Non-Chromated Paint Primers Webinar

WP-201132

Julia Russell - NAVAIR

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Agenda

- Julia Russell
  - Overview of non-chromate primers
  - Implementation of non-chromate primers
  - Aircraft Demonstrations

- Brenna Skelley
  - Research and Development
  - Lab Validation

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Overview

- Chromate primers contain hexavalent chromium which is a known carcinogen
- In 2009 the DoD issued a memorandum calling for the reduction of chromate across the DoD
- Non-chromate primers are important to reduce chromate waste and effects on the environment as well as ensure the safety of workers applying the primers

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Overview

- NAVAIR has lead non-chromate technology development
  - Maturation on commercial primers
  - Research and development of new technologies

- Funding
  - ESTCP
  - Navy Environmental Sustainability Development to Integration (NESDI) Project # 458
  - Office of Naval Research (ONR)
  - Naval Innovative Science and Engineering (NISE)

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Non- Critical Applications

"Non-critical application areas include support equipment and aircraft surfaces that are readily accessible and easily inspected. These are considered to be relatively low risk applications (see Section 3)…The following list covers basic requirements that non-chromate products shall meet in order to be considered for implementation in non-critical applications."

- *Non-Critical Application Test Criteria:*
  - Per applicable military specification and extended screening tests
  - Field Testing – 2-years in-service or 2 carrier deployments (see Section 2.2)
  - Same or better performance compared to controls using similar protection schemes

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Critical Applications

"Critical applications include all areas not covered above. Examples of these include, but are not limited to, critical safety items (CSI), dynamic components, wingfold areas, wing flaps, landing gear areas and components, inner mold line, and all interior areas that are not accessible for inspection….Due to the relative technical immaturity of non-chromate products, these criteria may be greater than what was required for legacy applications using chromate products."

- *Critical Application Test Criteria*:
  - Per applicable military specification and extended screening tests
  - Fatigue/Stress/Component Tests – Per application
  - Flight clearance depending on component/risk
  - Field Testing – More stringent validation path than for non-critical
  - Longer service life, more expensive, more sensitive, broader criteria, etc.

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Risk of Implementing NC Primer

*Probability of failure of non-chromate technology based on sufficient laboratory testing, comparison to current chromate technology for a particular application, and AIR-4.3.4 endorsement

Probability of Failure for Non-Chromate Technology vs. Chromate*	Impact of Non-Chromate Technology Failure			
	Mishap, Replacement	Reduced Service Life, High Repair Costs	Increased Maintenance Activities	Negligible
High				
Medium				
Low				
Same as Chromate				

	Critical Application Areas should be avoided until test data supports lowering risk level
	Application areas that need careful consideration and review based on test data (i.e. OML, IML, faying surfaces)
	Non-critical application areas suitable for Dem/val/implementation based on test data (ex: composites without metallic contact, fiberglass, low-impact/low cost components)

***Note: Factors such as platform/component operational environment and inspection intervals must be considered and may justify adjustment to the risk analysis level. Ex. Trainer aircraft operate in a less severe environment than ship based aircraft*

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Current Authorization Status

1. CNASC Ltr: 13150 Ser AIR-4.3.4/7.4629 Naval Air Systems Command Implementation Plan for Nonchromated Paint Primer Conforming to MIL-PRF-85582, of 18 April 2002

2. CNASC Ltr: 4123 Ser AIR-4.9.7/7.4801 Naval Air Systems Command Implementation Plan for Nonchromated Paint Primer Conforming to MIL-PRF-23377, of 1 March 2005

3. CNASC Ltr: 4123 Ser AIR-4.3.4/14-0035 Naval Air Systems Command Authorization Plan for Non-chromate Paint Primer Conforming to MIL-PRF-23377, Type 1, Class N, 11 December 2014***

