



# Environmentally Friendly Pretreatments for Ferrous and Non-ferrous Substrates

**Fred Lafferman/ ARL**

**Paul Robinson/ AMCOM G-4**

**Daniel Pope/ ARL**



U.S. ARMY  
**RDECOM**

# Agenda



- **Programs**
- **Laboratory Testing**
- **Ground Support Equipment Demonstrations**
- **Aviation Demonstrations**
- **Transition**



U.S. ARMY  
**RDECOM**

# Programs



- **Environmentally Friendly Zirconium Oxide Pretreatment (WP-1676)**
  - Funded By Strategic Environmental Research and Development Program (SERDP)
  - FY09- FY12
- **Demonstration of Zirconium Oxide Pretreatment to Prevent Corrosion (WP-201318)**
  - Funded by Environmental Security Technology Certification Program (ESTCP)
  - FY13-FY16
- **Environmentally Friendly Zirconium Oxide Pretreatment (W14AR01)**
  - Funded By Office of the Secretary of Defense (OSD)
  - FY14-FY16
- **Cr(VI)-Free Conversion Coatings (TMR 14-02)**
  - Funded as part of the Environmental Quality Technology Pollution Prevention Toxic Metal Reduction (TMR)
  - FY14-FY19



U.S. ARMY  
**RDECOM**

# Laboratory Testing

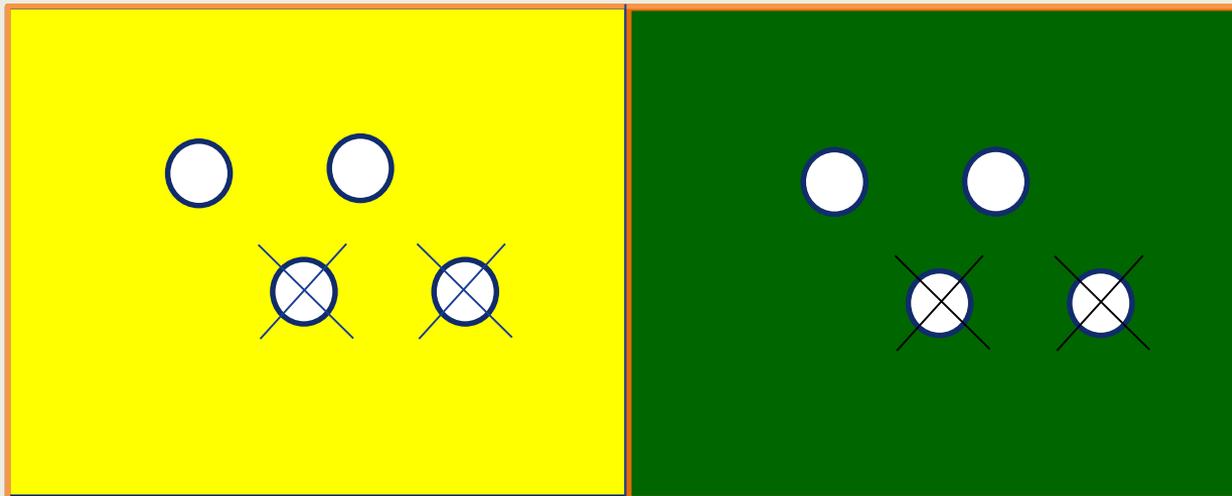
# ARL

- **Screen commercially available products**
  - Galvanic cyclic test
  - Cross hatch adhesion
- **Down selection the best performing products.**
- **Initiate long term testing on laboratory samples**
  - B-117 neutral salt fog
  - GMW-14872 Cyclic testing
  - Outdoor static testing
  - Additional Galvanic cyclic testing
  - All other Specification required testing
- **Final down selection**
- ***Start demonstrations at Army Depots and corrosion repair locations***



## Laboratory and Depot Testing:

- All coatings were initially assessed at ARL using the NAVAIR developed rapid screening galvanic test panels. (11 products screened)
- Rapid Galvanic panels allow ARL/NAVAIR to screen multiple products in a 21 day cyclic corrosion test (GMW 14852 Test)



