



# WP-201132 Comprehensive Evaluation and Transition of Non-Chromated Paint Primers

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## Background

**Performers:** NAWC-AD PAX & Fleet Readiness Centers, AMCOM, ARL, AFPCPO, AF CTIO, NASA KSC & Wallops Island, LMCO, Boeing St. Louis, and Sikorsky

### Technology Focus

Demonstrate non-chromate primers on aircraft that are exposed to the harsh environmental conditions in which the DoD operates. To show that non-chromate primers provide good corrosion performance and can be used as an alternative to hexavalent chromium primers in the environmental operating conditions of the DoD.

### Demonstration Sites

- NASA: Wallops Island – VA
- NAWC-AD: FRC-SE – Jacksonville, FL; FRC-SW – San Diego, CA
- AMCOM: TASM-G - Groton, CT; CCAD - Corpus Christi, TX
- USAF: WRAFB – Warner Robins, GA; Hill AFB – Ogden, UT
- USCG: ALC – Elizabeth City, NC



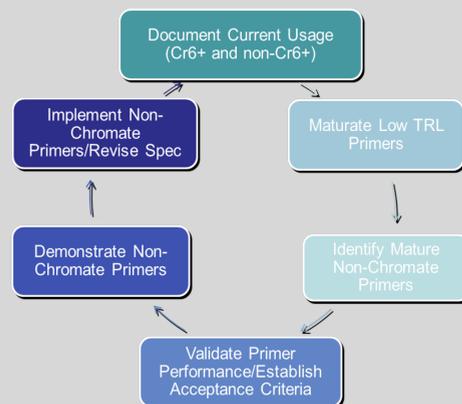
### Demonstration Objectives

Prove non-chromate coatings perform as well as, if not better than, current chromate primers used in the fleet.



## Technical Objectives

- Survey and document current usage of chromate and non-chromate primers
- Choose non-chromate primers to evaluate in the lab
- Take lab validated products and proceed to aircraft demonstrations
- Implement non-chromate primers that successfully completed aircraft demonstrations for fleet use.



## Laboratory Testing of Commercial Products

Commercial products lab tested:

Products	Applicable specification
PPG CA 7233	MIL-PRF-23377, Ty I, Class C
PPG EWDY048A	MIL-PRF-85582, Ty I, Class N
PPG EWAE118A	MIL-PRF-23377, Ty II, Class N
Deft 44-GN-007	MIL-PRF-85582, Ty I, Class C
Deft 44-GN-008A	MIL-PRF-85582, Ty II, Class C
Deft 02-GN-083	MIL-PRF-23377, Ty I, Class N
Deft 02-GN-084	MIL-PRF-23377, Ty I, Class N
Deft 02-Y-040B	MIL-PRF-23377, Ty I, Class C
Deft 02-GN-098	MIL-PRF-85582, Ty I, Class N
Hentzen Coatings 16708TEP	MIL-PRF-23377, Ty I, Class N
Hentzen Coatings 17176KEP	MIL-PRF-23377, Ty II, Class N

The following corrosion tests were performed on these products:

- ASTM B117
- ASTM G85.A4
- GMW14872
- Filliform
- Kennedy Space Center Beach Front Exposure

## Aircraft Demonstrations – NAVY

E-2C Demonstration at FRC-SW - San Diego, CA

Deft 02GN084 over chromate conversion coating on the outer mold line of the E-2C - **SUCCESSFUL**

TMS	BUNO	NORIS SEQ. No.	Induction Date	Type of Work	Non-Chromate Primer Date	Delivery Date	Carrier Deployments
E-2C	16449 7 (#642)	E558	Jan. 28, 2009	PMI-2 (180 days)	Jun. 26, 2009	Aug. 17, 2009	<b>No deployments;</b> transfers from VAW-120 to VAW-124 in June 2012
E-2C	16564 8 (#603)	E559	Apr. 10, 2009	PMI-2 (180 days)	Sept. 4, 2009	Oct. 7, 2009	VAW-126: <b>1<sup>st</sup> Deployment</b> aboard USS Truman (May – Dec 2010) VAW-116: <b>2<sup>nd</sup> Deployment</b> aboard USS Lincoln (Dec 2011 – June 2012) <b>3<sup>rd</sup> Deployment</b> aboard USS Vinson (Sept. 2014 - May 2015)
E-2C	16565 0 (#600)	E560	Jun. 16, 2009	PMI-2 (180 days)	Nov. 18, 2009	Dec. 23, 2009	VAW-116: <b>1<sup>st</sup> Deployment</b> aboard USS Lincoln (Sept 2010– Mar 2011) VAW-112: <b>2<sup>nd</sup> Deployment</b> aboard USS Stennis (Nov 2012 – June 2013)
E-2C	16581 1 (#654)	E563	Oct. 26, 2009	PMI-2 (180 days)	May 9, 2010	Oct. 2010	VAW-116: <b>1<sup>st</sup> Deployment</b> aboard USS Lincoln (Dec 2011- June 2012) <b>2<sup>nd</sup> Deployment</b> aboard USS Vinson (Sept. 2014 – May 2015)



## On-Going Demonstrations - NAVY

Six H-53's were primed with Hentzen 17176KEP, and the demonstration has been underway with no problems to report.