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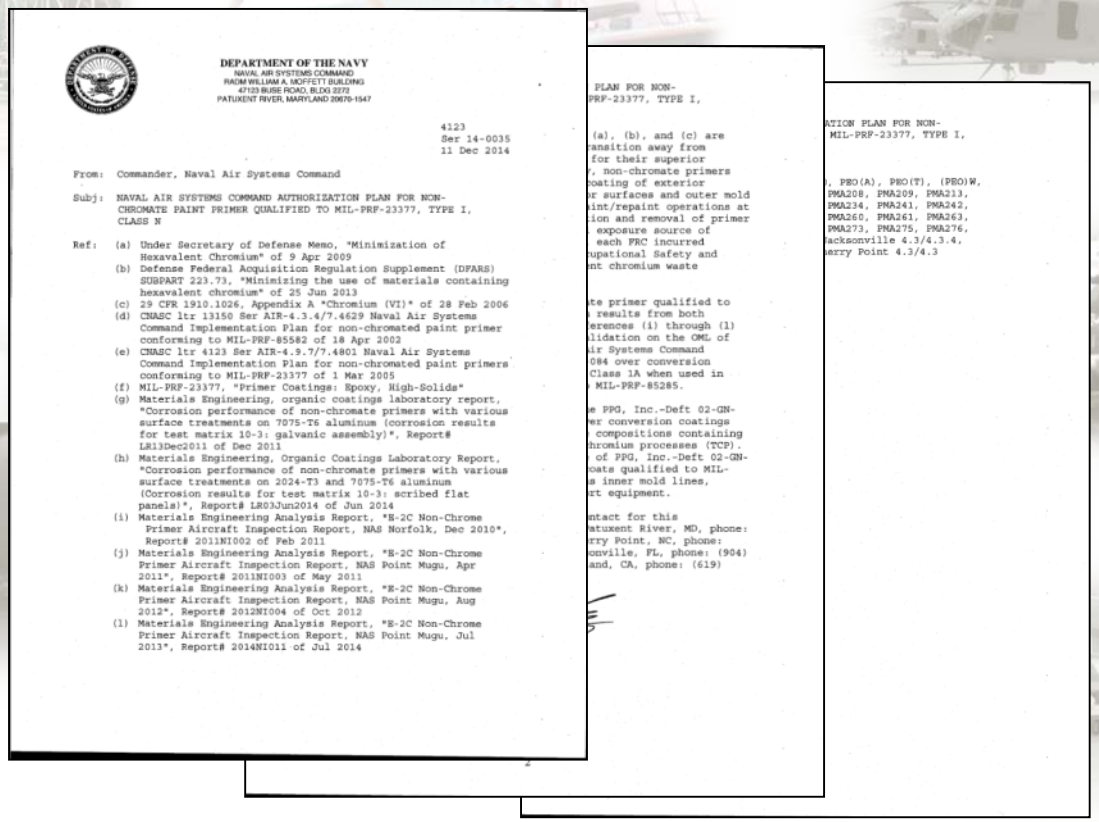
NAVAIR Authorization: PPG Industries-Deft 02GN084

- **NAVAIR Authorization Letter ~** Signed December 2014
  - **Product # 02GN084 (qualified to MIL-PRF-23377, Ty I, Cl. N) over Chromate Conversion Coating on Outer Mold Line of all USN gloss paint scheme Aircraft**



DEPARTMENT OF THE NAVY
NAVAL AIR SYSTEMS COMMAND
RADM WILLIAM A. MOFFETT BUILDING
47123 BUSE ROAD, BLDG 2272
PATUXENT RIVER, MARYLAND 20670-1547

4123
Ser 14-0035
11 Dec 2014

From: Commander, Naval Air Systems Command

Subj: NAVAL AIR SYSTEMS COMMAND AUTHORIZATION PLAN FOR NON-CHROMATE PAINT PRIMER QUALIFIED TO MIL-PRF-23377, TYPE I, CLASS N

