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# Replacement Materials for Hexavalent Chromium Conversion Coatings - Qualification and Implementation Processes

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# Agenda

**ARL**

- **Overview**
- **Program Reviews**
- **Demonstrations**
- **Specification Revisions and Qualification**
- **Transition**



# Overview

**ARL**

- **ESOH Drivers**
  - **ARL/AMCOM G-4/NAVAIR have been working for the past 8+ years on developing new pre-treatments and primers to meet existing and emergent Environmental, Safety and Occupational Health (ESOH) requirements**
  - **Primary focus has been to eliminate hexavalent chromium (Cr+6), other hazardous materials, while reducing or eliminating VOC/HAP emissions**
  - **The new coatings approved or under development are compliant under US ESOH Regulations including EPA, OSHA, TSCA as well as International regulations (EU REACH)**
  - **The new coatings:**
    - **Improves worker safety**
    - **Reduces regulatory burden**
    - **Reduces HazMat handling and disposal requirements**



## Programs on Development of Zirconium Pretreatments

**ARL**

- **Environmentally Friendly Zirconium Oxide Pretreatment (WP-1676)**
  - Funded By Strategic Environmental Research and Development Program (SERDP)
  - R&D Program on the Development of Zirconium Pretreatments
  - FY09- FY12
- **Demonstration of Zirconium Oxide Pretreatment to Prevent Corrosion (WP-201318)**
  - Funded by Environmental Security Technology Certification Program (ESTCP)
  - Demonstrations held at LEAD and MCLB Albany
  - FY13-FY16
- **Environmentally Friendly Zirconium Oxide Pretreatment (W14AR01)**
  - Funded By Office of the Secretary of Defense (OSD)
  - Demonstrations at CCAD
  - FY14-FY16
- **Cr(VI)-Free Conversion Coatings (TMR 14-02)**
  - Funded as part of the Environmental Quality Technology Pollution Prevention Toxic Metal Reduction (TMR)
  - Demonstrations at CCAD (Spray and Immersion), ANAD and TASM-G Groton
  - FY14-FY19



## 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



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Aluminum components pretreated at ANAD Oct 2016

