



Air Force Life Cycle Management Center



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U.S. AIR FORCE

AFLCMC Cd and Cr Replacement/ Elimination Strategy

Debbie Naguy

AFLCMC/EZP

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Report Documentation Page

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Product Support Engineering



- **AFLCMC/EZP: Established to support enterprise efforts to reduce product support costs and improve readiness**
 - Cd/Cr is an enterprise issue; to maximize limited resources enterprise approach is required
- **Collaborates closely with:**
 - CTIO & AFCPO
 - ESOH Leads
 - Corrosion Managers
 - Chief Engineers
 - Depot Community
 - AFRL
 - AFNWC
 - AFSPC
 - Lead Commands
 - Other Services (Army, Navy)
- **Follows Airworthiness Process for Deploying New or Substitute Materials, Processes, and Product Forms**



Abatement Costs



- **In Nov 2012, SECAF directed the AF find innovative solutions to controlling cost without endangering readiness**
- **OSHA requires “clean as practical” approach to exposure mitigation**
 - **>\$67 Mil spent to date on Depot abatement techniques**
 - **Additional Man Hours, Process Time and Training to implement mitigation**
- **Depots contract out Cd plating work**
 - **Contracting Plating results in extra cost**
 - **Results in impact to 50/50**



EZP Cd/Cr Strategy



- **Take an enterprise approach to elimination of Cd/Cr on Weapon Systems**
- **Gain PEO/Program Office buy-in to implement qualified products**
- **Use Airworthiness (AW) Process for implementation qualified alternative products**



AW Process for Deploying New or Substitute Materials, Processes, and Product Forms



- **Purpose**
 - Formalize process for M&P changes is needed for aircraft applications
- **Why to use it**
 - Many new M&P changes are cross-cutting and present unique challenges that must be characterized for the intended service environment, usage, and duration
 - Approval or disapproval should be documented by the appropriate authority, recognized by all AFMC and DLA personnel as a minimum, and implemented in each application
- **Benefits**
 - Ensure M&P changes are fully qualified prior to implementation
 - Encourage implementation of M&P changes when business case is favorable



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Notional Framework for Non-Chrome Deployment



		Corrosion and Mishap Risk Posed by this Application Area <i>(Green indicates application area will tolerate less capable alternatives)</i>		Risk Assessment of the Use of CrVI in this Application Area <i>(Green indicates application poses lower ESOH risks to AF personnel and installation environment)</i>		Risk Assessment of the Use of Alternatives in this Application Area <i>(Green indicates adoption of alternatives would not increase risk in these areas)</i>		
<u>Example</u> Cad-CrVI Applications		Life Cycle Corrosion	Life Cycle Mishap	DoD Worker Exposure Risk if CrVI Used	ESOH Life Cycle Cost	Corrosion Prevention Performance	Technical Maturity Risk	Life Cycle Cost
Near-term Focus Areas for Implementation	Primer on support equipment and infrastructure	Visible and repairable		Larger source of worker CrVI exposure	Larger source of installation ESOH costs			Some alternatives require more frequent inspection and application
	Aircraft Outer Mold Line (OML) Primer	Sometimes						
	Bare metal surface treatments/Conversion Coatings/"Sealers"	<u>improve performance of outer mold line replacement</u>						alternatives still require exposure controls
Longer-term Focus Areas	Sealants							
	Adhesive bonding primers							
	Internal Structural primer	Hidden, difficult to inspect or access	Known life cycle structural integrity risk	Limited or no expected worker exposure	Limited or no installation ESOH costs			Higher life cycle probability of loss of aircraft or of availability
	Fuel tank primers, coatings, and sealants	Frequent corrosion;	Known life cycle mishap risk					



Cr Elimination Current Projects



- **Current chrome alternatives available for near-term Outer Mold Line (OML) implementation**
 - Update MIL-PRF-32239 to capture top performing systems on QPL
 - Document coating application/integration process for non-chrome systems to include repair and characterization
 - Implementation strategy critical for success and risk reduction
- **Current Field Evaluations**
 - F-16, C-130, HH-60, Ground Support Equipment, ICBM Missile trailers
- **FY15 Sensors**
 - Accelerated Corrosion Testing Protocols
 - Evaluation of other non-chrome coatings



Cd Elimination Efforts



Components



- LHE Zn-Ni for LG at Hill AFB approved on all organic WS
- Zn-Ni for brush plating repair (on-going ESTCP)

Fasteners



- Zn-Ni for LSS (completed)
- Zn-Ni for HSS (on-going SBIR Phase III)

Connectors



- SEED SERDP



- **Cd-free Alternatives for Brush Plating Repair Operations / Dalistick Project**
 - Test and evaluate COTS Zinidal (Zn-Ni) brush plated coating on HSS and LSS for repair applications on WS parts and components
 - Demonstrate COTS brush plating tool Dalistick™ Station for selective plating, ensuring the safety and cost effectiveness of the novel brush plating technology
- **Cd replacement on Low and High Strength Steel Fasteners**
 - Validate and qualify LHE Zn-Ni coating with non-hex Cr conversion coating for applications on HSS and LSS threaded and unthreaded fasteners



Brush Repair - Dalistick Station

*Dalistick Station,
Dalic Inc*



Enables selective electrochemical treatments without electrolyte/hazardous chemical solution leakage during processing

- ❑ Practical and environment-friendly solution for brush plating technology
- ❑ Zinidal Zn-Ni as Cd replacement
- ❑ Recovers brush plating electrolyte at the point of contact and recycles it for reuse in a closed-loop process:
 - solution life/use is extended
 - hazardous solid waste is reduced

- ❑ Can be used for coating/rust removal, activation, and deposition of thin metallic layers on curved, horizontal or vertical surfaces and edges either in the field or at Depots



Cd Alternatives Strategy: Fasteners



- **Enterprise focus on outer mold line fasteners**
 - Approved aerospace alternatives exist (F-35, KC-46)
- **Utilizing supply chain management approach to quickly implement alternatives**
 - Thousands of TOs, drawings, and specs call out Cd
 - AFSC/LG mining FLIS for Cd fastener data
- **Working with AFSC/AFLCMC/DLA for approval process for alternative NSNs for fasteners**
 - Cd NSN would be linked to approved alternative to ensure Cd fasteners no longer purchased
 - Working with Joint Group on Environmental Attributes team for DoD solution



Future Projects Through WS-STEP and Enterprise Approach



- **Cr-free conversion coating (dip-tank process)**
- **Non-Cr fuel tank coating**
- **High-flexibility non-Cr primer**
- **Complete Cr-free coating system for LHE Zn-Ni and Cr-free anodize seals**
- **Non-Cr coating systems field evaluations**
- **Implementation of Non-Cr surface adhesion promoter (PreKote™)**
- **Cr-free alternatives for OML additional testing:**
 - **Process compatibility testing**
 - **Material compatibility testing**
 - **Weapon system requirements testing**
- **Planned evaluations :**
 - **Field testing on multiple WS (C-5, A-10, KC-135, B-1, E-3)**



Summary



- **Primary focus has been on Cr alternative for OML application due to Risk Assessment**
- **Secondary focus is on Cd alternatives for fasteners and repair operations**
- **Developed Cr/Cd elimination strategy linked with Airworthiness Process and Enterprise Approach for deployment of qualified alternatives**