Ref: (a) Under Secretary of Defense Memo, "Minimization of Hexavalent Chromium" of 9 Apr 2009
(b) Defense Federal Acquisition Regulation Supplement (DFARS) SUBPART 223.73, "Minimizing the use of materials containing hexavalent chromium" of 25 Jun 2013
(c) 29 CFR 1910.1026, Appendix A "Chromium (VI)" of 28 Feb 2006
(d) CNASC ltr 13150 Ser AIR-4.3.4/7.4629 Naval Air Systems Command Implementation Plan for non-chromated paint primer conforming to MIL-PRF-85582 of 18 Apr 2002
(e) CNASC ltr 4123 Ser AIR-4.9.7/7.4801 Naval Air Systems Command Implementation Plan for non-chromated paint primers conforming to MIL-PRF-23377 of 1 Mar 2005
(f) MIL-PRF-23377, "Primer Coatings: Epoxy, High-Solids"
(g) Materials Engineering, organic coatings laboratory report, "Corrosion performance of non-chromate primers with various surface treatments on 7075-T6 aluminum (corrosion results for test matrix 10-3: galvanic assembly)", Report# LR13Dec2011 of Dec 2011
(h) Materials Engineering, Organic Coatings Laboratory Report, "Corrosion performance of non-chromate primers with various surface treatments on 2024-T3 and 7075-T6 aluminum (Corrosion results for test matrix 10-3: scribed flat panels)", Report# LR03Jun2014 of Jun 2014
(i) Materials Engineering Analysis Report, "E-2C Non-Chrome Primer Aircraft Inspection Report, NAS Norfolk, Dec 2010", Report# 2011NI002 of Feb 2011
(j) Materials Engineering Analysis Report, "E-2C Non-Chrome Primer Aircraft Inspection Report, NAS Point Mugu, Apr 2011", Report# 2011NI003 of May 2011
(k) Materials Engineering Analysis Report, "E-2C Non-Chrome Primer Aircraft Inspection Report, NAS Point Mugu, Aug 2012", Report# 2012NI004 of Oct 2012
(l) Materials Engineering Analysis Report, "E-2C Non-Chrome Primer Aircraft Inspection Report, NAS Point Mugu, Jul 2013", Report# 2014NI011 of Jul 2014

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Aircraft Demonstration

E-2C aboard USS Vinson

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NC Primer Demos: Gloss Paint Scheme

Demonstration
COMPLETE

BUNO	Induction Date	Non-Chrome Primer Date	Delivery Date	Carrier Deployments
164497 (#642)	Jan. 28, 2009	Jun. 26, 2009	Aug. 17, 2009	No deployments; transferred from VAW-120 to VAW-124 in June 2012
165648 (#603)	Apr. 10, 2009	Sept. 4, 2009	Oct. 7, 2009	• VAW-126: 1st Deployment aboard USS Truman (May – Dec 2010) • VAW-116: 2ND Deployment aboard USS Lincoln (Dec 2011 – June 2012) • VAW-116: 3rd Deployment aboard USS Vinson (Sept 2014-Present)
165650 (#600)	Jun. 16, 2009	Nov. 18, 2009	Dec. 23, 2009	• VAW-116: 1st Deployment aboard USS Lincoln (Sept 2010– Mar 2011) • VAW-112: 2nd Deployment aboard USS Stennis (Oct 2012-June 2013)
165811 (#654)	Oct. 26, 2009	May 9, 2010	Oct. 2010	• VAW-116: 1ST Deployment aboard USS Vinson (Dec 2011-June 2012) • VAW-116: 2nd Deployment aboard USS Vinson (Sept 2014-Present)

