U.S. Army
Aviation & Missile Command
Hexavalent Chromium Coatings Replacement Program
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U.S. Army Aviation & Missile Command Hexavalent Chromium Coatings Replacement Program

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Surface Finishing and Repair Issues for Sustaining New Military Aircraft Workshop, February 26-28, 2008, Tempe, AZ. Sponsored by SERDP/ESTCP.
AMCOM Testing effort focused on the performance of the coating system

- Technical approach was more holistic
  - Focus was on coating system performance vice individual system component capabilities

Test Program leveraged off of other DoD and commercial test efforts

- NAVAIR – ESTCP Non-Chrome Aluminum Pretreatments
- Air Force - PreKote
- Air Force/NAVAIR Non-Chrome Epoxy Primer
- Deft/Hentzen Class N Primer development
Test Program Background

- Testing performed Fall/Winter/Spring 2003-2004 at NAVAIR Patuxent River and ARL Aberdeen
  - NAVAIR performed pretreatment and coating application
  - ARL performed corrosion, EIS and adhesion testing on the coated samples
    - ASTM Adhesion testing performed on both wet and dry samples
    - Corrosion testing evaluated samples in neutral salt fog (B117) and Cyclic (GM9540)
• Substrate Materials evaluated included:
  – 2024 and 7075 Aluminum (T6 tempers) various test pretreatments
  – 4340 High Strength Steel (Cd plated)
  – ZE41A Magnesium (Dow 17 and PreKote Treated)
  – G11 Composite (no pretreatment)
• Coating Products Evaluated
  – Class N Primer (MIL-PRF-85582 Type I)
  – MIL-DTL-53039 and 64159 CARCs
  – Alternate conversion coatings: Alodine 5700, Alodine T5900RTU and PreKote
Test results indicated the following materials were the best non-hexavalent chromium products

- MIL-DTL-81706 Type II (TCP)
  - 4 Manufacturers have qualified products
    - Products available as concentrates or ready-to-use
    - NSNs requested and Army transition will follow
- MIL-PRF-23377 Class N
  - 2 Manufacturers have qualified products
    - NSNs obtained and Army transition in-progress
ON-AIRCRAFT TESTING

• Initial Test coating applied to CH-47 by 1109th Aviation Classification Repair Activity Depot (AVCRAD) Groton Fall 2005
  – Pretreatment MIL-DTL-81706 Type II (TCP)
  – Upper fuselage received a Class C primer, lower fuselage the Class N primer
  – MIL-DTL-64159 Type II CARC

• Additional coating applications continued at the 1109th AVCRAD throughout 2006 and 2007
  – New coating system used on CH-47, UH-60 and AH-64 rotary-wing aircraft
Several Class N Primers are now available for use

MIL-PRF-23377 Type I and II Class N NSNs

- **Type I** – 8010-01-555-3381 (1 Gal Kit)
  - Mfr P/N 16708TEP/16709CEH Hentzen
  - Mfr P/N 02GN084 (Deft)
- **Type I** – 8010-01-555-3386 (1 Quart Kit)
  - Same P/N
- **Type II** – 8010-01-555-3383 (1 Gal Kit)
  - Mfr P/N – 17176KEP/16709CEH (Hentzen)
MIL-PRF-85582 Type I and II Class N NSNs

- Type I – 8010-01-555-3385 (1 Gal Kit)
  - Mfr P/N - 44GN098 (Deft)
- Type I – 8010-01-555-3388 (1 Quart Kit)
  - Mfr P/N - 44GN098 (Deft)
- Existing NSNs for MIL-PRF-85582 Type I and II Class N
  - 8010-01-466-9037 (Type I 2-Gal/Kit)
  - 8010-01-466-9313 (Type II 2-Gal/Kit)
• AMCOM Authorization for the use of Class N Primers in-progress
  – Maintenance Information Message (MIM) will be distributed when NSNs have been added to the Authorized Users List (AUL) for Aviation Systems and Equipment (in-progress)
    • Per discussion with the Integrated Material Management Center (IMMC), the MIM is still at Aviation Safety awaiting final approval before distribution
  – Follow-on MIMs will be issued for MIL-DTL-81706 Type II products when NSNs have been assigned
• Request has been submitted to the GSA for NSN Assignment for MIL-DTL-81706 Type II Class 1a and 3 products (Trivalent Chromium Process – TCP)
  – Type II products do not use hexavalent chromium (Cr+6)
  – Primer adhesion in many applications is improved over Type I conversion coatings
  – Corrosion inhibition performance not impacted by elevated temperatures
  • No breakdown when used under powder coatings cured at temperatures that would damage Type I conversion coatings
• May be other potential applications for the TCP materials
  – Testing is in-process to evaluate TCP as a seal coating over:
    • Acid and alkaline zinc-nickel plate
    • Zinc plate
    • Phosphate treatments over steel
    • Final rinse/seal over hard anodized aluminum