Conversion Coat & Primer  
– 2 S/S and 2 Ti Fasteners

Conversion Coat, Primer  
& Top Coat – 2 S/S and 2  
Ti Fasteners



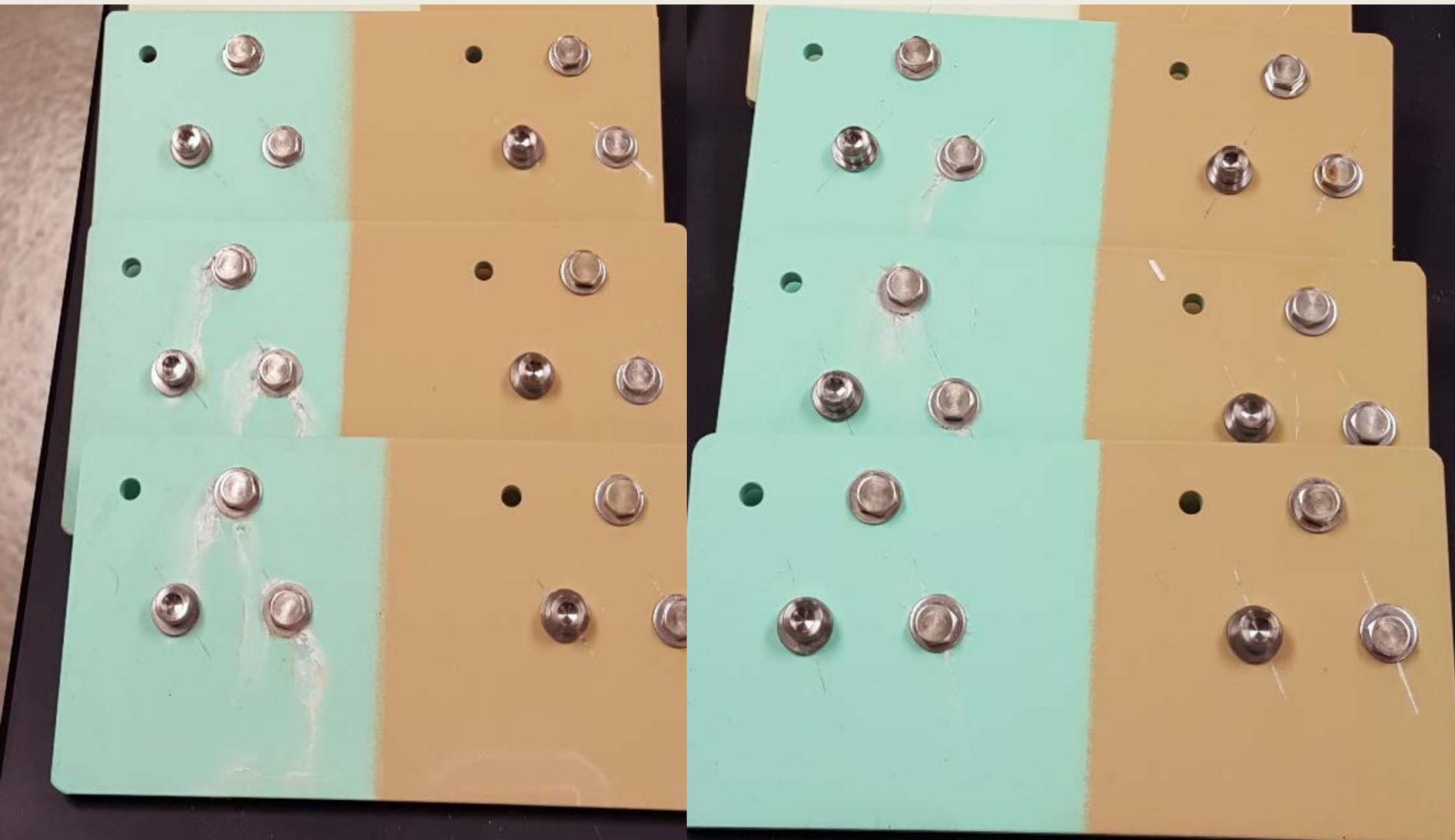
U.S. ARMY  
**RDECOM**

# Galvanic Test Results: Baselines



## Hexavalent Chrome Pretreatment

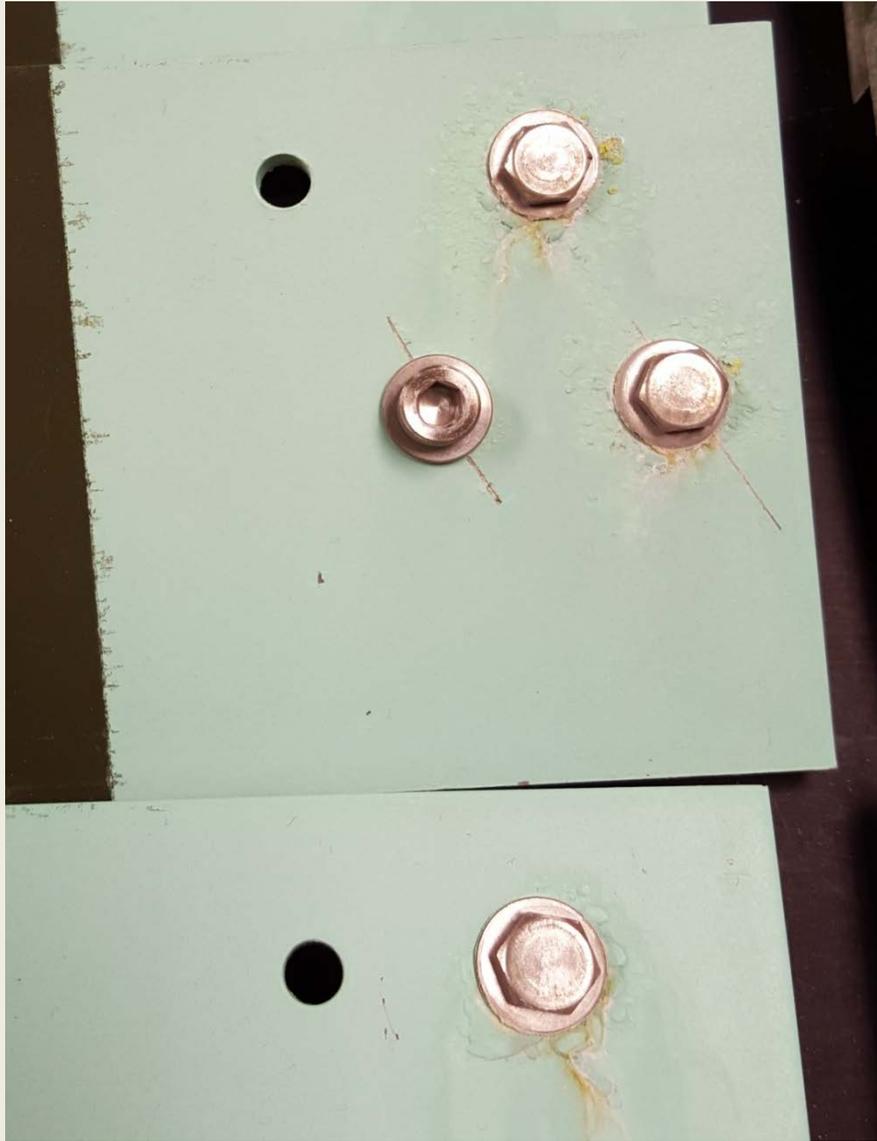
## Trivalent Chrome Pretreatment





U.S. ARMY  
**RDECOM**

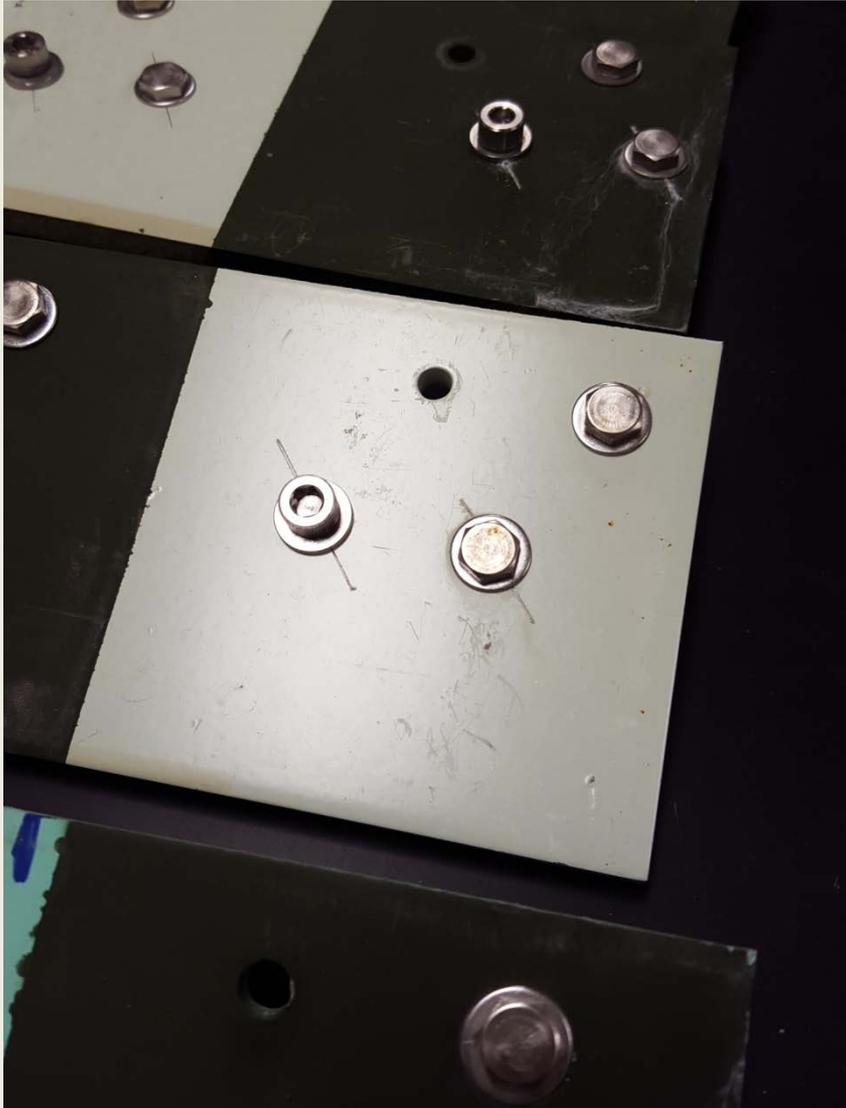
# Galvanic Test Results: Failures





U.S. ARMY  
**RDECOM**

# Galvanic Test Results: Passing





U.S. ARMY  