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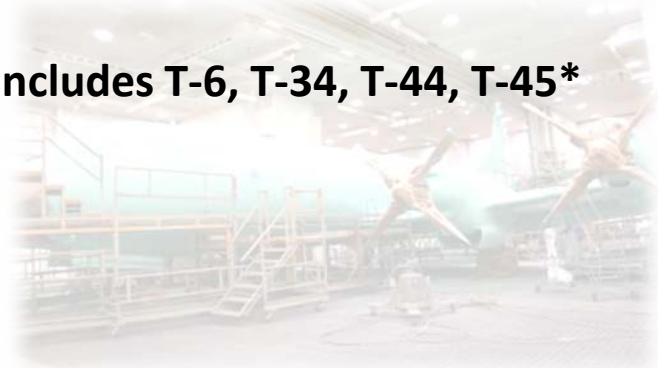
NC Primer Demos: Gloss Paint Scheme

NAS Meridean and NAS Kingsville *implemented* PPG-DEFT 02-GN-084 as a final prime on the OML of all USN trainers.

Includes T-6, T-34, T-44, T-45



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NC Primer Demos: Camo Paint Scheme

H-46

- **First full non-chromate coating system demonstration**
- **Hentzen 17176KEP (23377N, Ty II) over Henkel Alodine T5900 RTU (81706, Ty II)**
- **Three a/c primed with NC primer**

TMS	BUNO	Non-Chrome Primer Date	Carrier Deployments
H-46	154856	Dec. 2010	HMM-268: **1st Deployment** USS Makin Island (LHD 8) – Nov 2011 – June 2012
H-46	156474	Jan. 2012	None to date
H-46	153395	Aug. 2012	None to date

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NC Primer Demos: Camo Paint Scheme

F/A-18 Induction Coat @ FRC-SW (NAS Jacksonville)

MIL-PRF-85582 Chromate Primer Induction Coat

MIL-PRF-23377 Non-chromate Primer Induction Coat

- 17 A/C identified as candidates
- **7 depainted and repainted with NC Primer (Ty I & Ty II)**
- **2 depainted and induction primed with Ty I NC Primer**
- Remaining 11 scheduled for processing

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NC Primer Validation

New aircraft (primer applied during production)

- **PPG-Deft 02GN098 on F-35B and F-35C aircraft**
  - **No consistent ship environment until ~FY16**
- **PPG-Deft 02GN084 on MQ-8B Firescout test/LRIP aircraft**
  - **a/c already operating from ship during testing**
- **PPG-Deft 02GN084 on H-60R Seahawk production aircraft**
  - **On low risk interior surface per SIC/UT risk assessment method**
- **Hentzen 17176 Type II on EA-18G production aircraft**
  - **Overcoat application during production final assembly, chromated primer on detail parts**

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Brenna Skelley - NAVAIR

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Research and Development

- Naval Air Warfare Center Aircraft Division (NAWCAD) has developed a non-chromated primer using an aluminum alloy pigment. This primer has exhibited corrosion performance superior to that of the current high-performance non-chromate primers the fleet is using.

- The aluminum rich (Al-rich) primer has shown that it can perform well on aluminum and steel substrates making it a universal primer. Outside of NAVAIR this primer may have benefits across the Department of Defense and in commercial applications.

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Key Findings

- NAWCAD has developed a process for passivating the aluminum alloy pigment to give the coating greater resistance to self-corrosion and extended life to protect the substrate
- Primer performance was optimized based on numerous composition variables
    - Epoxy resin, metal pigment loading levels, high quality metal flakes, solvent package, anti-settling additives, and pigment coloration
- Al-rich primer optimized for steel and aluminum performance
- Touch up kit formulated, and tested at FRC-SW (Jacksonville) on wet installation of inserts used on the F-18 platform

