Fleet Readiness Center - Southeast
TECHNOLOGY DEVELOPMENT
PROGRAM
(Cadmium & Hexavalent Chromium Reduction)

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Corrosion Science & Engineering

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**Report Documentation Page**

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<th>13. SUPPLEMENTARY NOTES</th>
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<td>ASETSDefense 2014: Sustainable Surface Engineering for Aerospace and Defense, 18-20 Nov 2014, Fort Myer, VA.</td>
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<th>19a. NAME OF RESPONSIBLE PERSON</th>
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Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18
NAVAIR Technology Implementation Assessment for Reduction of Heavy Metals Usage

Goal: 90% Reduction Within 5 Years

- Task 1 – Identify HM Usage
- Task 2 – Workload Correlation and AUL
- Task 3 - Identify Process Alternatives
- Task 4 - Prioritize Implementation
- Task 5 - HM Analysis Report & POA&M
Policy Guidance

- **FRCSEINST 5103.15**
  - FRCSE Responsibilities
  - “Do not introduce new sources of heavy metals into repair, overhaul or modification processes…”

- **COMFRCINST 7500.1**
  - FRC Responsibilities
  - Reduced Exposure
  - Revision Requested

---

**FRC SOUTHEAST INSTRUCTION 5103.15B**

From: Commanding Officer

Subj: HEAVY METALS CONTROL PROGRAM

Ref: (a) 29 CFR 1910 OSHA Standards for General Industry
(b) FRCSEINST 4870.1 Facility Equipment and Industrial Plant Equipment (IEP) Management Program
(c) FRCSEINST 11014.2 Preventive Maintenance and

- Research and Engineering Group (code 40000)
  1. Ensure that revisions to FRCSE managed technical documentation (e.g., MIMs, Local Engineering Specifications (LES), drawings, etc.) do not introduce new sources of heavy metals into repair, overhaul, or modification processes unless technically required.

---

**COMFRC INST 7500.1**

From: Commander, Fleet Readiness Centers
To: Fleet Readiness Centers Distribution

Subj: COMMAND MANAGEMENT FLEET READINESS CENTERS CONTROL AND MANAGEMENT OF SURFACE ACCUMULATIONS FROM HEAVY METALS SUCH AS LEAD, HEXavalent CHROMIUM, Cesium, and OTHER HAZARDOUS RESIDUE OPERATIONS

(b) COMNAVAIRSCN MSG R 021117Z OCT 12
(c) Industrial Safety knowledgeable

- n. Evaluate emergent technology to reduce or eliminate potential HM exposure.
- o. Review engineering controls for effectiveness and modify/tailor appropriately.

b. Paragraph 4.n – “Evaluate, approve and implement the use of viable alternative technologies to reduce or eliminate HM usage and potential HM exposure.”

Requested Revision per 2014JX00417
Site Locations

- FRC East
- FRC Southeast
- FRC Southwest
- NAWC-AD
HM Cleaning Requirement(s)

Daily Break Room Cleaning

<table>
<thead>
<tr>
<th>SECTION I - BASIC INFORMATION</th>
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</thead>
<tbody>
<tr>
<td>1. SBT</td>
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<td></td>
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</table>

SECTION II - A SHIFT

1. CLEAN ALL SURFACES OF THE FOLLOWING ITEMS (initial each block DAILY once completed):
   a. Interior & exterior parts of doors (including handles & knobs)
   b. All food preparation surfaces
   c. Tables/chairs/benches (including legs)
   d. Refrigerators, coffee pots, toasters, ice machine
   e. Vending machines (including key pads & doors)
   f. Microwave ovens (including handles & keypad)
   g. Shelving/Cabinets
   h. Televisions, radios, fan guards & blades
   i. All other horizontal surfaces (molding, chair rails, window/door & picture frames, pipe/conduit/ducts, bulletin boards etc.) (8 feet & below)
2. Mop floor - HEPA vacuum first if necessary. DO NOT DRY SWEEP
3. Ensure sticky mats are still effective
4. A SHIFT CLEANER - AFTER ALL ITEMS ARE CLEANED AND INITIALED. PRINT NAME & SIGN

