

# Electrocoat Process for Non-Chromate Primers in DoD Manufacturing

**ESTCP Project: WP-201010**

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**18 August 2011**



# 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)

*3<sup>rd</sup> 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)
- SO<sub>2</sub> 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.

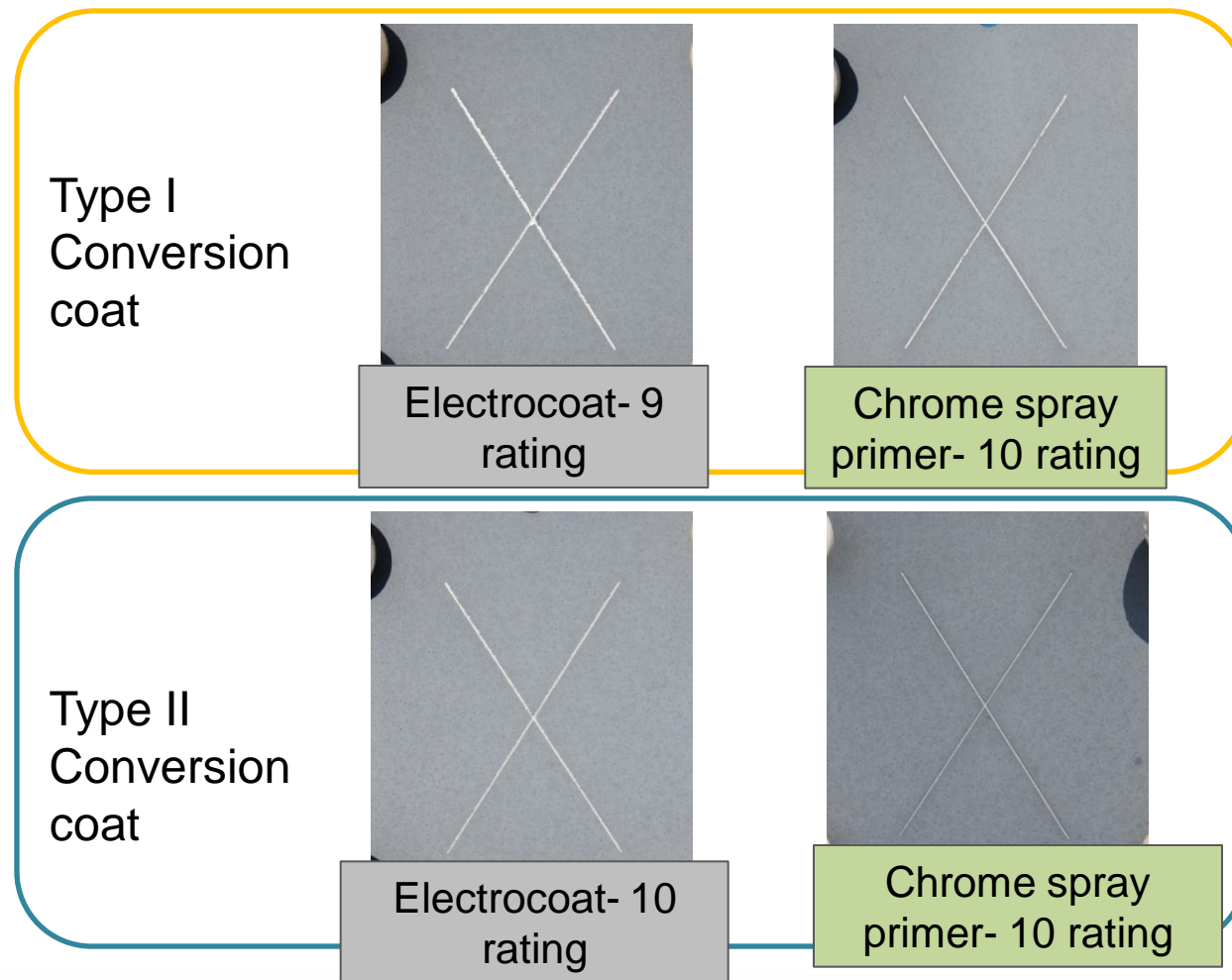


# Project Tasks

- **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

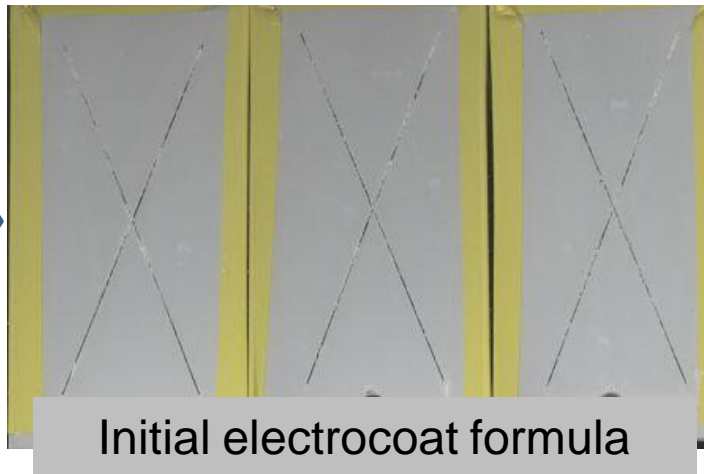


# Kennedy Space Center Beach Exposure (24 months)

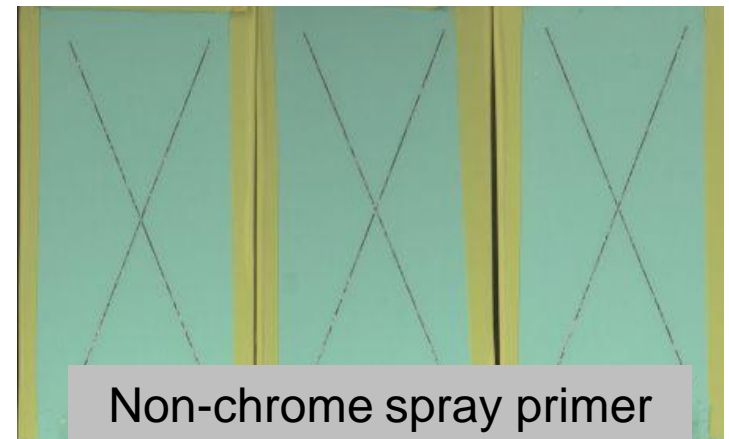
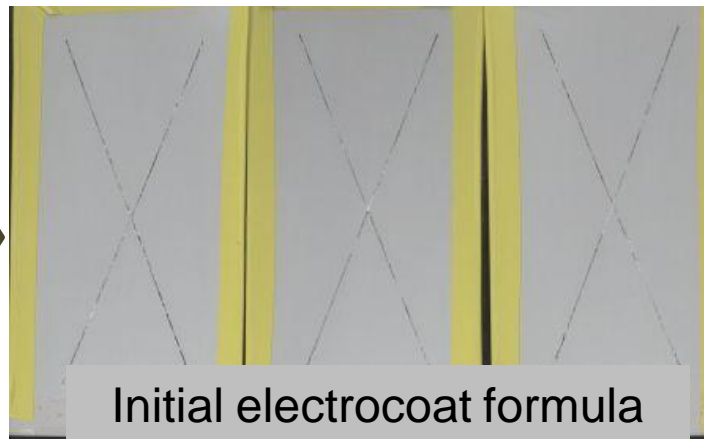