One H-53, painted June 2013, spent two years in the fleet was deployed once for a 6 month period. Post-deployment observation shows non-chromate primer performed as well as the chromate control.

Location: FRC-E - Cherry Point, NC and FRC-SW - San Diego, CA



## Aircraft Demonstrations - ARMY

- Applied non-chromate touch up coating to galvanic test articles. These assemblies are being tested in ARL Cyclic and NSF chambers and at the Kennedy Space Center beach exposure site.
- AMCOM revised the Aviation Painting Technical Manual (TM 1-1500-345-23 to include technical guidance on using non-chromate primers)

AMCOM Non-Chromate Primer Demo:



1107<sup>th</sup> TASM-G – Springfield, MO – May 2014

## Aircraft Demonstrations – AIR FORCE

- Qualifying non-chromate coating systems to MIL-PRF-32239, a military specification the Air Force's Coating Corrosion Erosion Laboratory (CCEL) previously created, that has outdoor exposure testing as a requirement.
- CCEL is presently working to identify and address potential integration issues with the non-chromate coating systems and working toward field testing and implementation

C-130 – 4 Aircraft – Complete coverage

- 2 aircraft - DEFT RECC/DEFT 02GN093/DEFT 99GY001
- 2 aircraft - Prekote/ AE2100 (Mg Rich Primer)/AE 5000



## Aluminum-Rich Primer - NAVY

**Goal:** To develop and validate an epoxy-based primer that meets the performance requirements of MIL-PRF-23377 with the corrosion performance better than Class C products.

In 2009, NAVAIR began research on an aluminum-rich sacrificial coating that would be non-chromate and could perform as well as the chromate primers. This primer was included in the ESTCP project starting in FY14 when it reached higher TRL levels.

Benefits of Aluminum Pigment:

- Commercially available in large quantities
- Pigment stability
- Coating potential that is high enough, but not too high to cause self corrosion
- Low toxicity of aluminum
- Light weight

## Aluminum-Rich Data

Aluminum-rich primer provides superior protection against galvanic corrosion



Aluminum-rich Primer



Qualified 23377 Chromate Primer



Qualified 53022 Type IV Primer

Galvanic panels were chemically stripped after 500 hours in cyclic corrosion testing

## Aluminum-Rich Demonstrations

NASA C-130 and P-3 access panels were coated with aluminum-rich primer



US Coast Guard H-60 tail boom was coated with aluminum-rich primer



## Conclusions

Current TRL Levels of Non-Chromate Primers in FY16:

Product	Relevant Specification(s)	Technical Development Status (TRL)	Commercial Availability (MRL)	Qualified	NSN	Project Supporting
Deft 02GN084	MIL-PRF-23377 Class N Type I	8- med risk a/c interior, 9- low risk a/c exterior	10	yes	yes	X
PPG EWDY048A/B	MIL-PRF-85582 Class N Type I	8- components	10	yes	yes	
Deft 44GN098	MIL-PRF-85582 Class N Type I	7/8- high risk to low risk a/c (F-35)	10	yes	yes	
Hentzen 16708TEP/16709C EH	MIL-PRF-23377 Class N Type I	7	10	yes	yes	X
Hentzen 17176KEP/16709C EH	MIL-PRF-23377 Class N Type II	8- med risk a/c exterior	10	yes	yes	X
PPG EWAE118A/B	MIL-PRF-85582 Class N Type I	9- low risk a/c exterior	10	yes	yes	
<b>Al-Rich Primer</b>	<b>MIL-PRF-23377 Class N, Ty I</b>	<b>6</b>	<b>5</b>	<b>No</b>	<b>No</b>	<b>X</b>
Akzo Nobel MgRP003	TBD- 23377 or new metal-rich	7	10	no	no	X
PPG Aerocron 1100 (e-coat)	MIL-DTL-53084	7	10	no	no	
Crosslink ZnDmCt	MIL-PRF-23377	3	4	no	no	X
PPG CA7502/CA7222	MIL-PRF-23377	5	10	no	no	X
PPG CA7211	MIL-PRF-23377	6	10	no	no	X
PPG CA7238	MIL-PRF-23377	5	10	no	no	X
Akzo Nobel MO 2111	MIL-PRF-23377	5	10	no	no	X
Deft 65GN015	MIL-PRF-85582	3	5	no	no	
Zn-Ni Nano Layer Coating	ASTM WK 29468 (Draft)	6-med risk on high strength gun base bolts	6	no	no	

### NAVAIR Implementation Requirement:

Coating must be applied to a minimum of 2 aircraft and each aircraft must have 2 carrier deployments

- A successful demonstration led to authorization of PPG-Deft 02GN084 over chromate pre-treatment on the outer mold line of all gloss paint schemes of United States Navy aircraft including:
  - ◆ Patrol: P-3, P-8
  - ◆ Cargo: C-130, C-2, C-40
  - ◆ Trainers: T-6, T-34, T-44, T-45
  - ◆ Electronic: E-2C/E-2D

### Continued Work:

- Demonstrations of the aluminum rich primer with the Army, Navy, NASA and US Coast Guard are scheduled for FY16-FY17
- Continued demonstrations of commercial non-chromate primers continue at the Navy FRC's

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