NAVAIR Corrosion Overview

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Frederick Lancaster – NAVAIR Materials Engineering Corrosion & Wear Branch
NAVAIR Corrosion Overview

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MATERIALS ENGINEERING
SERVING NAVAL AVIATION ENTERPRISE NEEDS

A FULL SPECTRUM APPROACH - S&T, ACQUISITION AND SUSTAINMENT TECHNOLOGIES FULLY INTEGRATED FOR ALL AEROSPACE SYSTEMS:

• AIR VEHICLES
• PROPULSION

• WEAPON SYSTEMS
• AVIONICS & SENSORS

• AIRCRAFT LAUNCH & RECOVERY EQUIPMENT
• SUPPORT EQUIPMENT

MATERIALS S & T
• 6.1 - 6.4
• SBIR and ILIR
• Manufacturing Technology
• Environmental Programs
• Technology Transfer
  ➢ Metals and Ceramics
  ➢ Propulsion Materials
  ➢ Corrosion Technology
    - Materials Protection
  ➢ Advanced Polymers and Composites
  ➢ NDI
  ➢ Functional materials

ACQUISITION SUPPORT/ RISK ASSESSMENT
• Requirements Definition
• Source Selection
• Design Reviews (PDR/CDR..)
• Materials & Process Specifications/CDRLs
• Design Allowables
• Performance Monitor
• M&P Certification
• Flight Clearance
• Technology Transition
• Repair Development/ Analysis

IN-SERVICE ENGINEERING/PRODUCTION SUPPORT
• FRC/ISSC Engineering Support
• Corrosion Prevention & Control
• HAZMAT Minimization / Environmental Compliance
• Aircraft and Engine Maintenance/ Repair/Life Extension Technology
• Engineering Investigations
  • Failure Analysis
• Mishap Investigation
• Aging Aircraft Initiatives
• GS and T/M/S Manuals
• Fleet Bulletins & Inspections
AMCOM-NAVAIR Corrosion Partnership

Working together to Solve Common Corrosion Issues

- Mg Components
- Shrink Wrap
- Mildew
- OIF/OEF Helicopters
- Connectors
Technology Transition with the Army

TARR Radome Boot Remover

Wash Pads

Old Scotch-Brite

New JetPad

CPC's – (eg fluid film)

Cleaners
**Corrosion-Inhibited Mildew Remover**

- Joint NAVAIR & AMCOM assessment of reformulated Mildew Remover
  - Meets critical characteristics specified in MIL-PRF-85570 and ADS-61A-PRF cleaning specs
  - Effectively removes mildew without corrosion risk of bleach
- U.S. Patent applications filed for compositions & kit
- Composition and kit licensed to commercial supplier
- NAVAIR & AMCOM authorized in 2005
- Implementation pending current FIFRA registration and NSN assignment
- Initerim Kits delivered to Fleet and to Army Units
**Long-Lived CPC’s**

**DESCRIPTION:**
Field validation of improved MIL-PRF-81309 CPC
- Validate performance on multiple platforms
  - Navy, Marines, & Army
- Qualify products to MIL-PRF-81309
- Evaluate performance
  - General use & electrical/avionics applications
- Leveraged with NAVAIR AERMIP program

**APPLICATION:**
- Aviation weapon systems, support equipment and avionics

**HIGHLIGHTS:**
- F/A-18 dem/val underway
  - CSFWL reports excellent performance
- Commercial product being validated against NAVAIR control formula.
- Two licensed products being tested against Type II & Type III

**DEMONSTRATION:**
Field validation – completed 24 months on aircraft
- Report in DRAFT
  - Navy: 17 F/A-18’s, 5 EA-6B’s, 4 H-46’s
  - Army: 1 H-60
  - USMC: 8 EFV’s
- **Develop new spec for long lived CPC’s**
Before deployment…

…after (no degradation with use of gasket)

HH-60H Lower UHF/VHF/TACAN Antenna

AvDEC Gaskets for aircraft:
- Conductive for antenna, static wick and other electrical applications
- Non-conductive for floorboards
- Reduced or eliminated com “gripes” and failures during mission

Estimated ROI: 2.1 (recently re-validated by 4.2 cost analysis on EA-6B and H-60 fleet implementation)
- Type II savings: Time on Wing
  - H-60: now 364 FH (48% improvement)
  - EA-6B: now 449 FH (43% improvement)

Improved Gaskets

Before Gasket
- Time to remove antenna: 45 minutes
- Condition: Moderate to severe corrosion on antenna base and aircraft skin.

Antenna replacement:
Average 2.5 per deployment per squadron (i.e. BUNO 164239)

F/A-18 Integrated Antenna Cost: $143K

After Gasket
- Time to remove antenna: 4 minutes
- Condition: No corrosion on aircraft skin or antenna.