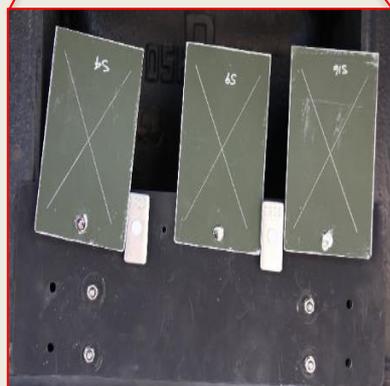


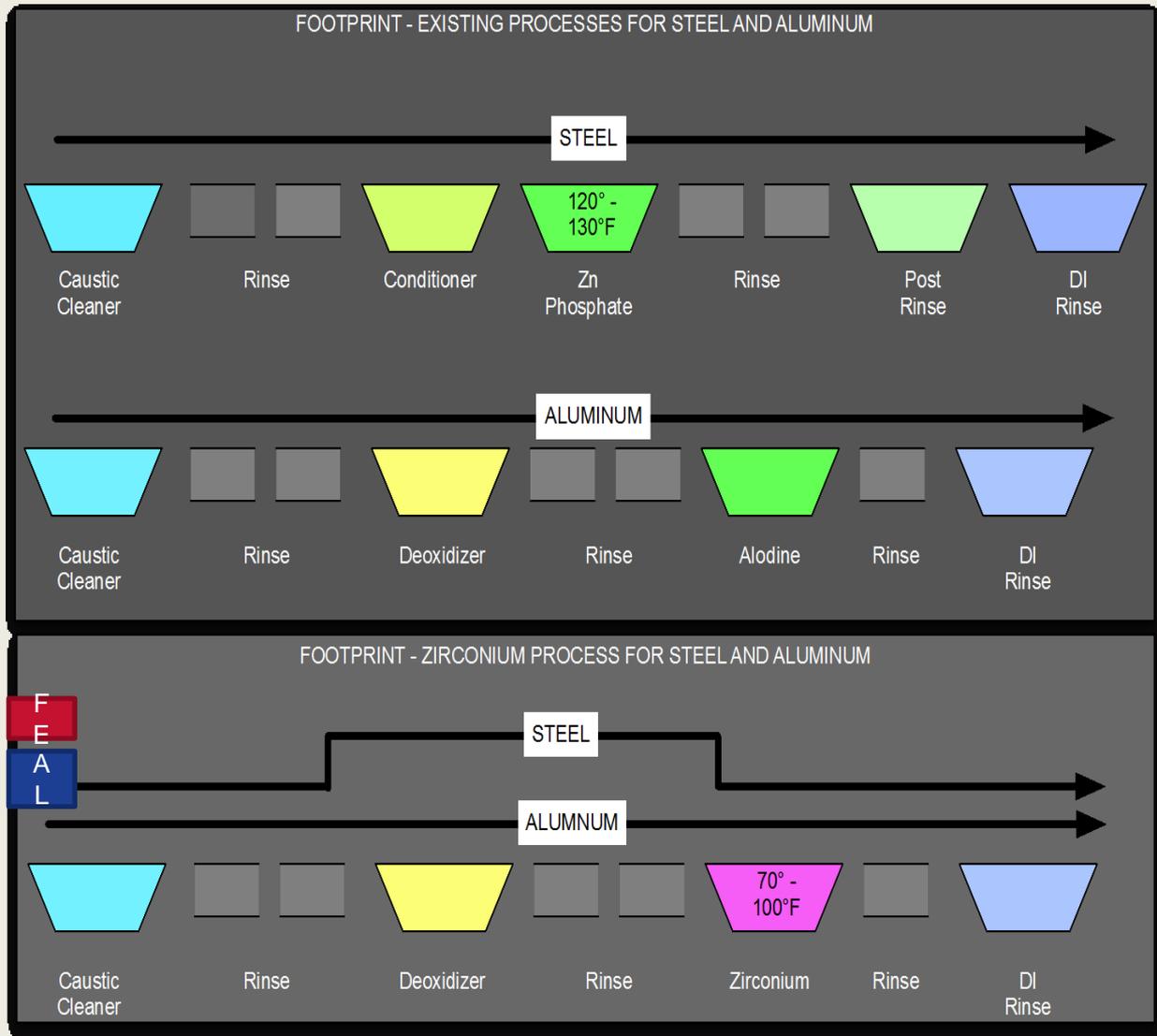


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# Parts and Panels from Demonstrations at LEAD and MCLB

**ARL**







# Ferrous Test Results



## Two year Outdoor Exposure: Camp Lejeune and shipboard deployment Panels coated at Albany Marine Corps Logistics Base Aug 2014