**RDECOM**

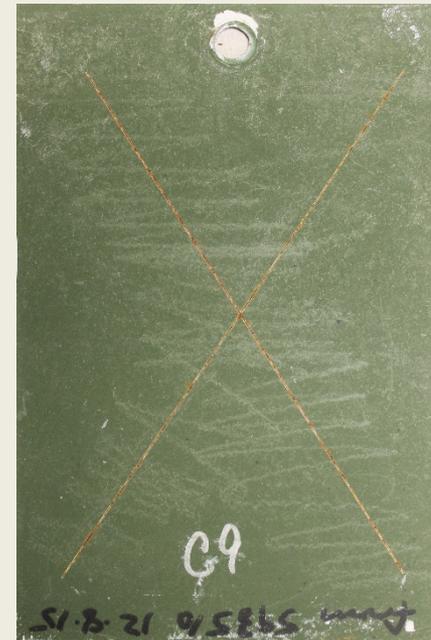
# Ferrous Test Results



## One year Outdoor Exposure Two years complete December 2016



Zirconium Pretreatment  
X-Bond<sup>®</sup> 4000  
MIL-DTL-53022 Type III Primer  
MIL-DTL-53039 CARC



Zinc Phosphate  
Chrysocoat OC  
MIL-DTL-53022 Type III Primer  
MIL-DTL-53039 CARC



U.S. ARMY  
**RDECOM**

**ARL**

# Ground Support Equipment Demonstrations



U.S. ARMY  