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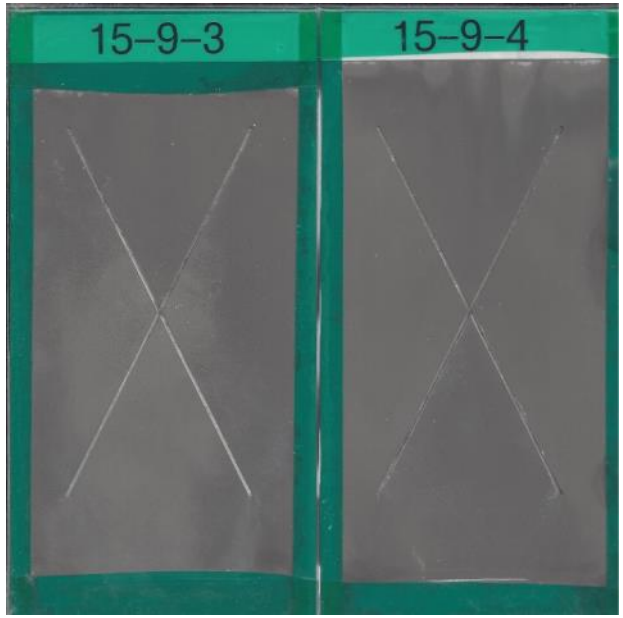
Lab Validation Results

- Al-rich primer performance over 2024 with passivated aluminum pigment



Al-rich over 2024-T3 aluminum with a TCP pretreatment after 2000 hours in ASTM B117, left, and 2000 hours in cyclic GMW 14872, right.

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Lab Validation Results

LP formulation of Al-rich primer with 53039 Type IV topcoat, DFT: 3-5 mils

MIL-PRF-24441 steel control with 53039 Type IV topcoat, DFT: 3-5 mils

After 2000 hours in Cyclic GMW 14872

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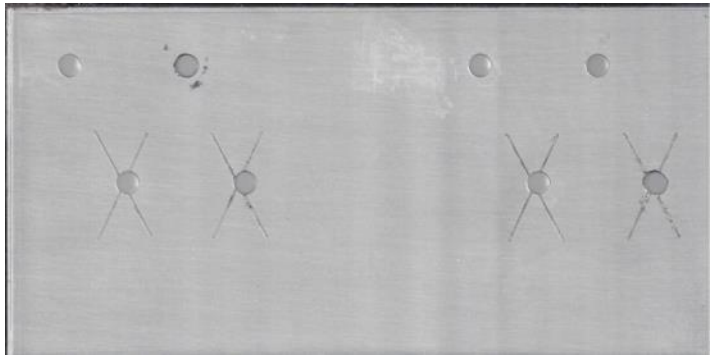
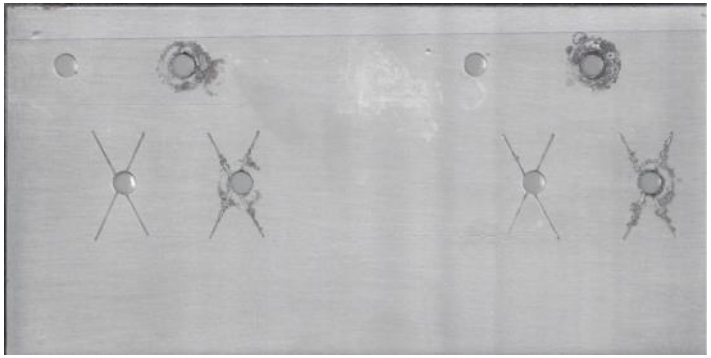
Lab Validation Results

- Galvanic Interfaces 2024-T3



Latest metal rich primer formulation



Current qualified chromate primer

Primers on 2024-T3 aluminum with MIL-DTL-81706 Type II conversion coating, 1.5 mil thick, galvanic assemblies, after 500 hours in cyclic GMW 14872, coatings and fasteners removed.