Zirconium Pretreatment  
MIL-DTL-53022 Type II  
MIL-DTL-53039 CARC



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



# Aviation

## Demonstrations for Approval to Aluminum Conversion Coatings per MIL-DTL-5541



## Location:

**Corpus Christi Army Depot  
(CCAD)**

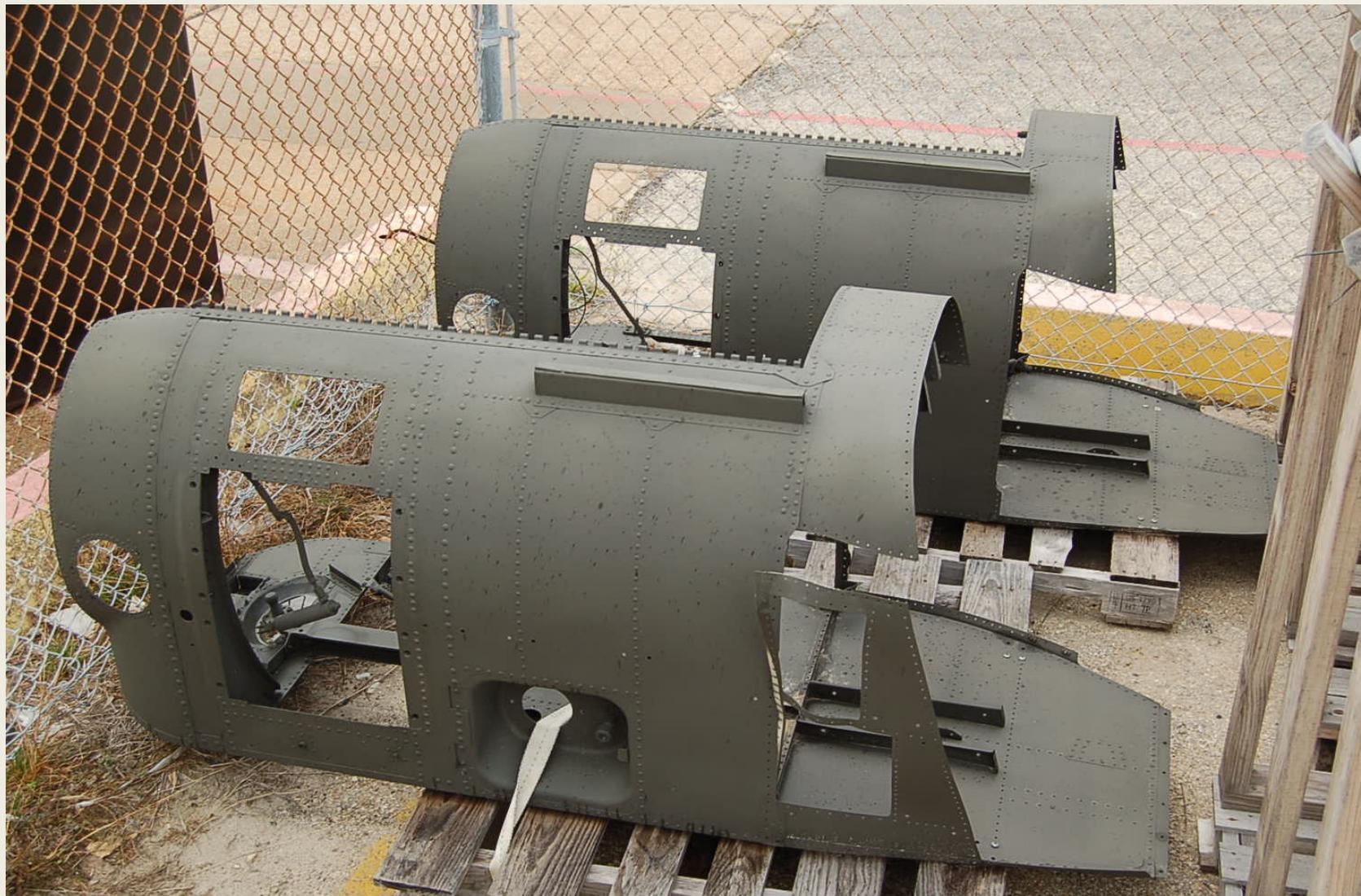
## Date:

**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**









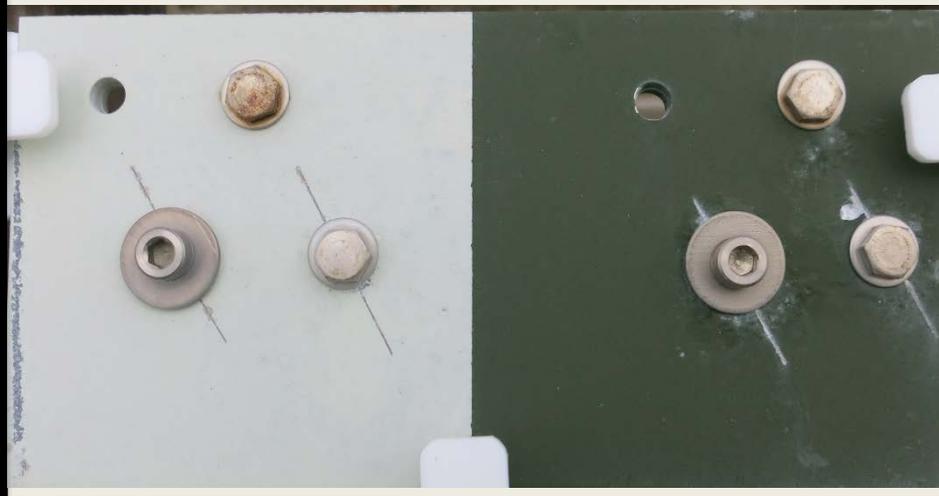
# CCAFS Results (Lab Application 24 Month, Spray)



Baselines:  
Top: Cr VI / Bottom Cr III



Zirconium Pretreatments



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# Specifications and Qualifications

**ARL**

- Qualification to TT-C-490
  - Type IV
  - Alternative to zinc phosphate
  - ETA: Complete
  
- Revision to MIL-DTL-53072
  - Allow use in place of TT-C-490 Type I
  - ETA: Complete
  
- Revision, Qualification to MIL-DTL-5541
  - In coordination with NAVAIR
  - Adding new type and class
  - Updated testing requirements
  - ETA: FY 2019





