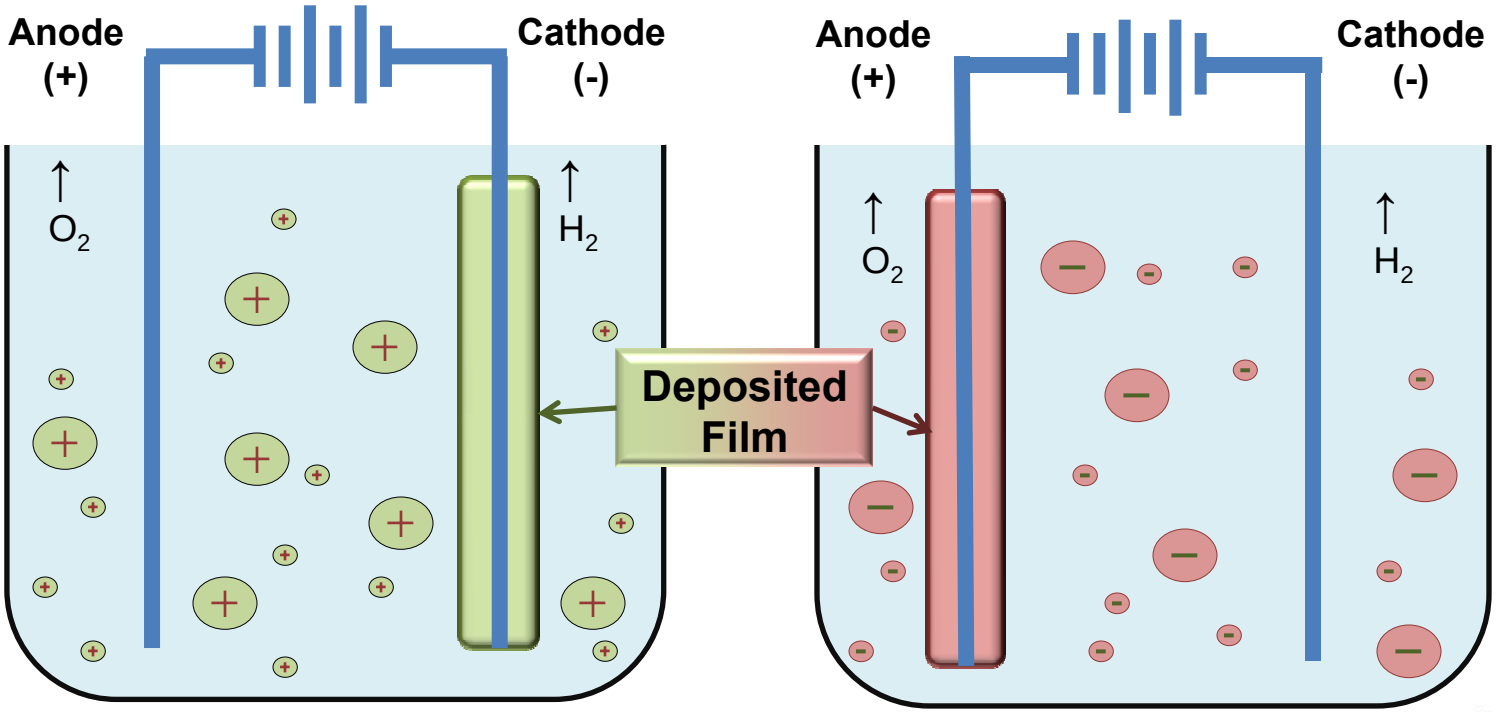
- Electrodeposition Process
  - Method of applying a coating which uses electrical current to deposit aqueous dispersed resins and pigments onto a conductive substrate
  - Coatings can be applied via anodic or cathodic deposition



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Cathodic vs. Anodic Electrocoat

- **Cathodic**
  - Positively charged paint particles
  - 300°F or higher cure
  - Excellent corrosion resistance for Ferrous substrates
    - Armor, ground support equipment, munitions
- **Anodic**
  - Negatively charged paint particles
  - Lower temperature cure 200 – 250°F
  - Especially applicable to Aluminum substrates
    - Aircraft, wheels, light weight vehicles