**RDECOM**

# GSE Demonstrations

**ARL**

**Location/ Date:**

**Letterkenny Army Depot (LEAD)**

**Jun 2014**

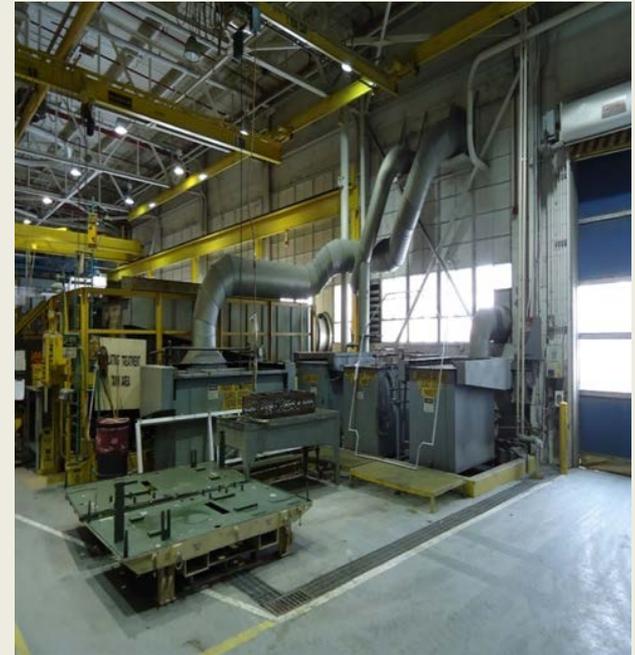
**Albany Marine Corps Logistics Base**

**Aug 2014**

**Anniston Army Depot (ANAD)**

**Oct 2016**

- **Six stage pretreatment process @LEAD and MCLB for Fe and AL**
- **Six stage pretreatment process for Fe and nine stage process for AL @ANAD**
- **Zirconium operation performed at room temperature**
- **Recoat with CARC primer as soon as parts are dry-no waiting 18-24 hours**
- **No sludge or solid waste developed**