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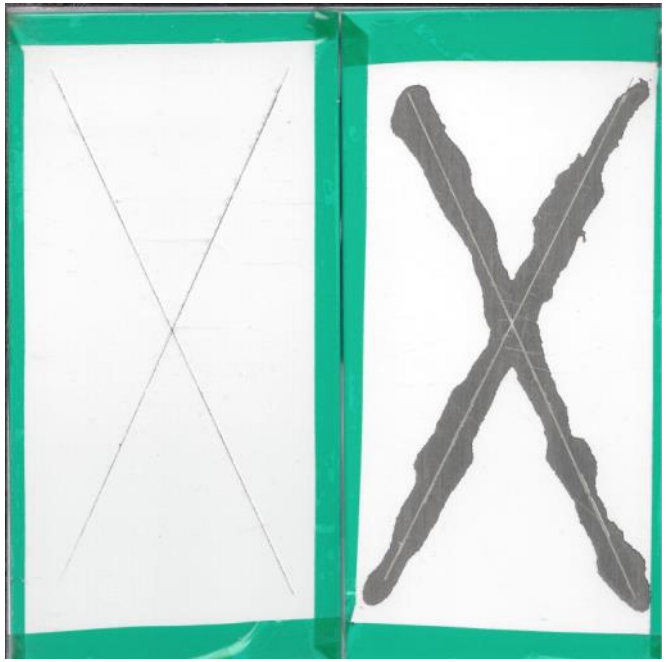
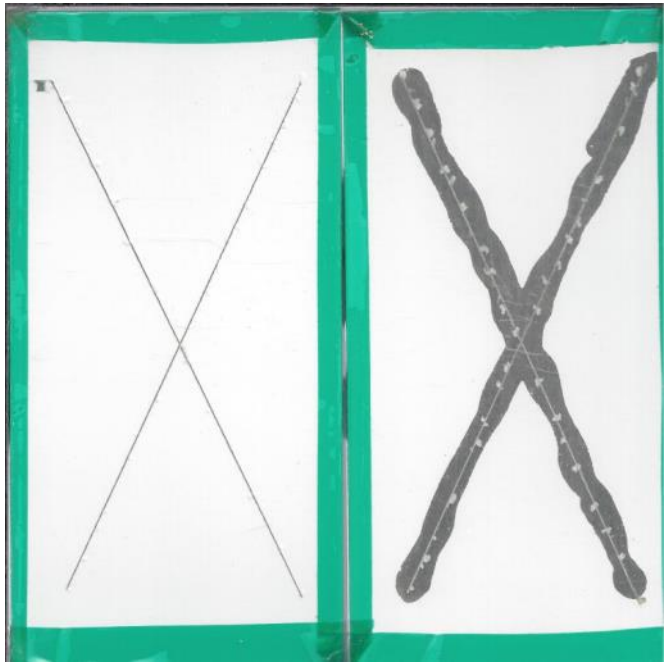
Lab Validation Results

- Filiform Corrosion



Al-rich primer over 2024 chromate pretreated panels



Qualified Chromate Primer over 2024 chromate pretreated panels

Completed filiform test (1000 hrs.) with left panels showing stripped scribe area

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Outdoor Exposure

- U.S.S. Wasp Exposure
  - In January 2015, shipboard exposure racks were placed on the U.S.S. Wasp with Al-rich primer and control primers

Left panel is MIL-PRF-23377 Class N with MIL-PRF-85285 Type IV topcoat, and the right is Al-rich primer with MIL-PRF-85285 Type IV topcoat. Photos from August 2015.

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Significance of Results

- The Al-rich primer has corrosion performance comparable to chromate primers
- It is an environmentally friendly primer that can work well on aluminum and steel substrates
- Provides a weight savings in comparison to Zinc-rich primers

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Conclusions

- NAVAIR has authorized PPG Industries – Deft 084 for use on certain areas of gloss paint scheme aircraft
- Elimination of chromate is important for worker safety and the environment
- Several successful aircraft demonstrations have been done on commercial non-chromate primers
- The Al-rich primer show great promise as a alternative to chromate primers

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For additional information, please visit: https://www.serdp-estcp.org/

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