MIL-DTL-81706
• New CARC coatings conforming to MIL-DTL-53039 Type II will be available in the near future
  - Type II products contain <1.5 lb/gal VOCs and 0 Volatile Hazardous Air Pollutants
  - CARCs use either silica or polymeric bead flattening
  - New NSNs to be assigned to differentiate from older MIL-C- or MIL-DTL-53039 coatings
New ‘53039 Type II Beaded CARC will initially be available in the most common Aviation colors:

- Aircraft Green (Color No. 34031),
- Aircraft Black (Color No. 37038),
- Aircraft Interior Black (Color No. 37031) and
- Aircraft Interior Grey (Color No. 36231)
- Still awaiting final qualification of the new Desert Sage color (Color No. 34201) for the CH-47
- Insignia Blue (35044), Aircraft Red (31136), Aircraft White (37875) will be available as a Type I coating for the immediate future (silica flatteners)
• When changing to the new primer and CARC coatings initial results were mixed
  – AVCRAD personnel closely followed mix/application guidelines with OEM techreps present
    • No noted difficulties and good results
  – Other facility painters did not review technical guidelines and proceeded to apply the new primer like the previous products
    • Inadequate mixing resulted in some of the coating failures
    • Wet/dry film thickness was not properly controlled
    • Improper paint gun settings and tip orifice sizes resulted in poor control of the applied coating
    • Top-coating was applied before primer had sufficient time to fully cure
G-4/Coating OEM performed an on-site assessment of the painting operations at a primary AMCOM facility.

Personnel provided recommendations to improve painting operations, maximize productivity, minimize waste:

Infrastructure review focused on several contributing areas:

- Storage areas need to be less exposed to wide temperature swings
- Mixing Equipment
  - Single or Dual Arm aggressive paint “shakers” are needed to properly mix the new high solids primer and CARC coatings
  - Proper process needs to be followed to mix the two-component coatings
• Infrastructure review (continued):
  – Application Equipment
    • High Volume/Low Pressure (HVLP) guns
      – All of the paint guns in each paint shop should be standardized (standardized in entire facility would be best)
        » Proper repair parts must be available in each shop
      – Proper tip orifice critical with the new coatings
    • Paint pots that use vertical or paddle agitators to keep suspended solids evenly distributed are required
      – Proper operation of in-pot agitators is important
      – Paint pots must be kept on optimum condition
• **Infrastructure Review** (continued)
  
  – **Supply air**
    
    • Supply air systems must provide sufficient pressure and volume
    
    • Inline air dryers to ensure air supplied to pressure pot/gun is moisture- and oil-free
    
    • Easily accessible and operable traps and blow downs to keep air lines contaminant free
    
    • Regular inspections and maintenance on the systems to maintain top performance
    
    • Airlines should be properly sized and configured for optimum performance
      
      – Separate supply lines for pot pressurization and atomization air
• Infrastructure Review (continued)

  – Paint Booth Climate Controls
    • Need to keep the booth at a nominal 50% relative humidity
    • Control temperatures in the booth at:
      – 70°F or above (winter months),
      – 90°F or below (summer months)
    • Aircraft should be acclimated to the booth temperature prior to coating application
• New Primers and CARCs are not the same coatings as previously used
  – Transition to the new coatings will require painter familiarization with the coating prior to spraying an aircraft
  • Hands-on training and test panel spraying recommended prior to 1st application on an aircraft
  • Training should emphasize:
    – Understanding ambient condition impacts on coating application and drying
      » Temperature and humidity
    – Proper mixing
    – Sufficient drying time between coating applications
    – Controlling wet-film thickness and edge blending
• POCs
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