

Electrocoat Process for Non-Chromate Primers in DoD Manufacturing

ESTCP Project: WP-201010

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DoD Need for Non-chromate Primer

- Reduce/eliminate worker exposure to Cr(IV)
- Reduce VOCs
- Eliminate drips/sags & inconsistent spray paint film on complex shape components



Electrocoat potential to address DoD Needs

- ✓ **Environmental, Health and Safety Considerations**
 - Heavy metal-free (no Cr, Ce, Co, or Ni)
 - Aqueous based (lower VOC)
 - 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 °F)



Ecoat development for DoD applications

AFRL Project FA8650-5-C-5010 Task 8 (2007-2010)

3rd Party Evaluation to MIL-PRF-23377 :

- Adhesion (3.7.4)
- Flexibility (3.7.5)
- Water Resistance (3.8.1)
- Salt Spray (3.8.1.2)
- Filiform (3.8.2.2)
- Solvent Resistance (3.8.3)
- Fluid Resistance (3.8.4)
- SO₂ salt fog (ASTM G 85 Annex 4)

Passed all applicable requirements



Technical Goals of ESTCP Project

1. Optimize and validate electrocoat primer formulation to obtain performance equivalent to or better than qualified non-chromated & chromated primers.
2. Demonstrate unique anionic electrodeposition application process during depot-level aluminum component rework.
3. Demonstrate environmental, productivity, and life cycle cost benefits of technology.



Project Tasks

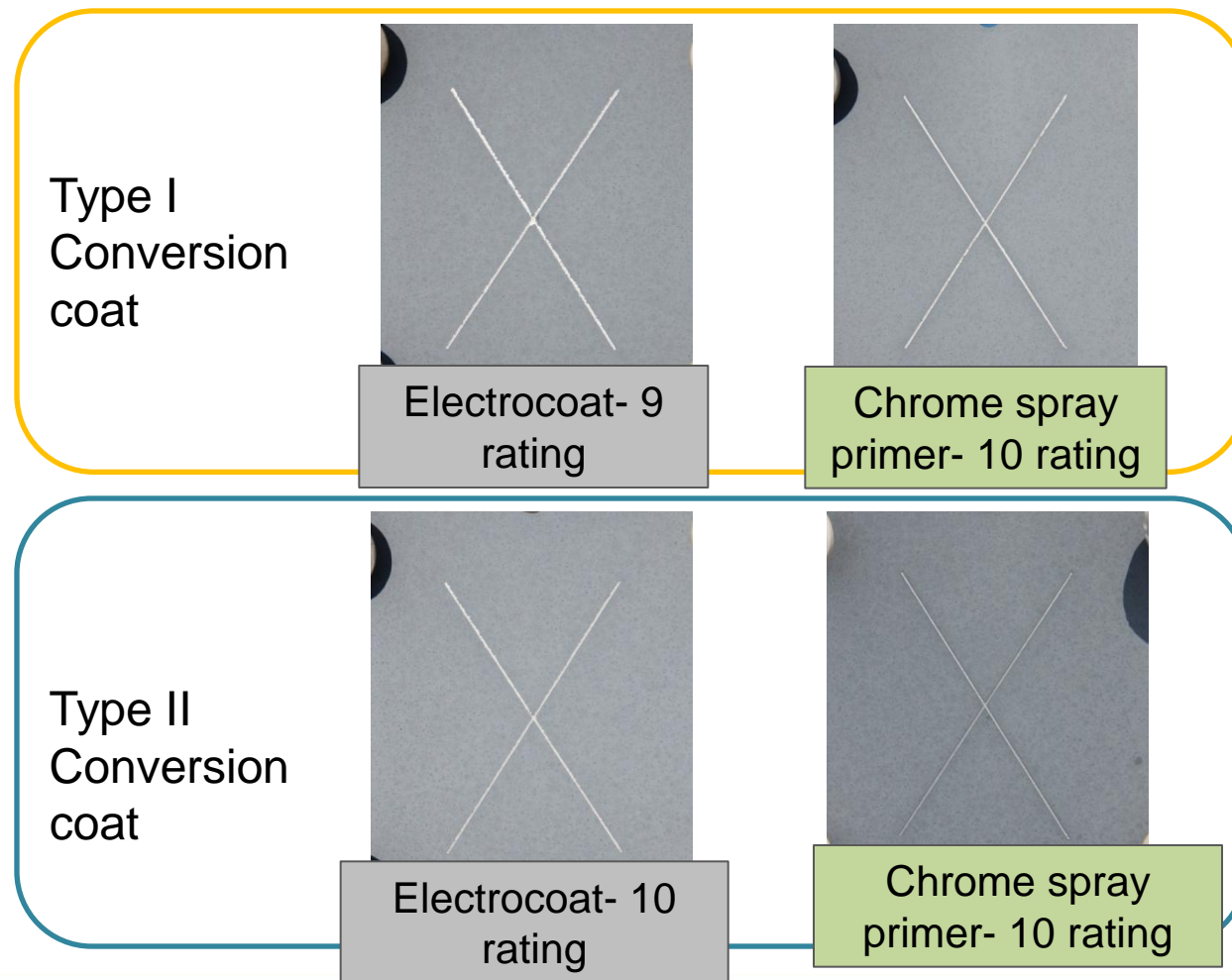
- **Task 1: Proof of Concept/Formula Optimization**
 - Joint Test Protocol to evaluate ecoat against current qualified primers