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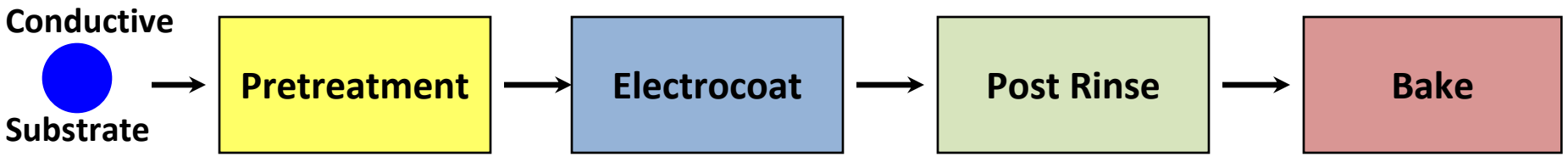
Typical Electrocoat Process



Process Considerations

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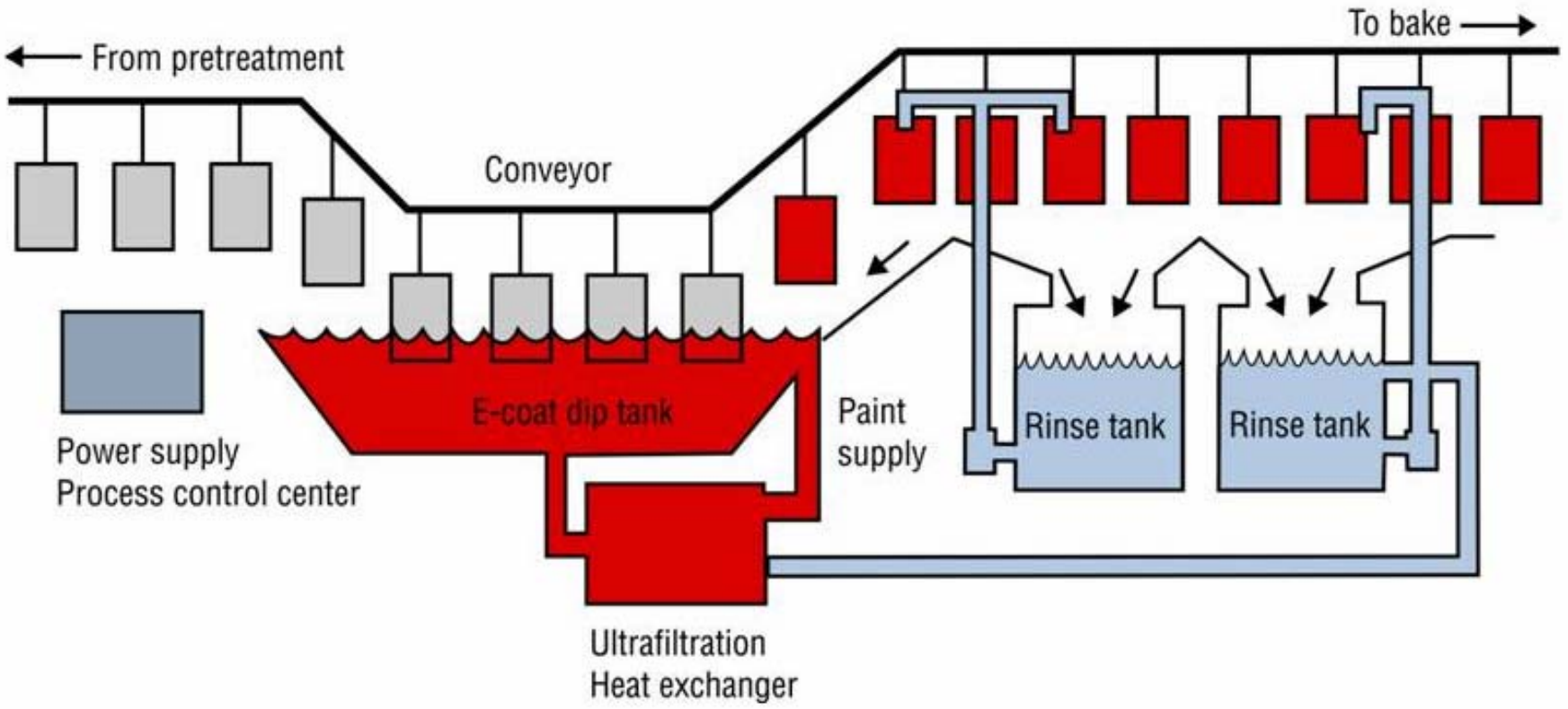
Components of an Electrocoat Conveyor Process



Why Electrocoat for Aerospace?