- MIL-DTL-5541 - Revision to current specification
  - NAVAIR is the MIL-DTL-5541 Preparing Activity and ARL is the Lead Standardization Activity
  - ARL, NAVAIR and AMCOM have developed draft language to revise the existing specification
  - NAVAIR is preparing the initial document draft for distribution and comment
- Revised Specification Draft will list a new Type and Class (Type 3 Class IV) material
  - Type 3 – Products containing no chromium (no Cr<sup>+6</sup> or Cr<sup>+3</sup>)
  - Class IV – products that are to be tested in a coated condition (minimum of one coat of primer) or as a full coating stack-up (pretreatment, primer and top coating)



## DETAIL SPECIFICATION

### CHEMICAL CONVERSION MATERIALS FOR COATING ALUMINUM AND ALUMINUM ALLOYS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers chemical conversion materials used in the formation of coatings by the reaction of the material with the surfaces of aluminum and aluminum alloys.

1.2 Classification. The chemical conversion materials and application methods are of the following types, classes, material forms, and methods.

1.2.1. Types. The chemical conversion materials are of the following types (see 6.4.2).

Type I – Compositions containing hexavalent chromium.

Type II – Compositions containing no hexavalent chromium.

Type IIc – Compositions containing no hexavalent chromium that form color change film

Type III - Compositions containing no chromium materials (requires approval of cognizant authority)

1.2.2 Classes. The materials, which form protective coatings by chemical reaction with aluminum and aluminum alloys, are of the following classes (see 6.4.2).

Class 1A - For maximum protection against corrosion, painted or unpainted.

Class 3 - For protection against corrosion where low electrical resistance is required.

Class 4 – Type III products must be coated with the appropriate organic coating stackup



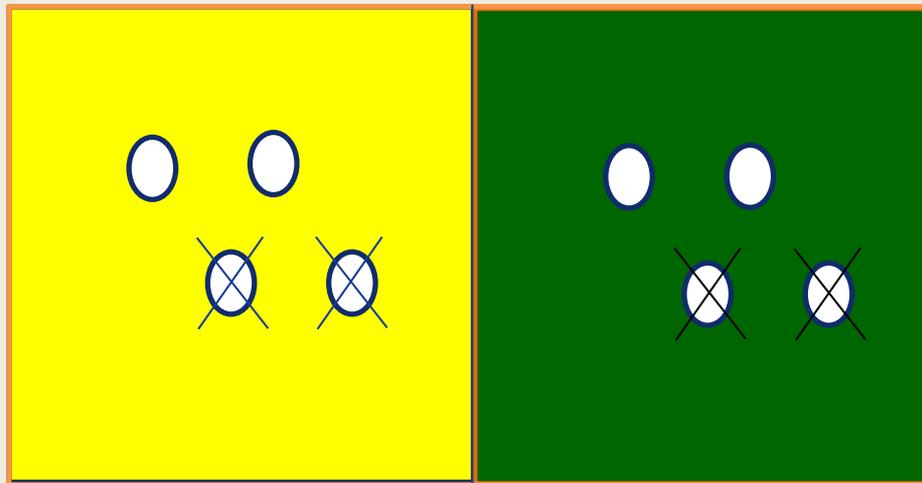
- Qualification to MIL-DTL-5541 Specification
  - Screening and qualification testing will use NAVAIR developed Galvanic Test Article
  - Test article shall be prepared per manufacturers recommended processes for the pretreatment under evaluation
  - The test article shall then be coated with primer and one-half shall be coated with the appropriate top coating (CARC for Army assets)
  - Testing will consist of XXX number of cycles of the GM 14872 Cyclic Corrosion Test
- When test has been successfully completed, NAVAIR will update the appropriate QPL/QPD



# Galvanic Cyclic 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 14872 Test)



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

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



- AMCOM will coordinate with appropriate Engineering Authorities and Program Offices to begin transition process
  - In coordination with CCAD Aviation Engineering Directorate (AED-AEM) to develop appropriate Maintenance Engineering Orders (MEOs) and Depot Maintenance Work Requirement (DMWR) revisions
  - ARL and AMCOM will coordinate development of recommended revisions to the 1-1500-344-23 and 1-1500-345-23 Technical Manuals
  - When required ARL, NAVAIR and AMCOM will assist in training appropriate depot and facility artisans to use the new processes and materials during the transition phase.



# Questions