- **Task 2: Install a 2000-gallon electrocoat equipment at FRC-Southwest (NAS NI)**
 - Provides the capacity to coat parts and assemblies up to several feet in circumference.

- **Task 3: Track and evaluate the performance of the coated parts relative to current qualified primers, as they are**
 - Parts installed on Naval, Air Force, and Coast Guard aircraft
 - Life cycle benefits will be measured in terms of material usage, labor costs, hazardous waste volumes and other environmental considerations

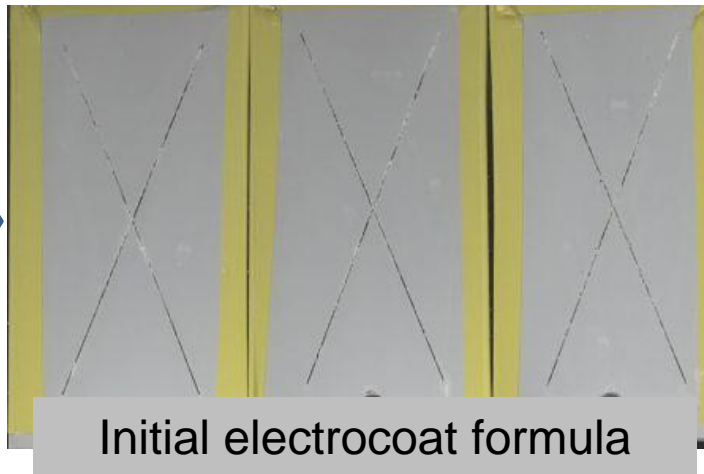


Kennedy Space Center Beach Exposure (24 months)