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- Environmental, Health and Safety Considerations
  - Aqueous based
  - Minimal waste discharge – closed loop process
  - Minimal exposure of workers to hazardous materials
- Productivity / Efficiency
  - Automated process – increased productivity
  - Virtually 100% materials utilization
  - Immediate part handling after thermal cure (30 minutes @ 200 ^{o}F)
    - Do not have “dry to touch”, “dry to tape”, “dry to fly” restrictions
- Application / Performance
  - Uniform film across entire surface including recessed areas
  - Excellent barrier / corrosion resistance properties

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EH & S and Productivity Considerations

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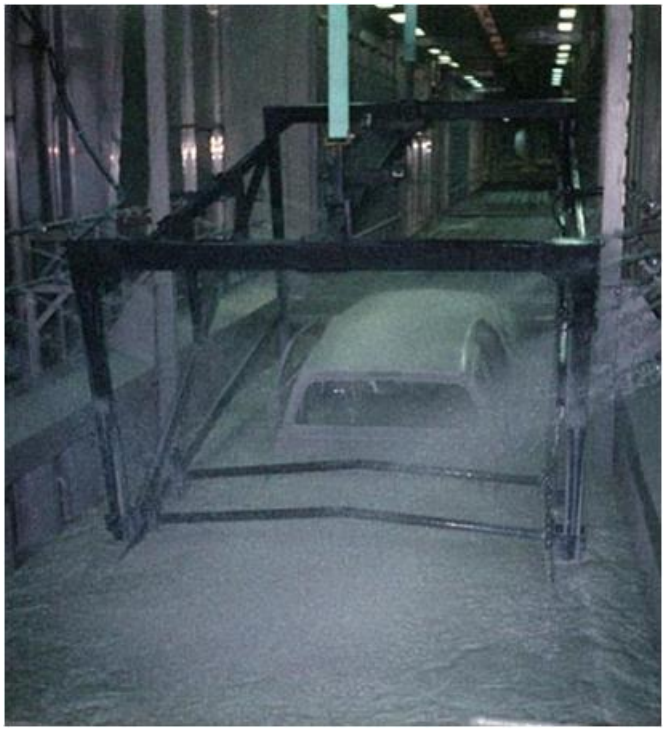
Conventional Solvent based spray coating process

- Use of PPE required
- Labor intensive

Standard OEM Electrocoat process



- Aqueous based coating
- Automated process minimizes worker exposure

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Application Considerations

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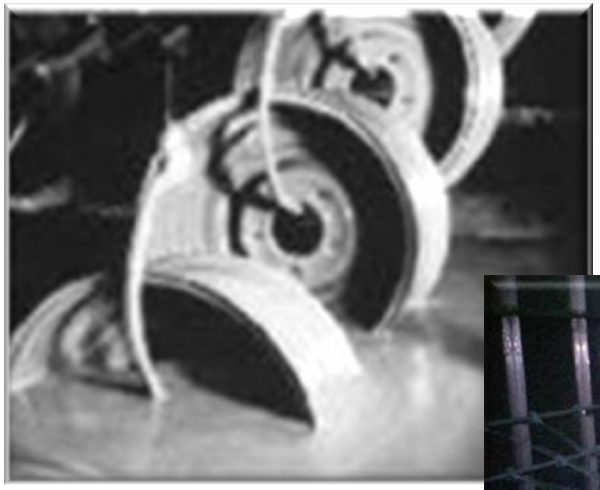
- Ability to coat complex shapes