☐ Approximately $1M/year labor/materials for HM daily cleaning at FRC
Task 1: Active Usage by NSN Cr+6

Count of Active

FRCE Cr+6 - NSN Total

Count of Category

FRCSE Cr+6 - NSN Total (D007)
Task 1: Active Usage by NSN Cd
## Task 2: AUL Correlation

### AUL - Authorized Use List

**Zone Material Authorization Report by NSN**

<table>
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<tr>
<th>Zone</th>
<th>NSN</th>
<th>Part Number</th>
<th>Trade Name</th>
<th>Item Name</th>
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<td>6810002643939</td>
<td>TECHNICAL, CHROMIUM TRIOXIDE, CHROMIC ACID</td>
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<td>STANNATE, TRIHYDRATE</td>
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<td>7790, CUPRIC SULFATE</td>
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<tr>
<td></td>
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**Production Code**
62722 - Electroplating

**National Stock Number**
6810002643939
6810002646713
6810002812035
6810002812686
6810002816333
6810002818804
HM Process Areas

Focus Areas
- Primer
- Metals Finishing
- Electroplating
- Sealant
- Depainting

Processes
- Aircraft Priming – Ty I
- Aircraft Priming – Ty II
- Component Priming
- Aluminum CC
- Magnesium CC
- Anodize Seal
- Anodize Strip
- Chemical Deoxidizing
- Phosphate Rinse
- Black Oxide Rinse
- CRES Passivation
- Chrome Plating
- Cadmium Plating
- Cadmium Brush Plating

Alternatives
- Class N (TRL 9)
- Class N (TRL 7)
- Class N (TRL 6)
- TCP - NCP
- No Activity
- TCP
- NC Deoxidizing
- NC Deoxidizing
- Non-Cr Rinse
- Non-Cr Rinse
- Citric Acid
- nCoP – Cr+3
- IVD – Zn/Ni - DVD
- Cold Spray – Zn/Ni Brush
### FRCSE Listing of Cd and Cr+6 Processes

<table>
<thead>
<tr>
<th>Process Area</th>
<th>Description</th>
<th>Specification</th>
<th>Material</th>
<th>Technical Instruction</th>
<th>Alternatives</th>
<th>FRCSE Active</th>
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<tr>
<td>Painting</td>
<td>Epoxy Primer</td>
<td>MIL-PRF-23377, MIL-PRF-85582</td>
<td>DEFT 44-GN</td>
<td>LPS 650</td>
<td>Class N</td>
<td>Y</td>
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<td>Painting</td>
<td>Epoxy Primer</td>
<td>MIL-PRF-23377, MIL-PRF-85582</td>
<td>DEFT 44-GN</td>
<td>LPS 650, LPS 660</td>
<td>Low Temp P-Coat</td>
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<td>IFT Coating</td>
<td>AMS-C-27725</td>
<td>PRC 825X09</td>
<td>LPS 670</td>
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<td>Polysulfide Sealant</td>
<td>MIL-PRF-87133, Ty III</td>
<td>PR-1436</td>
<td>LPS 680</td>
<td>Grade B (No Products)</td>
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<td>Aluminum Chromate Conversion Coating</td>
<td>MIL-DTL-81706</td>
<td>Aiolone 600</td>
<td>LPS 320</td>
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<td>Surface Finishing</td>
<td>Magnesium Chromate Conversion Coating</td>
<td>AMS-M-3171, Ty III</td>
<td>Sodium Dichromate - Technical Grade</td>
<td>LPS 315</td>
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<td>Passivation</td>
<td>AMS-QQ-P-35, Ty II, AMS 2700</td>
<td>Sodium Dichromate - Technical Grade</td>
<td>LPS 325</td>
<td>Citric Acid (All Alloys)</td>
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<td>Aluminum Deox</td>
<td>MIL-DTL-13924</td>
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<td>Aluminum Deox - Spot Weld Cleaning</td>
<td>MIL-DTL-16232</td>
<td>Turco Deox 6/16</td>
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<td>Anodize Strip</td>
<td>MIL-DTL-81706</td>
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<td>IVD Post Treatment</td>
<td>AMS QQ-P-416, AMS 2400</td>
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<td>Cadmium Post Treatment</td>
<td>MIL-A-8625</td>
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<td>Black Oxide - Chromic Acid Rinse</td>
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<td>AMS QQ-P-320, AMS 2460</td>
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<td>IVD-Al, IZ-C17+ (Zinc-Nickel), Cold Spray, Alumiplate</td>
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<td>Silver Plating - Tarnish Resistance</td>
<td>ASTM B700, Grade A</td>
<td>Sodium Dichromate - Technical Grade</td>
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- Prioritize to develop implementation strategy based upon FRC impact and engineering approval.
FRCSE Aspect List