AvDEC Conductive Gasket

NAVAIR AvDec Implementation Status Jan 2008
- All Aircraft (73%)
- AC Complete
- AC Funded Being Implemented
- AC Pending Funding
- AC Pending $ Feedback
- AC Acquisition/No Decision
- AC Other Method (Pending)
- Awaiting Contact
**Aviation Sheltering**

F/A-18 shelters at China Lake, CA

- Evaluation of impact on aircraft corrosion (and other maintenance) planned for 2006-2008:
  - EA-6B at NAS Whidbey, WA (Installed waivers in place)
  - T-45 at NAS Kingsville & NAS Meridian
  - F/A-18 at NAS Oceana, VA (Planned)
  - NAS Patuxent River FA-18G
- Assess aircraft performance compared to sensor data

**Funding:** OSD Corrosion IPT and DLA Reliability Program
- Purchase and install shelters at Whidbey Island and Oceana (EOY 2006)
- Monitor performance of aircraft under shelters compared to control aircraft
- Install corrosivity sensors under shelter and next to shelter, collect data and compare results to aircraft

**Corrosion Kinetics of 2024 T3 Aluminum At Navy Sites**

- Sheltering showing up to 5-fold reduction in corrosivity in carrier environment and similar attenuation at Tyndall AFB, FL
Pre Coated Fasteners

Objectives
- Dem/Val field performance of a pre-coated/self-sealing fastener technology on Navy/USMC aircraft in operating environments and compare to existing practices

Problem
- Military standards require permanently installed fasteners to be treated with a corrosion-inhibiting, “wet” sealant prior to installation to meet the stringent corrosion performance required by the military aerospace operational environment.
- The process is expensive, time consuming, subject to technician error, and requires the use of an environmentally hazardous sealant.

Candidate Coatings
- 14 Candidate Coatings screened down to two.
  - Pre-applied Sealant w/ sizecoat
  - Magnesium rich primer

A. Test Plan

B. Technical Qualification
- Laboratory Screening Testing

C. Technical Validation
- Field Testing (on aircraft)/Mechanical Test

D. Tech Transfer
- Assign NSN
- Add to manuals
**Background**

- Several studies to evaluate the ability of CPCs to reduce/eliminate corrosion failures.
- Some CPCs more effective than others on component types tested.
- Some CPCs promoted corrosion.
- Unable to control the material meeting older specification.
- A new CPC and specification were developed to better control materials.
- AF and NAVAIR mandates that CPCs be applied to all areas of aircraft.
- NAVAIR request to evaluate new CPC for use on aircraft wiring systems.

**Project Schedule**

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<tr>
<th>Project</th>
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<tr>
<td>Project Approved/Funded</td>
<td>Jan</td>
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<td>Testing</td>
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<tr>
<td>Data Analysis and Reporting</td>
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**Impact to Fleet/Issues**

Designed to determine interaction between CPCs and wiring component materials.

- Materials degradation (hardness, swelling, electrical properties)
- Corrosion growth (visual, electrical resistance, functionality, maintenance)

**STATUS:**

- Testing Complete – final report and incorporation into maintenance documents
Information Transition

Many Products…

Multiple Applications…
H-60 Aluminum Gearbox

DESCRIPTION:
Prototype new casting process for gearbox manufacturing using aluminum alloys
- New Casting Process - Alcoa
- Working with US Army and Sikorsky Aircraft
- Aluminum offers significant corrosion benefits over magnesium
- Potential to reduce or eliminate weight debit with aluminum components

APPLICATION:
- H-60 and other rotary wing gearbox assemblies

HIGHLIGHTS:
- Funds received – working contract vehicle through Army H-60 program office for SAC partnership
- Weight debits from aluminum castings not as large as previously reported
- Aluminum protective coatings weigh much less than resins used for magnesium

COST IMPACT:
- H-60 main gearbox: $291K
- H-60 tail gearbox: $93.4K

LABOR IMPACT:
- H-60 main gearbox: 223 man hours
- H-60 tail gearbox: 57 man hours

Annual:
- Corrosion Scrap Rate – H-60 TGB 27/yr
- Cost – 1 TGB – $94,400 & 57 MHrs
  - $99,530 parts and labor
- Total Annual Expense – $2,687,310*
**PEDS Inspection Tool**

- **PEDS** – Personal Electronic Device
- **O-level inspection & data capture tool**
- **Demonstration & Validation Project**
  - Tool functionality collaboratively built with fleet

- **Phase I** – Initial focus on MCI/Visual reference tool, MRC’s, 509
  - Electronic data capture, WUC’s embedded behind interface
  - Report format output/VIDSMAF

- **Phase II** – Transition Goal: ADCS/NALCOMIS Upload
Pulsed Waterjet Decoating

• Pulse Water Jet Stripping of Chrome Plating and HVOF Coatings from Jet Engine Components for NAVAL Aircraft Applications
  – Ultrasonic pulse added to waterjet stream
  – Resonant frequency matched to substrate for coating removal
• Validate the Pulse Water Jet process for stripping chrome plating and HVOF coating from engine alloys without damaging the base metal.
• Strip chrome plated and HVOF coated parts to verify capability on actual engine components.
Meeting the needs of the fleet