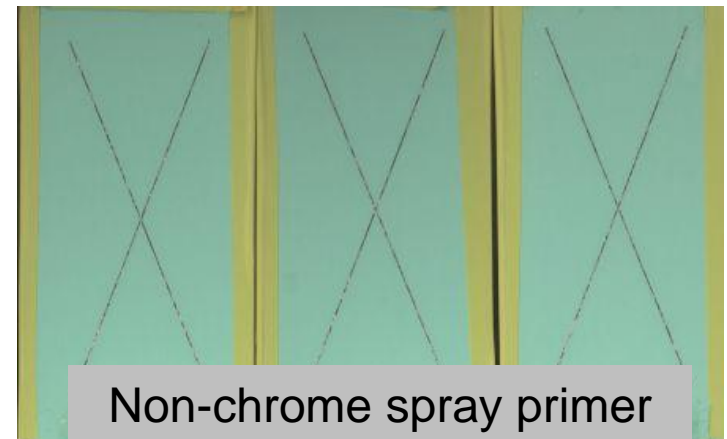
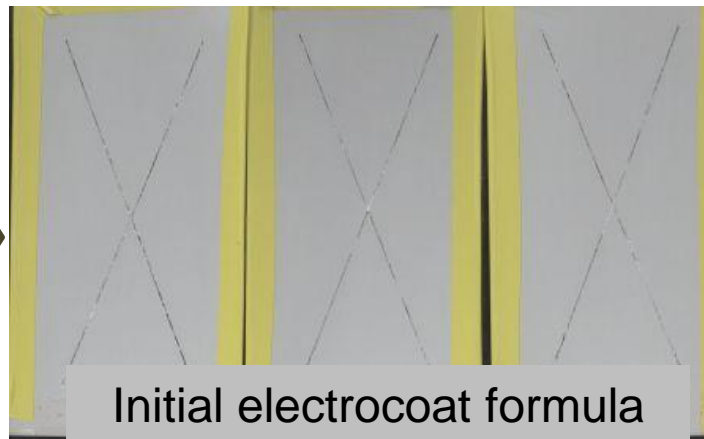


Initial panel screening with NAVAIR (Spring 2010)

2000 hrs
ASTM
B117

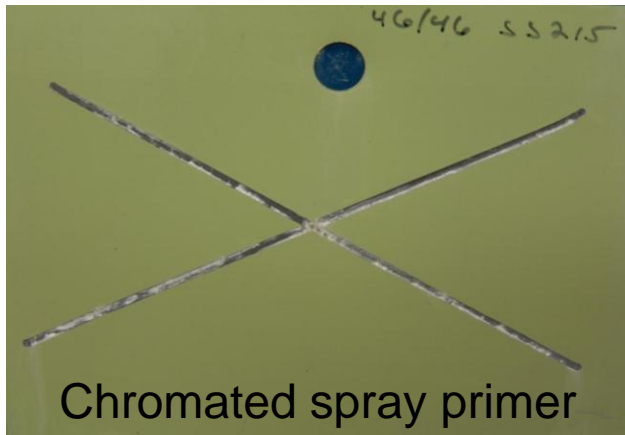
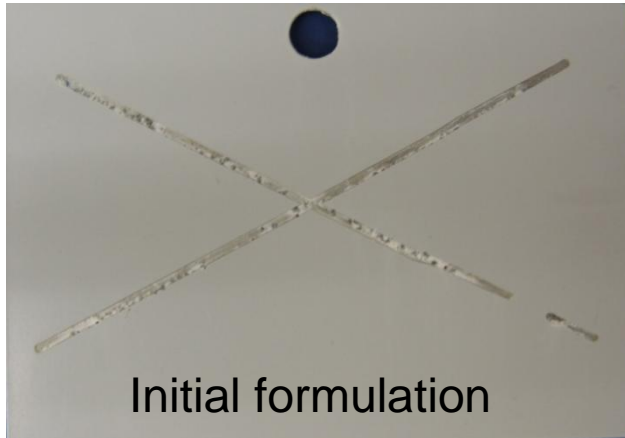



1500 hrs
ASTM
G85.A4

Formula Optimization

B117 salt spray (3500 hrs)