FY14 Process Activities with ‘Significant’ Environmental Aspects and Impacts (Top 20%)

- Industrial Waste Water Treatment
- Aircraft & Component Paint Removal (ABM & Chemical)
- Chrome Electroplating
- Corrosion Treatment
- Aircraft & Component Paint Operations
- Chromate Conversion (A/C & Components)
- Hazardous Material Management
- Oxygen Cleaning (ODS)
- Cadmium & Silver (cyanide) Electroplating
- Metal Finishing – Anodize (Hex Chrome post treatment)
- Energy Use; Electrical (& Steam)
- NDI- Florescent Penetrant
- Solvent Tank Cleaning
- Water (& Sanitary) Use

Generated from EMS Metrics
**Aircraft Priming**

**NAVAIR Fleet Readiness Center Jacksonville**

- MIL-PRF-85582 Epoxy Primer (Class C1)
- Type I - Class N Authorization Pending
- Type II – Class N Authorization (Dem/Val)

**Ty II Epoxy Primer Approval is Required**

Dem/Val Delays w/ A/C Delivery Schedules

- H-60 Seahawk
- P-3 Orion
- F/A-18 Hornet
- F/A-18 Superhornet
- EA-6B Prowler
- T-34 Mentor
- T-44 Pegasus

A/C Paint Bay - Shop 62716
NAVAIR Fleet Readiness Center Jacksonville

- 1885 gallon process tank
- TCP Substitution Authorized
- Boiling chromate solution

Tank 9 – Shop 62713

CIP Project Scheduled for Installation 2014

Major Modification of Anodize Process Line
NAVAIR Fleet Readiness Center Jacksonville
- 740 gallon process tank
- Boiling chromate Solution

NO Active Development
TCP – Potential Solution
Drop in replacement, minor modification

Tank 30 – Shop 62713
NAVAIR Fleet Readiness Center Jacksonville

- 598 gallon process tank
- TCP Substitution Authorized
- Aluminum Alloys & IVD post treatment

Color Additive Recommended for process control
NESDI Proposal in Review
Drop in replacement, minor modification

Tank 8 – Shop 62713
NAVAIR Fleet Readiness Center Jacksonville

- 740 gallon process tank (120-130F)
- Need all in one replacement
- FRC alloy systems (Citric Acid?)

Tank 26 – Shop 62713

Minor Modification of Process Line

Passivation
(Nitric Acid 30-40%)

TANK NO. 26
GALLONS 740
TEMPERATURE Ambient
Plant Acct: 65886000198

Consult MSDS and HAZCOM Manual for further information and instructions.
NAVAIR Fleet Readiness Center Jacksonville

- 360 gallon process tank (150-190F)
- Phosphate - Steel Alloys
- Black Oxide – Steel Alloys

No Active Development TCP Potential Solution
Drop In Replacement
Minor Modification to Process Tank

Tank 23 – Shop 62713
NAVAIR Fleet Readiness Center Jacksonville

- 1885 gallon process tank
- Turco Deox 6/16
- Required for Spot Weld Cleaning
- Anodize Strip

Non-Cr Alternative Exists
Need development for spot weld cleaning
Drop In Replacement
Minor Modification to Process Tank

Tank 12 – Shop 62713
NAVAIR Fleet Readiness Center Jacksonville

- Various process tanks
- Chromic Acid (130F -140F)

ESTCP Dem/Val In Progress
Cobalt Electroplating
Major Modification to Process Line

HVOF Transition of line of sight areas
NAVAIR Fleet Readiness Center Jacksonville

- 658 gallon process tank (Post Treatment)