U.S. ARMY  
**RDECOM**

# GSE Demonstrations



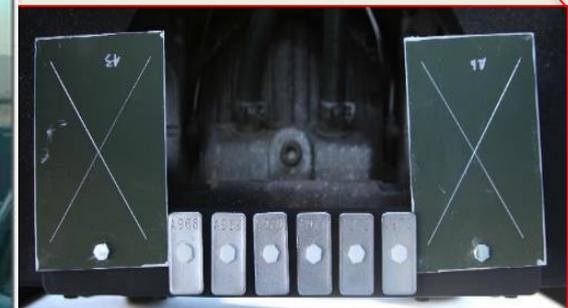
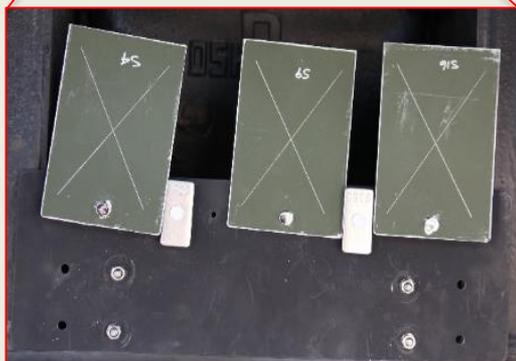
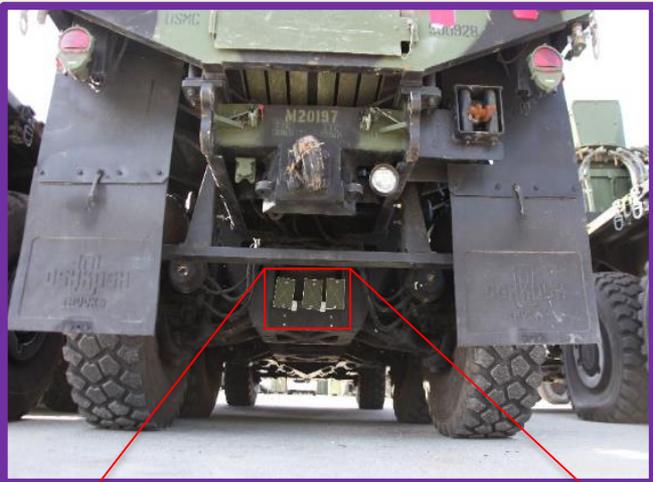
Aluminum components pretreated at ANAD Oct 2016