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Performance Considerations

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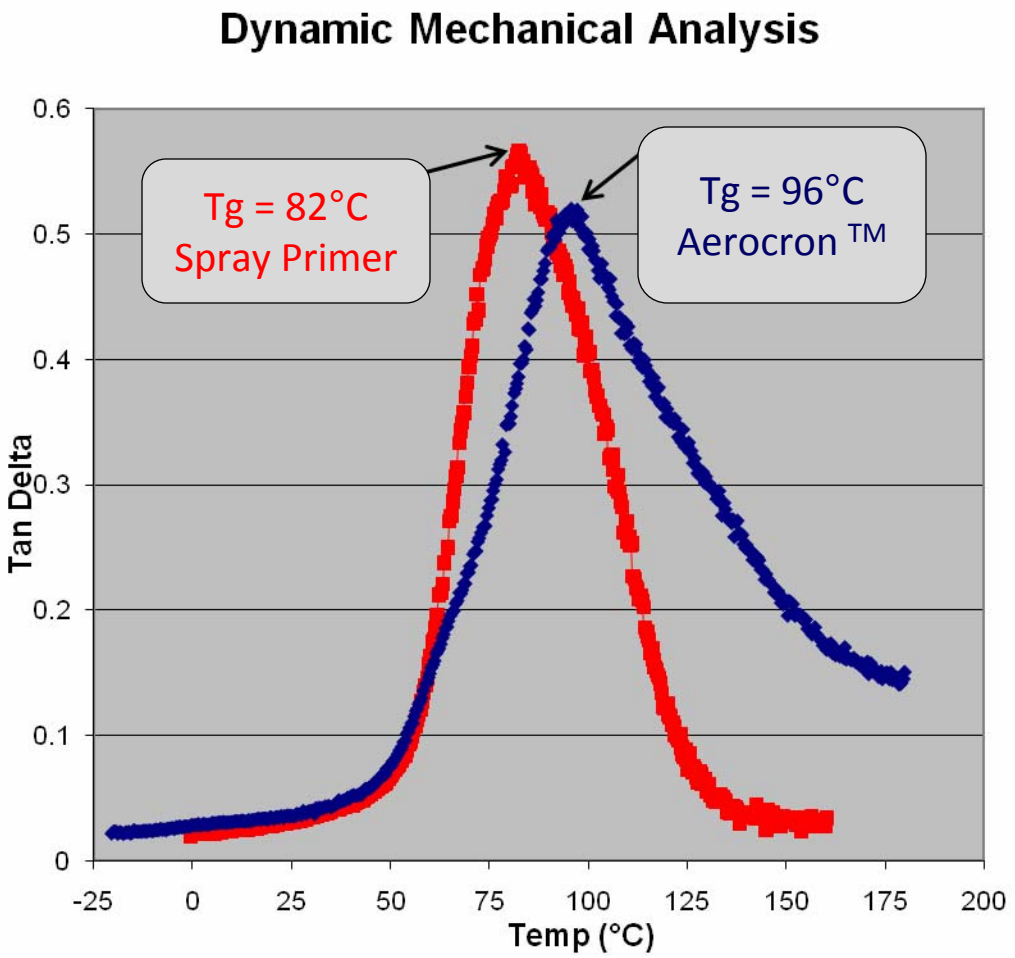
- Uniform Coating Thickness
- High Crosslink Density
- Good Barrier Properties



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Coating Performance Criteria
Spray Applied Coatings

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- Various Aerospace Specifications
  - MIL-PRF-23377J
  - BMS 10-11Y
  - BMS 10-79M
  - MIL-PRF-85582
  - MIL-PRF-85285

- **Key Performance Criteria**
  - **Corrosion**
  - **Fluid Resistance**
  - **Adhesion**
  - **Flexibility**

- Key Application Criteria
  - Mixing and Dilution
  - Viscosity
  - Pot life
  - Cure / Drying Time

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Coating Performance Criteria
Electrocoat Primer Coatings

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-
raft of Aerospace Electrocoat Primer Specification
  - AMS G8 Aerospace Organic Coatings Committee - passed July 2009
  - Awaiting Aerospace Council review / approval

- **Key Performance Criteria**
  - **Corrosion**
  - **Fluid Resistance**
  - **Adhesion**
  - **Flexibility**

- Key Application Criteria
  - Electrocoat Parameters (solids, pH, conductivity)
  - Electrocoat Temperature
  - Thermal Cure Conditions

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Test Results – Adhesion

- Dry Adhesion - **PASS**
  - requirement better than 7 rating per BSS 7225
- Water Resistance – **PASS**
  - 4 days immersion at 120°F
  - No wrinkling, blistering or other coating deficiency
- Humidity Resistance – **PASS**
  - 30 days at 120°F with condensing humidity conditions
  - No loss of adhesion, blistering, or other visible defects

Test Results – Physical Properties

- Pencil Hardness - **PASS**
  - Minimum hardness of F
- Solvent Resistance – **PASS**
  - 50 passes with MEK with no rub through to metal
- Flexibility – **PASS**
  - Room Temperature (75°F)
  - Low (4 hours @ -70°F)
  - High (70 hours @ 350°F)
  - Temperature Shock (160°F to -65°F)
- Impact Resistance - **PASS**
  - No cracking/ loss of adhesion in 50 in/lbs fwd & 30 in/lbs reverse