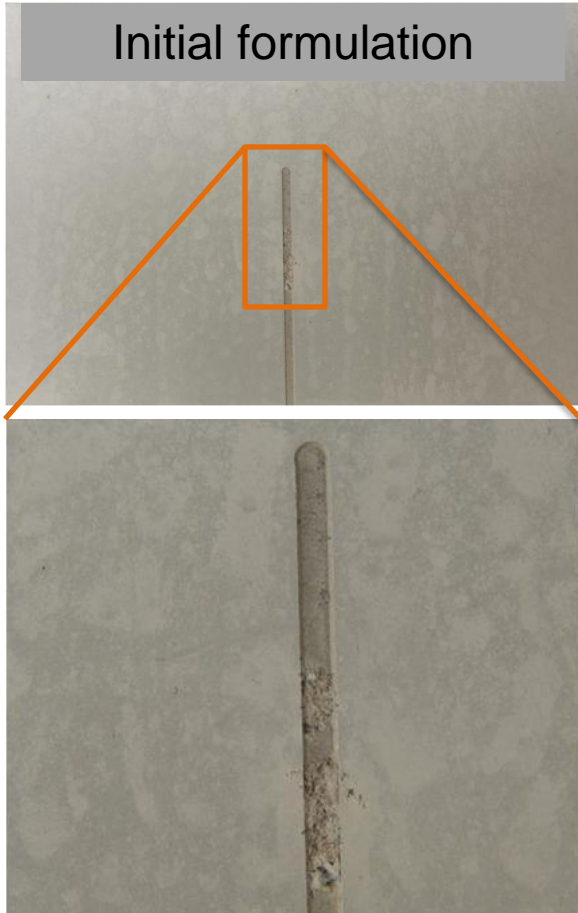
Formulation shows a reduction of corrosion in scribe



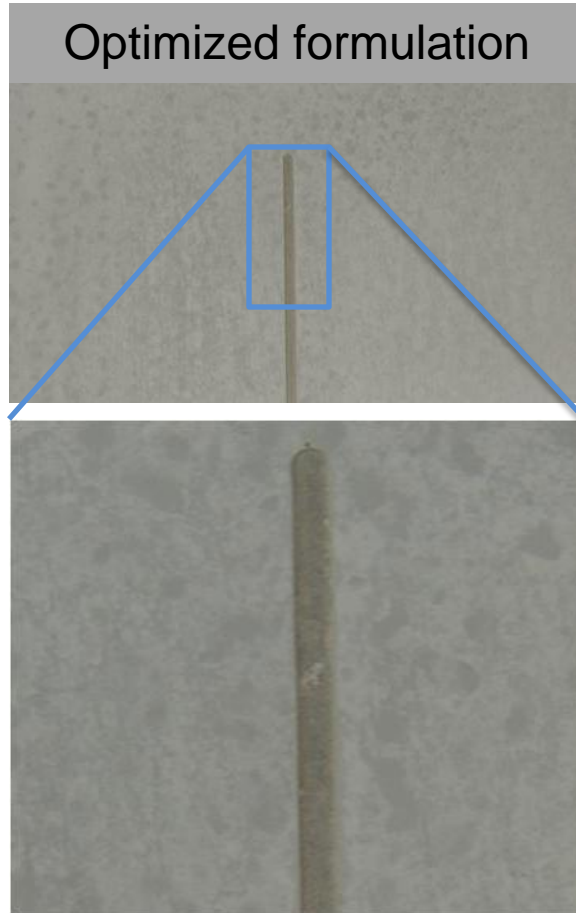
Formula Optimization

Cyclic corrosion/ GMW14872 (120 cycles)