U.S. ARMY  
**RDECOM**

# GSE Demonstrations





U.S. ARMY  
**RDECOM**

# Outdoor Exposure: GSE





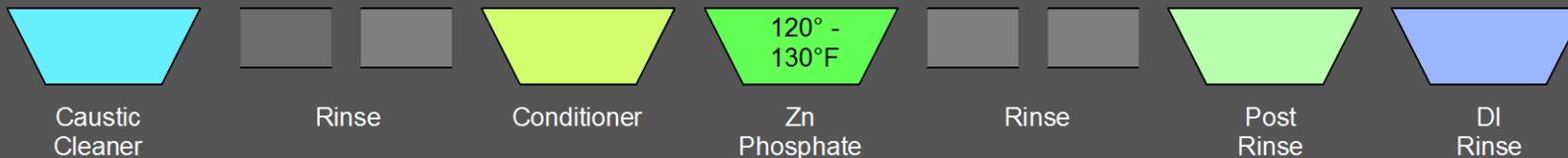
U.S. ARMY  
**RDECOM**

# GSE Processes



## FOOTPRINT - EXISTING PROCESSES FOR STEEL AND ALUMINUM

STEEL



ALUMINUM

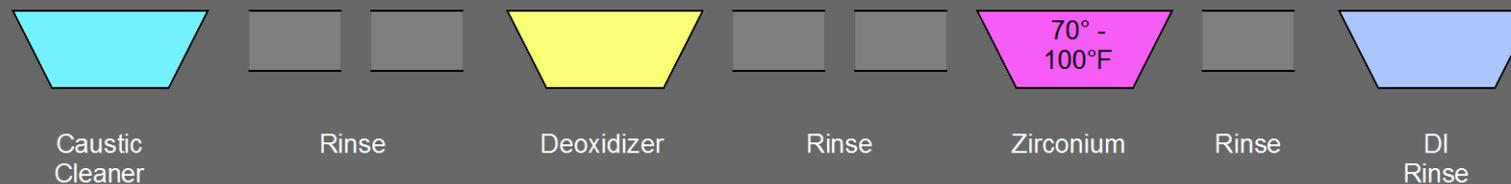


## FOOTPRINT - ZIRCONIUM PROCESS FOR STEEL AND ALUMINUM

STEEL

ALUMINUM

FE  
AL





U.S. ARMY  
**RDECOM**

**ARL**

# Aviation Demonstrations



U.S. ARMY  
**RDECOM**

# Aviation Demonstration



**Location:**

**Corpus Christi Army Depot (CCAD)**

**Date:**

**January 25<sup>th</sup>- 29<sup>th</sup> 2016 (Spray)**

**June 13<sup>th</sup>-17<sup>th</sup> 2016 (Immersion)**

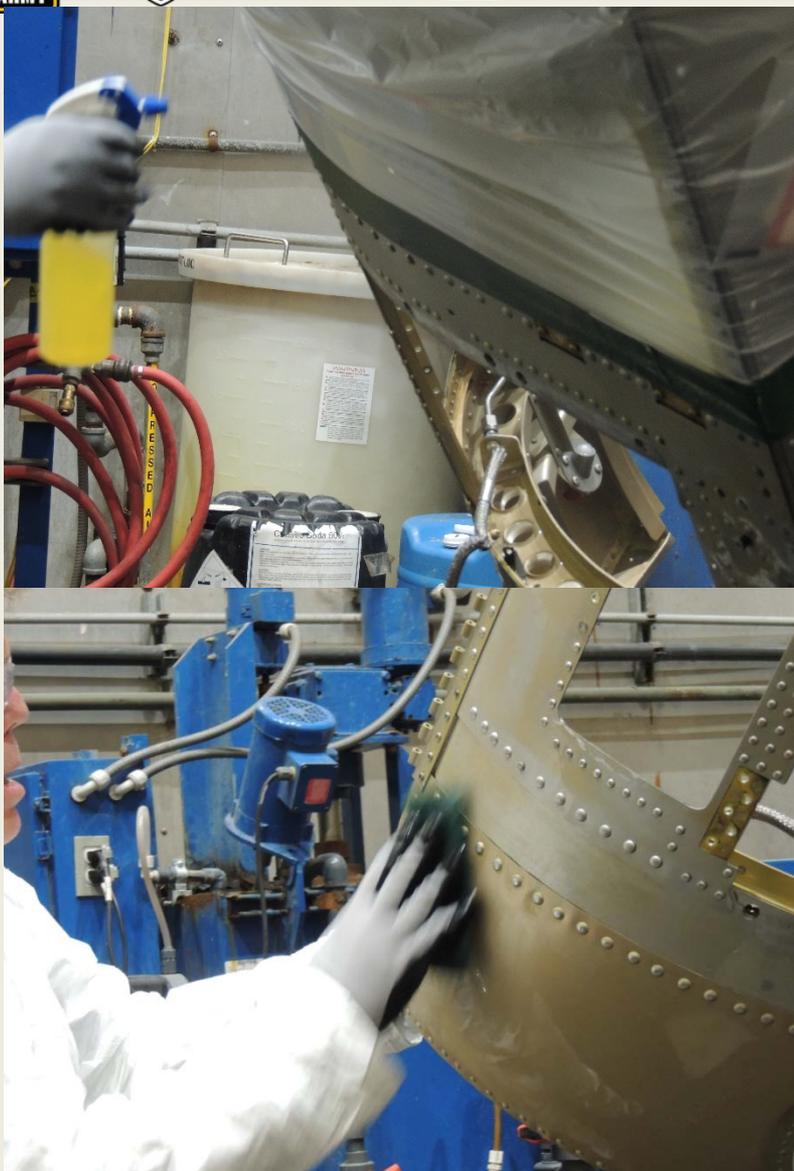
- **3 vendors selected for spray demonstration, 1 vendor for immersion**
- **Vendors required to bring all material and equipment for application**