Test Results – Fluid Resistance

- Fluid Resistance – **PASS**
  - Fluids evaluated
    - Skydrol LD4
    - Jet A Fuel
    - Turbo 2380 Engine Oil
  - No blistering, wrinkling or other visible defects, minimum HB pencil hardness after 30 days of immersion

Test Results – Corrosion

- 3000 Hour Salt Fog Corrosion - **PASS**
  - No blisters or loss of adhesion beyond 1/8 inch from scribe after 3000 hrs of 5% salt spray exposure
- SO2 – **PASS**
  - Mean creepage from scribe ≤ current corrosion protection system
  - Per Joint Test Protocol J-00-GV-001-P1
- Filiform – **PASS**
  - No blisters or loss of adhesion beyond 1/8 inch from scribe after 30 days of humidity exposure

Aerocron™ Electrocoat Performance

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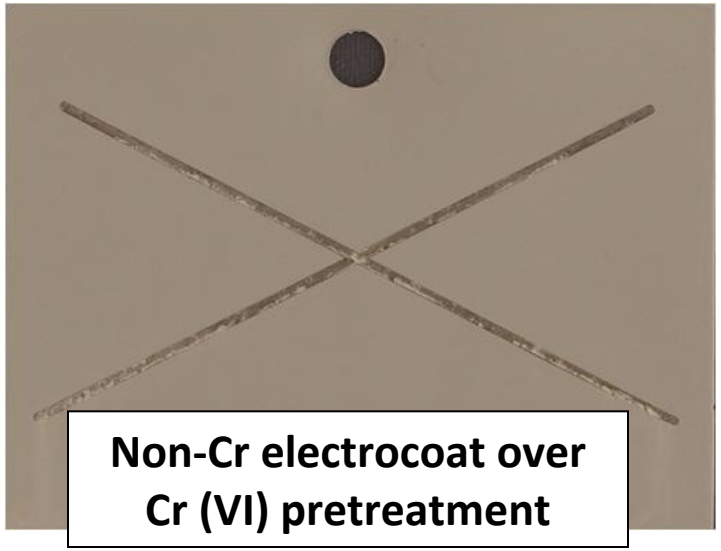
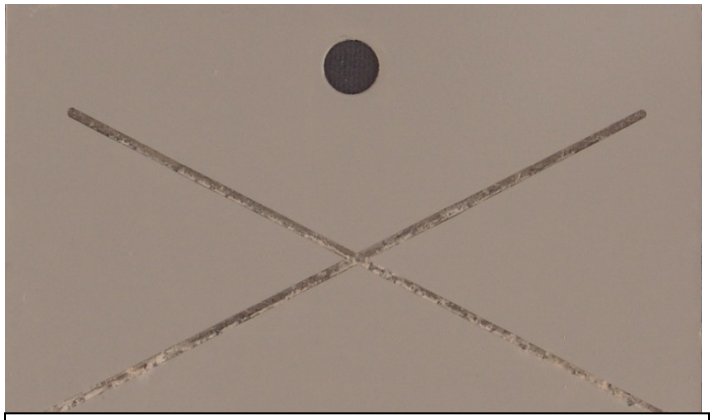


Non-Cr electrocoat over Cr (VI) pretreatment

Salt Fog
(ASTM B117)

3000 Hours



Non-Cr electrocoat over proprietary Cr-free pretreatment

Commercial Cr (VI) spray primer with Cr (VI) pretreatment

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Aerocron™ Electrocoat Performance