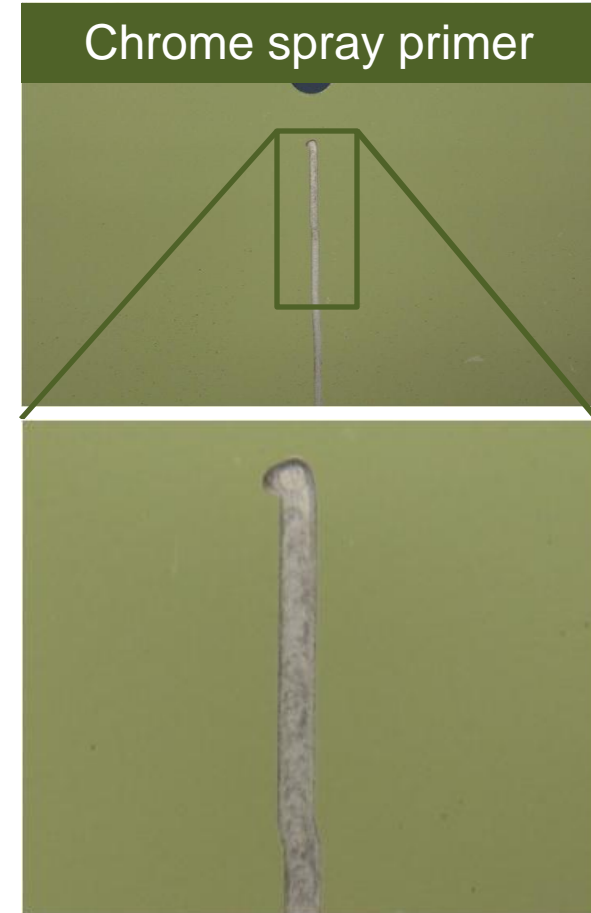
Initial formulation



Optimized formulation



Chrome spray primer



*Optimized formulation shows a **significant** reduction of corrosion in scribe*



Color development

- Original is distinct enough to be unpainted and recognized, but not different enough to be 'flagged'



Phase I-Testing

Joint Test Protocol is based primarily on MIL-PRF-23377, MIL-PRF-32239, and MIL-PRF-85285

- Atmospheric Corrosion Testing:
 - Neutral Salt Spray
 - SO₂ Salt Spray
 - GM9540P (Cyclic Salt Spray)
 - Filiform
 - Beach Environment
 - Flat and galvanic assemblies
- Adhesion
- Flexibility
- Fluid Resistance



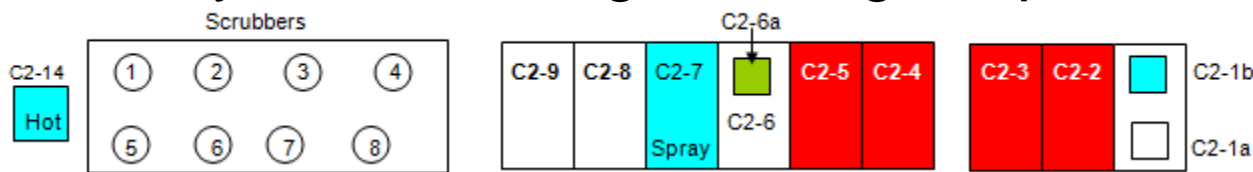
Key Parameters

- Aluminum substrates: AA 2024-T3/T0 & AA7075-T6
- Surface Treatments: MIL-DTL-81706 Type I & II conversion coatings, MIL-A-8625 Type II Anodize w/ dichromate seal, Prekote
- Evaluate two electrocoat formulations alongside qualified Type 1 primers:
 - MIL-PRF-23377C (*PPG CA7233*)
 - MIL-PRF-23377N (*Deft 02GN084*)
 - MIL-PRF-85582C (*Deft 44GN07A*)
- Evaluate coatings systems with topcoat where applicable
 - MIL-PRF-85285 ,Type I (PPG CA8201) F17925 gloss white