# Initial panel screening with NAVAIR (Spring 2010)

2000 hrs  
ASTM  
B117

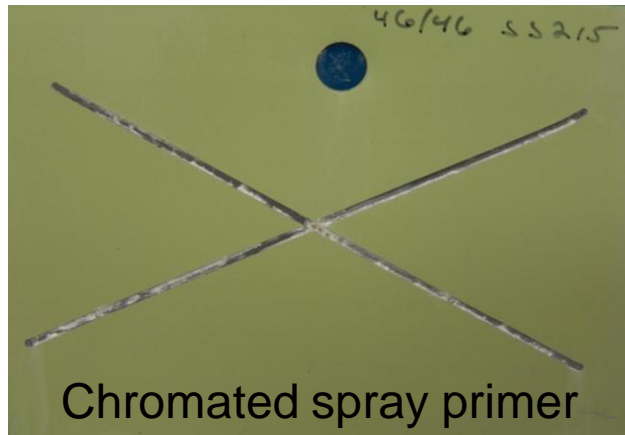
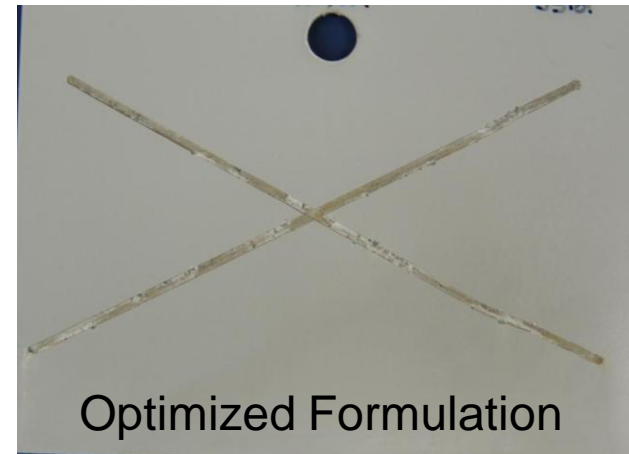
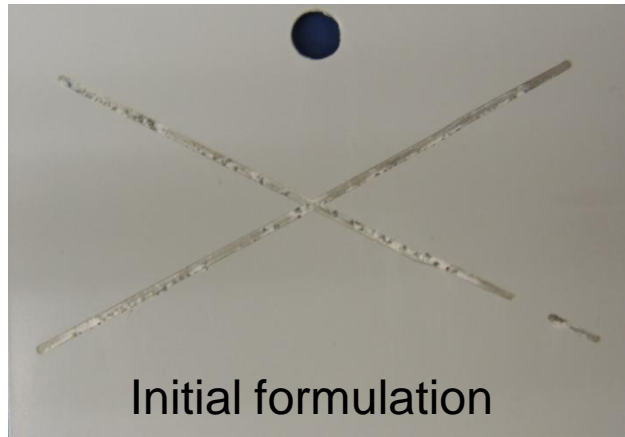


1500 hrs  
ASTM  
G85.A4



# Formula Optimization

B117 salt spray (3500 hrs)



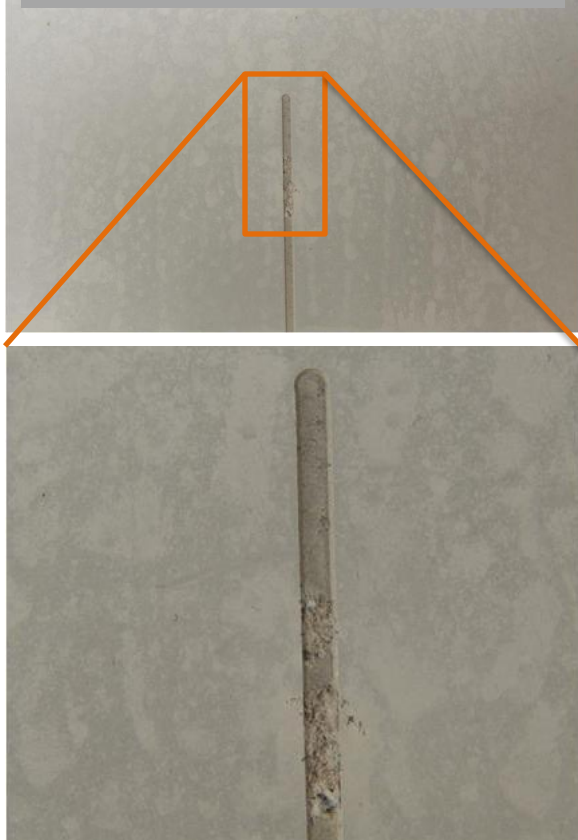
*Formulation shows a reduction of corrosion in scribe*