IZ-C17+ Dem/Val In Progress
Drop In Replacement w/ TCP

Moderate Modification to Process Line

Tank E-2 – Shop 62722
Aircraft Depainting Operations

Chromate Waste Stream
Advanced Aluminum Anodize

- FY11 CIP – New Process Line
  - Increase Tank Size
  - Automated Hoist Controls
- MIL-A-8625 Update Required

8500 hrs
Improved Corrosion Performance

TCP Seal Authorized

Technology Authorization
nCoP (Cobalt–Phosphorus Plating)

- **Process Comparison**

<table>
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<tr>
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<th>Nanovate™ CR</th>
<th>EHC</th>
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<tbody>
<tr>
<td>Deposition Method</td>
<td>Electrodeposition (Pulse)</td>
<td>Electrodeposition (DC)</td>
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<tr>
<td>Part Geometries</td>
<td>LOS and NLOS</td>
<td>LOS and NLOS</td>
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<td>Efficiency</td>
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<td>15-35%</td>
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<td>0.0005”-0.001” /hr</td>
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<tr>
<td>Emission Analysis</td>
<td>*Below OSHA limits</td>
<td>Cr+6</td>
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- **Cathode Efficiency**

  - Approaches 100% efficiency

- **Nanovate™ CoP Plating Tank at FRCSE**

  - Up to 8X faster than Chrome plating
  - Increased throughput
  - One Nanovate CR tank can replace several EHC tanks
  - More efficient (~ 90% Reduced power consumption)
  - Bath is Stable
IZ-C17+ (Zinc-Nickel Plating)

Operational Need/ Objective:
• Assess the corrosion fatigue and stress-corrosion cracking performance of IZ-C17+ zinc-nickel sacrificial coating for high-strength steel components
• Process and coating are being demonstrated/validated at FRC Southeast.

Proposed Solution/ Technology:
• IZ-C17+ zinc-nickel with a trivalent chromium passivation as alternative to cadmium with hexavalent chromium passivation
• Acceptable SCC and CF data is required to authorize
• Process is planned to be implemented at FRCs, with FRC Southeast as lead site

DoD/Naval Impacts/Benefits:
• Cadmium and hexavalent chromium are carcinogens and targeted by DoD/Navy/FRCs for minimization
• Compliance costs to use cadmium and hexavalent chromium will remain
Cold Spray Metallization

- AERMIP Funded
- National Team (PAX)
  - Brush Cadmium Alternative
  - Dem/Val F/A-18 Bomb Rack
  - Modifying Equipment for Pure Al Powder
eTCP w/ Color Additive

- NESDI Proposal
- National Team (JAX, PAX, CP, NI)
  - COTS TCP Vendors
  - COTS Color Additives
  - 2015 Proposed Start
Aluminum IVD

ION VAPOR DEPOSITION OF ALUMINUM

LPS/JX 342-154 (1987)
LPS/JX 300 (2000)
Powder Coat Technology

- A/C O2 & Fire Bottles
  - Zinc Rich Epoxy Primer
  - TGIC Topcoat

Powder coating implemented within the FRC Engine Finish Shop to eliminate the usage of chromated epoxy primer during finish system restoration of a/c oxygen and fire bottles.
Processing of P-3 a/c using MIL-PRF-23377, Class N non-chromate primer. Process implemented to reduce artisan exposure to hexavalent chromium during application and maintenance.
Processing of T-44 a/c using MIL-PRF-23377, Class N non-chromate primer. Process implemented to reduce artisan exposure to hexavalent chromium during application and maintenance.
F/A-18 Application, Class N Primer

- F/A-18 dem/val on 12 aircraft
  - paints split between FRC-SW
  - and FRC-SE

  *Shop prime applied to F/A-18 dem/val aircraft in October 2013 at FRC-SE - 1 March 2014 at FRC-SE - 2*

- On-going dem/val on H-53
  - painted at FRC-E
The T-45 GOSHAWK is a two seat, single engine jet trainer aircraft used for advanced jet training of the US Navy carrier based pilots. It’s based in Kingsville TX, Meridian MS and Pensacola FL. It’s a derivative of the United Kingdom’s Hawk.
Questions