U.S. ARMY  
**RDECOM**

# Aviation Demonstration #1





U.S. ARMY  
**RDECOM**

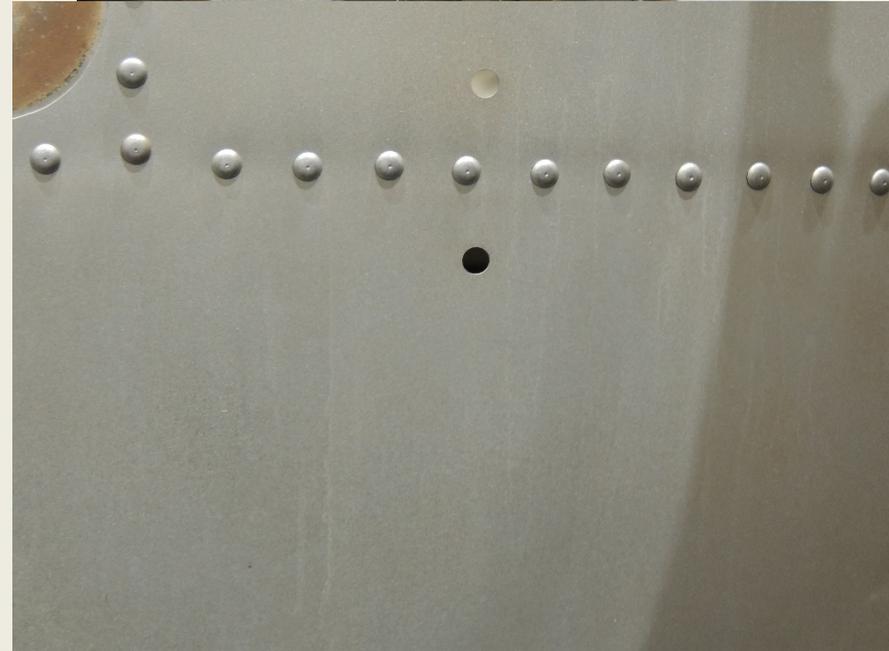
# Aviation Demonstration #2





U.S. ARMY  
**RDECOM**

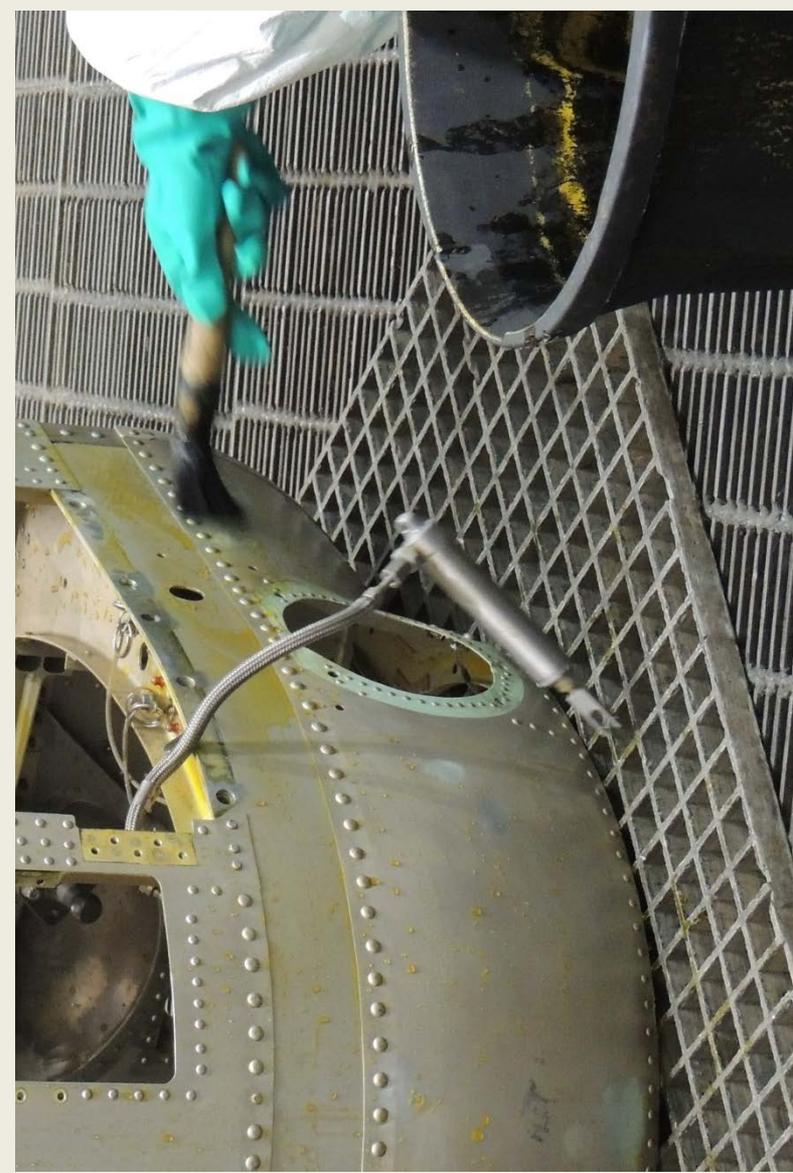
# Aviation Demonstration #3





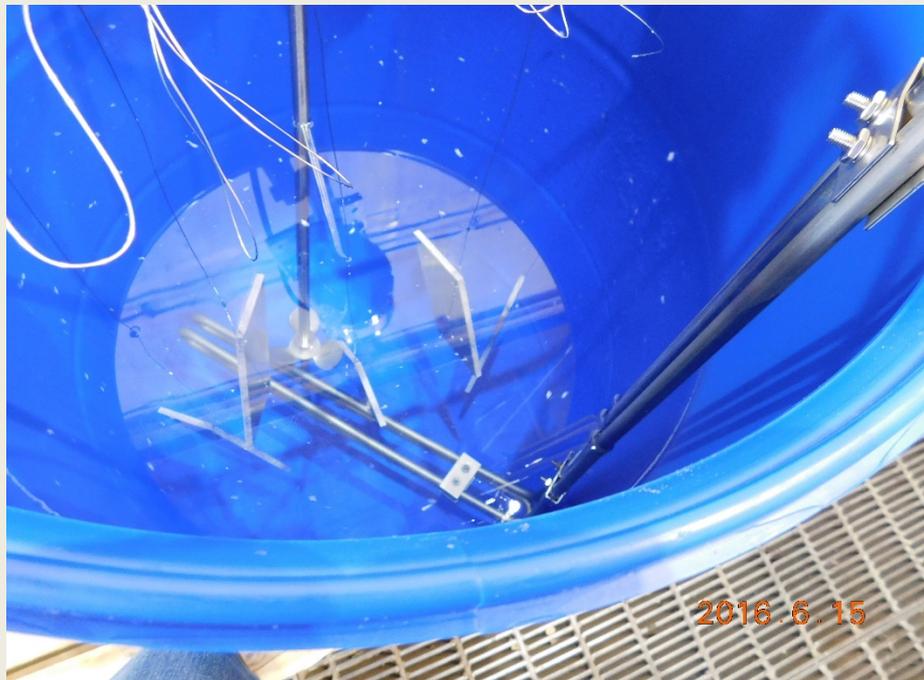
U.S. ARMY  
**RDECOM**

# Baseline Pretreatment





# Immersion Process



Deoxidizer Tank  
Heated to 110°F



Conversion Coat Tank  
Room Temperature



U.S. ARMY  
**RDECOM**

Aviation Immersion Demonstration



Components Drying (upper left)  
BER components after final paint



U.S. ARMY  
**RDECOM**

# Outdoor Exposure: Aviation



6 Month Outdoor Exposure at CCAD



U.S. ARMY  
**RDECOM**

# Outdoor Exposure: Aviation



12 Month Outdoor Exposure at Cape Canaveral



U.S. ARMY  
**RDECOM**

Aviation Demonstration: Upcoming

**ARL**

## Upcoming Demonstration:

- **The next demonstration will be on a flyable asset at the 1109<sup>th</sup> TASM-G in Groton, CT.**
- **This demonstration will also include the latest generation of non-chromate primers (Al-rich technology)**