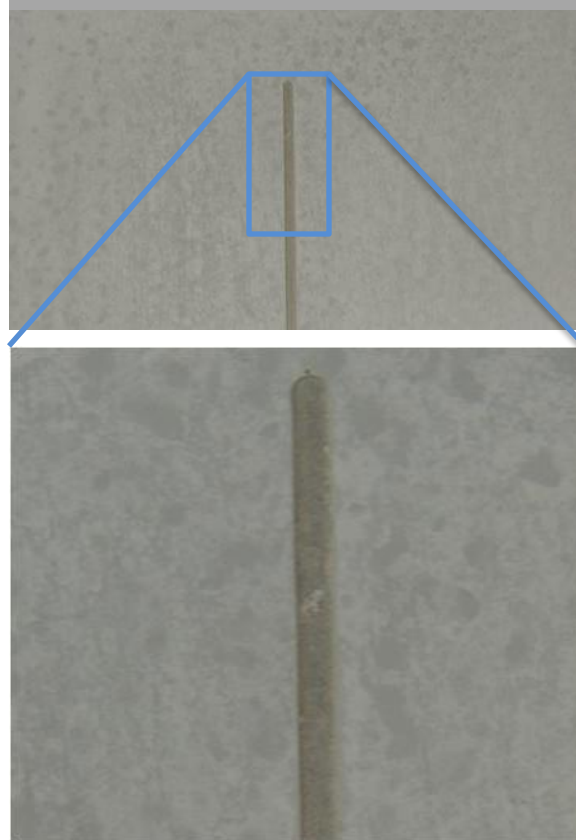
# Formula Optimization

## Cyclic corrosion/ GMW14872 (120 cycles)

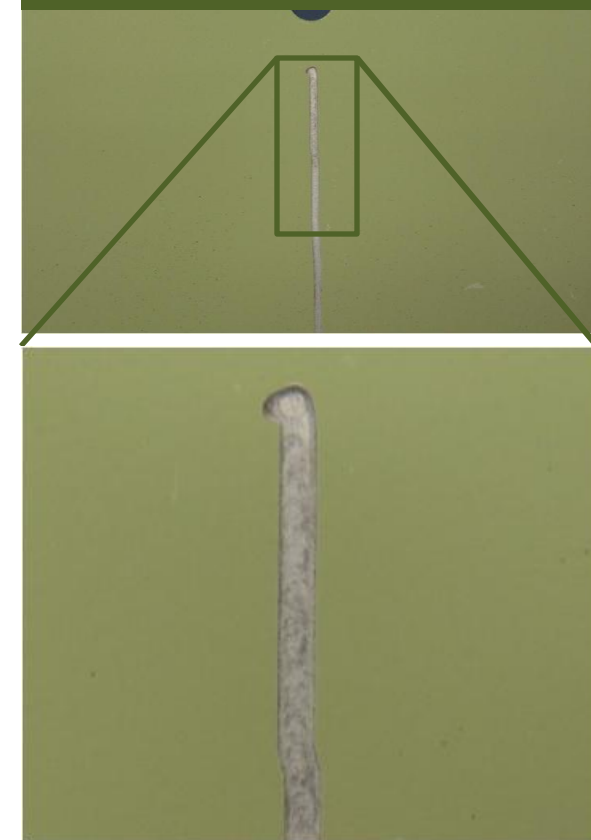
Initial formulation



Optimized formulation



Chrome spray primer



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



# Color development

- Original is distinct enough to be easily 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
  - SO<sub>2</sub> Salt Spray
  - GM9540P (Cyclic Salt Spray)
  - Filiform
  - Beach Environment
    - Flat and galvanic assemblies
- Adhesion
- Flexibility
- Fluid Resistance