Task 2: Installation of electrocoat system

Layout of existing cleaning shop tanks at North Island



Proposed site for electrocoat system

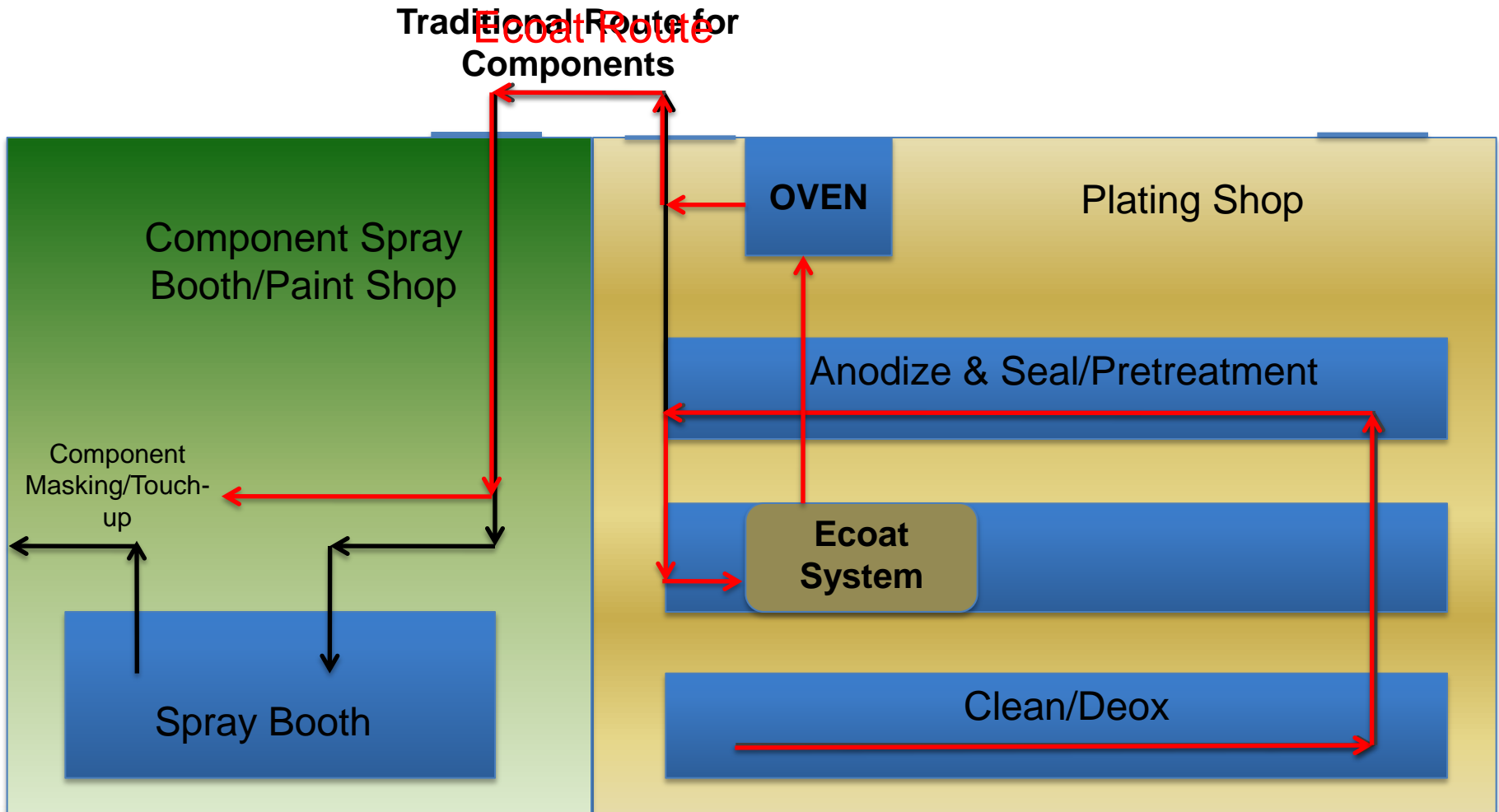


Existing hoist can be used



Proposed tank capabilities

At FRC-SW, Component plating and primer shops located within the same building:



Components ready for installation upon removal from oven



Task III- Select parts and track performance

- Focus on **low-risk components**, such as wheel assemblies, to be installed on Air Force, Naval and Coast Guard aircraft.
- Performance will be tracked relative to hexavalent chromated spray controls
- Electrocoat productivity will be measured in terms of material usage, labor costs, hazardous waste volumes for life cycle calculations.



Challenges

- Electrocoating over anodized & sealed surface
 - Majority of aluminum components are Ty II anodized and sealed with boiling dichromate
 - Anodize insulates the metal while the dichromate seal closes off the pores
 - Results in loss of conductivity and mechanical adhesion
- Re-evaluating FRC SW anodize process
 - Try to replicate FRC SW anodize process at FRC-SE & Boeing St. Louis
 - Evaluate use of TCP as anodize seal



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*Co-PI

‡Co-performer