Environmental issues in Southeast Asia

– Based upon feedback from Navy, Marine, Air Force & Army aviation units deployed to Southeast Asia.
– Main driver is the lack of available clean water for aviation corrosion maintenance.
– Qualified products not available.
Qualification of Ready To Use (RTU) MIL-PRF-85570 Ty II Cleaners

Description
- Evaluate currently qualified MIL-PRF-85570 Ty II cleaners in a pre-diluted form and qualify for use. Revise 01-1A-509 and MIL-PRF-85570 specification to include new class
- Benefits: Prevents the use of unauthorized / unqualified products which pose health, safety and aircraft corrosion problems.
- Satisfy fleet need for aircraft spot cleaner as a replacement for high aromatic solvents

Status
- 4 QPL products currently identified and testing in work (5th to be tested)
  - Cleaning Efficiency
  - Hydrogen Embrittlement
  - Corrosion Testing
  - Storage Stability (1 & 2 year extended)
  - Pump Bottles, 5 gal pail, 55 gal drum

Melamine Wash Pad plus RTU Cleaner yields exceptional results from a water based product.
## Qualification of MIL-PRF-85570 Type I Aerosol and Pre-Moistened Wipes

### Description

- Evaluate currently qualified MIL-PRF-85570 Ty I products in an aerosol version and pre-moistened wipe form.
- **Benefits:** Will be a direct replacement for the high solvent unauthorized MIL-C-43616 aerosol.
- Fulfill the need for acceptable aircraft spot cleaners

### Status

- Received 2 candidate products (2 aerosol & 2 wipes) for in-house for testing. Wipe prototype field **tested at Oceana with positive fleet feedback**
- Received second generation prototype wipes & aerosol cans, tested at **Andrews AFB-VAQ 209 with positive feedback**
  - 1:1 dilution on wipes seems optimal
**Micro Mesh Cloths for Non Chemical Canopy and Optics Cleaning**

**Description**

- Evaluate the feasibility of using 3M Micro Fiber Cloth with only water for cleaning aircraft canopies, windscreens, windows, optics and instruments without the use of chemicals

**Status**

- Received candidate product in house for testing
- Initial testing for haze, transmittance and clarity showed no effects on acrylic or polycarbonate materials when used with water

**Issues & Actions**

- No issues
- Survey of areas application to be conducted during fleet visits
- Coordinating with Subsystems & internal Materials who have auspices over optical material

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Microfiber candidate for windows, glass and originally made for optics cleaning
Meeting the needs of the fleet

Environmental needs

– Each of the following projects address current environmental needs
  • Comply with current legislated regulations
  • HAPS/VOC issues with paint strippers
  • Chrome VI elimination
  • HAPS compliance – fluorinated propellant.
Description

- Demonstrate and validate the performance of commercially available peroxide-assisted benzyl alcohol chemical paint strippers and qualify for use on aircraft substrates. If successful, output would be multiple new products qualified to TT-R-2918 which are environmentally preferred and technically effective, and safe on metals especially high strength steels.

Status

- Compiled candidate products for in house for testing
  - McGean E-3000, Dekote, next two TBD.
  - Samples ordered for E-3000 & Dekote

- Monitoring Army & SERDP R&D projects for paint removal mechanisms to see if new products evolve out of those efforts.

- Recent Fleet and FRC visits confirm need and issues.

Issues & Actions

- Start and end dates were adjusted due to delay in getting TPOC on board.
  - TPOC is on board and started work on project

- Ordering aluminum & steel test coupons
  - Arranging for cad plating of test coupons (landing gear)

- Ordering primers and topcoats for panel tests.

- Reviewing toxicity of products
Description

- Currently, **MIL-DTL-81706** Method D applicator pen is qualified only with hexavalent chromium, Type I, product (Alodine 1132 Touch N Prep Pen).
- Aircraft maintainers do not have environmentally friendly, non-hexavalent chromium, Type II, option.

Status

- Received candidate touch up pens in house for testing
  - **Surtec 650, Surtec 650C pen, Henkel 817**
- Coordinating testing between Cherry Point and Pax River.
- Test panels being prepared at Pax River for testing.

Issues & Actions

- No issues
- Note: Will be considered a “Weapon System Coded” item in the supply system.
- Presently coordinating testing with Materials Lab AIR 4.3 at Cherry Point, NC for field testing.
**Description**

- Identify commercial-off-the-shelf (COTS) products formulated with a fluorinated lubricant or formulate Class L products with a fluorinated lubricant if there is no COTS product or COTS products do not meet the performance expectations.
- Test in laboratories and fields.
- Revise the specification and technical manuals as needed.

**Status**

- Miller-Stephenson MS-738 has been identified as a potential product.
- Testing requirements have been identified.
- Test Requirements document has been prepared.
- Test panels for plastics and elastomers compatibility tests were ordered and received.
- Chemicals for a new formulation were ordered and received.

**Schedule** (just physically mark up I will do the rest)

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