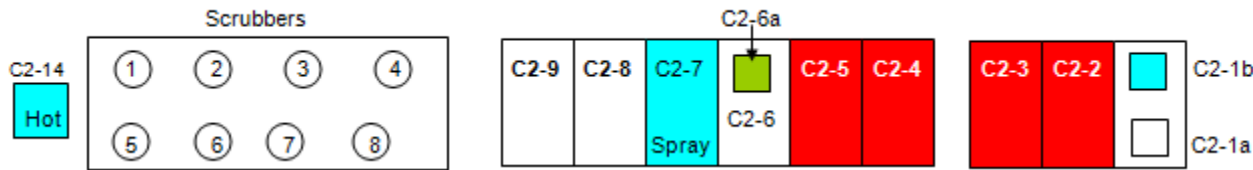
# Key Parameters

- 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

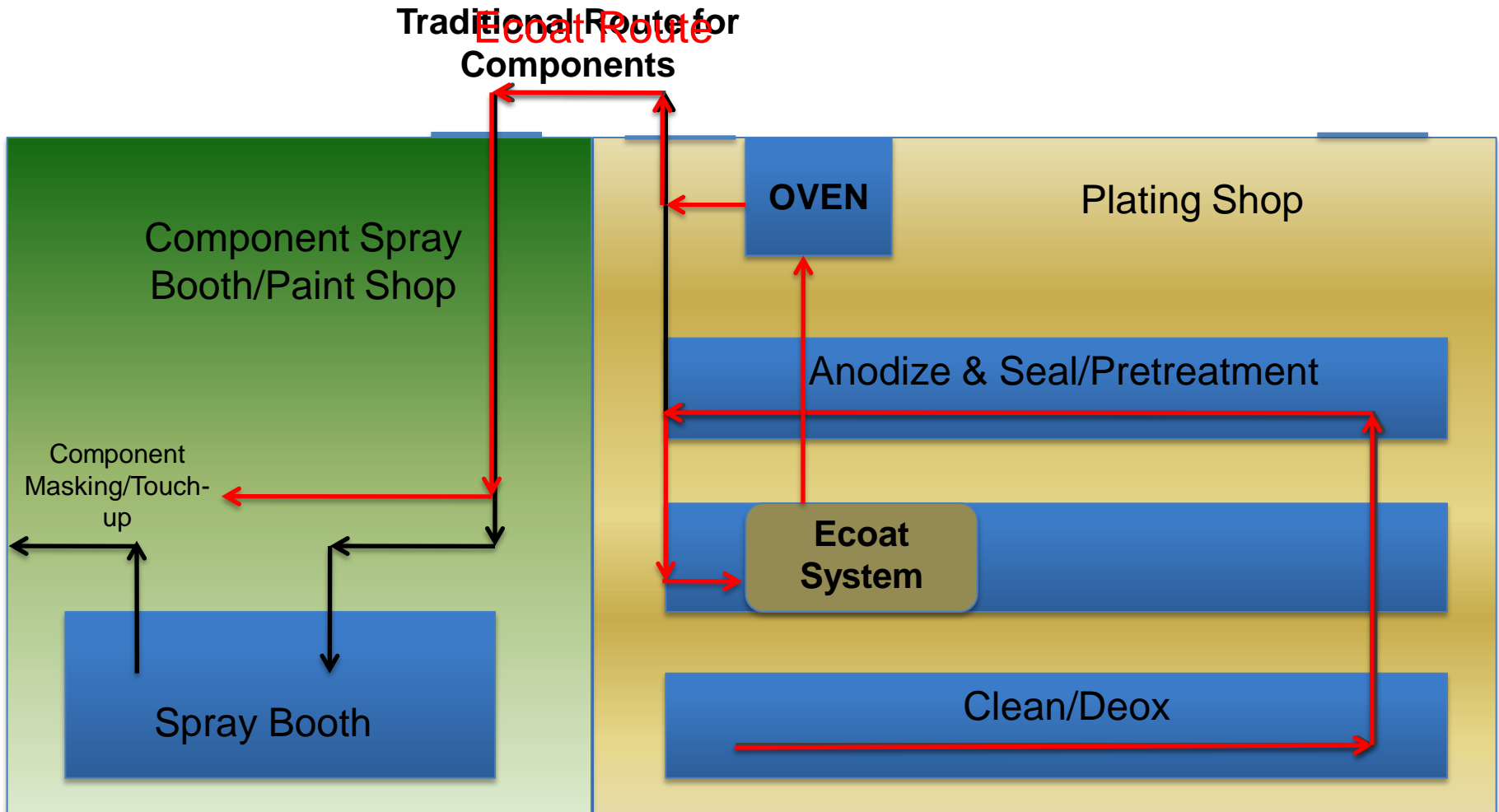


Existing hoist can be used



# 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



# Acknowledgements

- ESTCP
  - Bruce Sartwell
- Air Force CPCO
  - 2<sup>nd</sup> Lt. Kevin Chang‡
  - 1<sup>st</sup> Lt. Doug Banning
  - SMSgt Scott Pagenkopf
  - Mark Foley
  - Corey Bliss
    - Air Force Research Labs
- US Coast Guard
  - CWO Randall Langley ‡
    - USCG Airworthiness Sustainment Branch, Corrosion Program Manager
  - Sam Benavides
- NAVAIR
  - Craig Matzdorf
    - NAVAIR Materials Engineering, NAS PAX
  - Bill Nickerson
  - Luc Doan ‡
    - Southwest Fleet Readiness Center
- PPG
  - Thor Lingenfelter\*
  - Robin Peffer
  - Duane Utter
  - Mike Pawlik

\*Co-PI

‡Co-performer