- **Demo coatings will be applied to selected parts and components on a UH-60L**
  - **Nose door, Gunners window frames, cargo doors, decoy launcher frames and stabilator (1/2-n-1/2)**
  - **Good mix of metallic and composite components to verify the new coating(s) performance for the next 2 years**



U.S. ARMY  
**RDECOM**

# Transition

# ARL

- **Qualification to TT-C-490**
  - **Type IV**
  - **Alternative to zinc phosphate**
  - **ETA: Jan 2017**
- **Revision to MIL-DTL-53072**
  - **Allow use in place of TT-C-490 Type I**
  - **ETA: Feb 2017**
- **Revision, Qualification to MIL-DTL-5541**
  - **In coordination with NAVAIR**
  - **Updated testing requirements**
  - **ETA: 2018**



U.S. ARMY  
**RDECOM**

## Contact Information

**ARL**

**Fred Lafferman, ARL**

**(410) 306-1520**

**[fred.l.lafferman2.civ@mail.mil](mailto:fred.l.lafferman2.civ@mail.mil)**

**Paul Robinson, AMCOM G-4**

**(256) 842-0251**

**[james.p.robinson2.civ@mail.mil](mailto:james.p.robinson2.civ@mail.mil)**

**Daniel Pope, ARL**

**(410)306-1688**

**[Daniel.a.pope.ctr@mail.mil](mailto:Daniel.a.pope.ctr@mail.mil)**



U.S. ARMY  
**RDECOM**

**ARL**

# Questions