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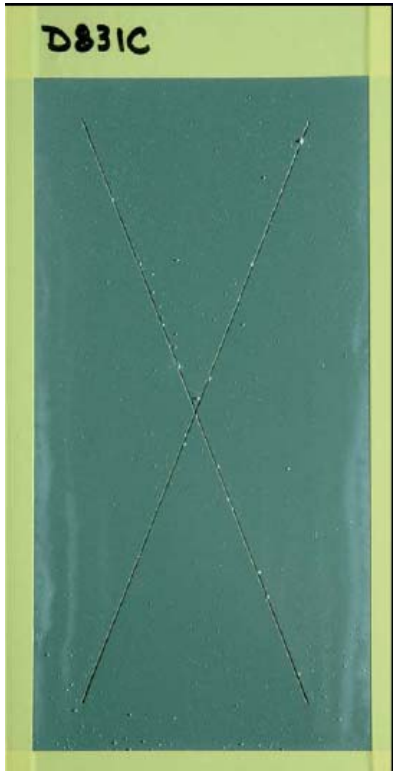
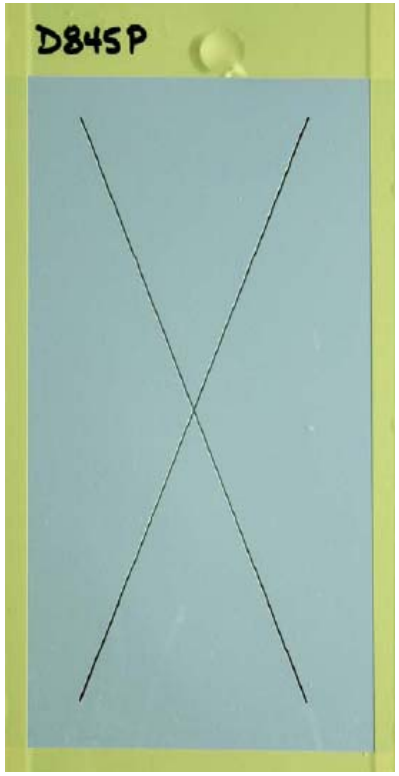
SO_2 testing

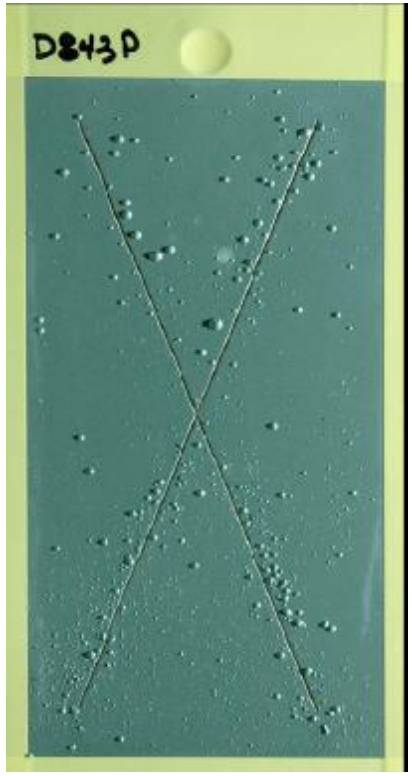
336 hours



Commercial Cr (VI) spray primer with Cr (VI) pretreatment



Non-Cr Electrocoat with Cr-free pretreatment



Commercial Cr (VI) spray primer with Cr-free pretreatment

Test Results – Beach Exposure

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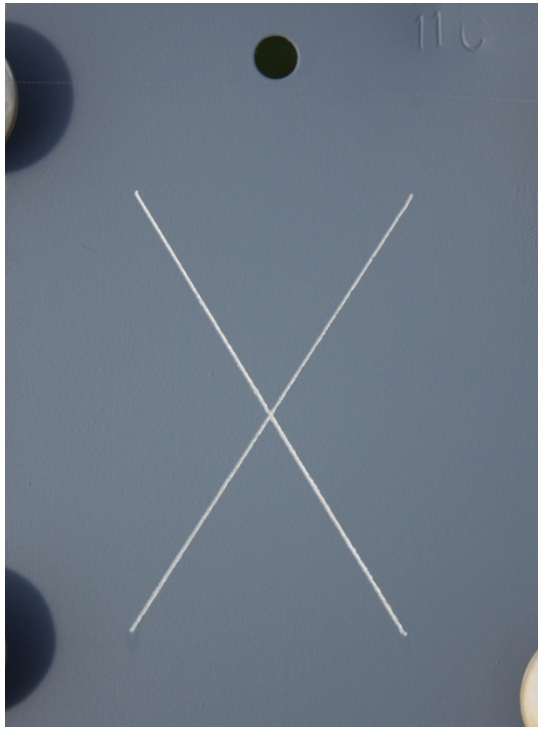
Kennedy Space Center

Topcoated
Commercial Cr (VI) spray primer
with Cr (VI) pretreatment

3 months



Topcoated
Non-Cr Electrocoat
with Cr-free pretreatment

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Conclusions

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Electrocoat Primers for the Aerospace Industry

- Electrocoat primers can provide good performance relative to conventional spray primers
- Advantages of Electrocoat
  - Increased productivity
  - Mitigation of Cr(VI)
  - Full automation
  - Lower waste disposal costs
  - Increased material utilization
  - Uniform coating of complex parts
  - Overall weight reduction

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