

NAVAIR Corrosion Overview



February 2009

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

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE FEB 2009		2. REPORT TYPE		3. DATES COVERED 00-00-2009 to 00-00-2009	
4. TITLE AND SUBTITLE NAVAIR Corrosion Overview				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NAVAIR Materials,Engineering Corrosion & Wear Branch,Lakehurst,NJ,08733				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES 2009 U.S. Army Corrosion Summit, 3-5 Feb, Clearwater Beach, FL					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

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 & 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

- | | |
|---|--|
| <ul style="list-style-type: none"> • FRC/ISSC Engineering Support • Corrosion Prevention & Control • HAZMAT Minimization / Environmental Compliance • Aircraft and Engine Maintenance/ Repair/Life Extension Technology | <ul style="list-style-type: none"> • Engineering Investigations Failure Analysis • Mishap Investigation • Aging Aircraft Initiatives • GS and T/M/S Manuals • Fleet Bulletins & Inspections |
|---|--|



FLEET
OPNAV
NATEC

Group
Integration

Solutions

Depots NAWCs NAVAIR

NAV AIR MATERIALS ENGINEERING

Materials Engineering Division

Metals &
Ceramics
Branch

Industrial /
Operational
Chemicals
Branch

Nondestructive
Inspection
Branch

Polymers &
Composites
Branch

Analytical
Chemistry &
Testing
Branch

Corrosion &
Wear
Branch



AMCOM-NAVAIR Corrosion Partnership



Working together to Solve Common Corrosion Issues



Mg Components



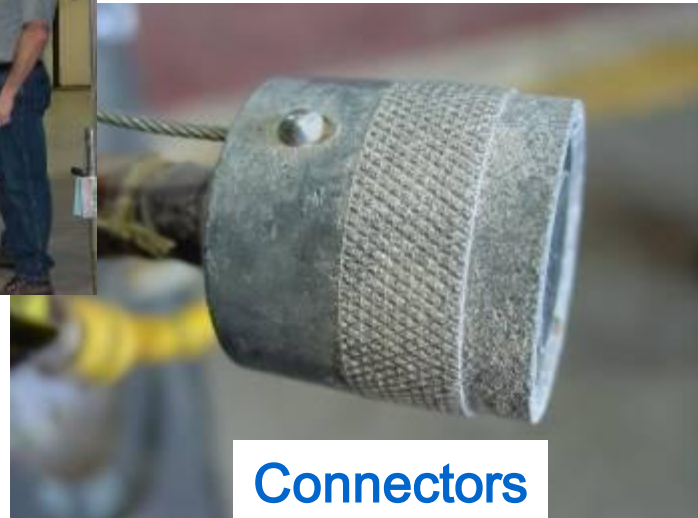
Shrink Wrap



OIF/OEF Helicopters



Mildew



Connectors

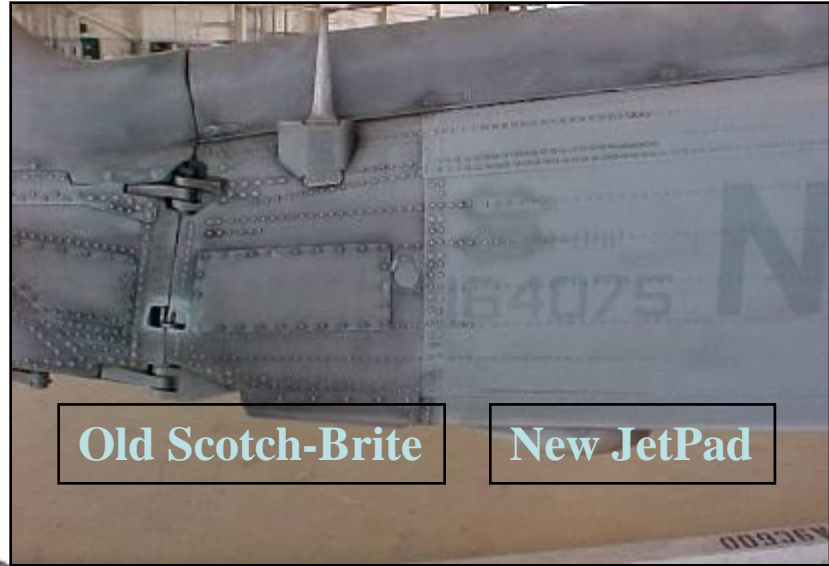
Technology Transition with the Army



TARR Radome Boot Remover



Wash Pads



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
- Interim Kits delivered to Fleet and to Army Units

Mildew Growth Inside T-39 Aircraft Before Cleaning



Cleaning Mildew Growth by Spraying Mildew Remover



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*



VV-L-800
AISI 4130 Steel



MIL-C-81309
AISI 4130 Steel



NAVGUARD
AISI 4130 Steel



Before deployment...



HH-60H Lower UHF/VHF/TACAN Antenna

...after (no degradation with use of gasket)



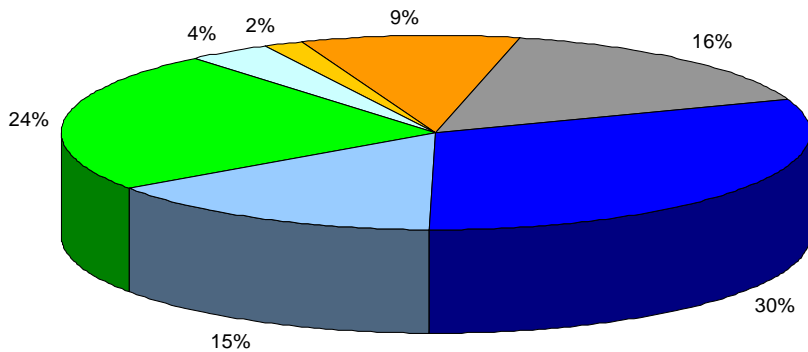
DESCRIPTION

- 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)

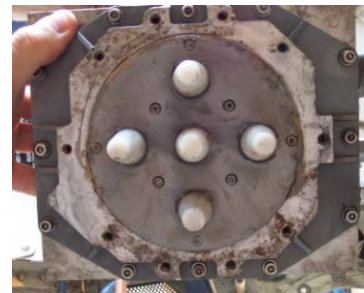


AvDEC Conductive Gasket

**NAVAIR AvDec Implementation Status Jan 2008
All Aircraft (73%)**



- AC Complete
- AC Pending Funding
- AC Acquisition/No Decision
- Awaiting Contact
- AC Funded Being Implemented
- AC Pending \$ Feedback
- AC Other Method (Pending)



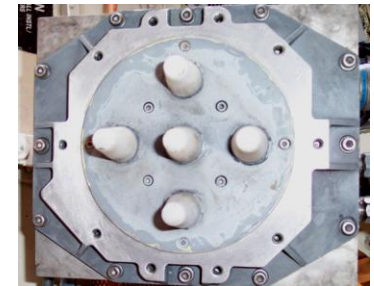
Before Gasket

- **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.



F/A-18 shelters at China Lake, CA



Installed corrosivity sensors at China Lake to prove concept for Navy and study shelter effect on corrosion in desert environment

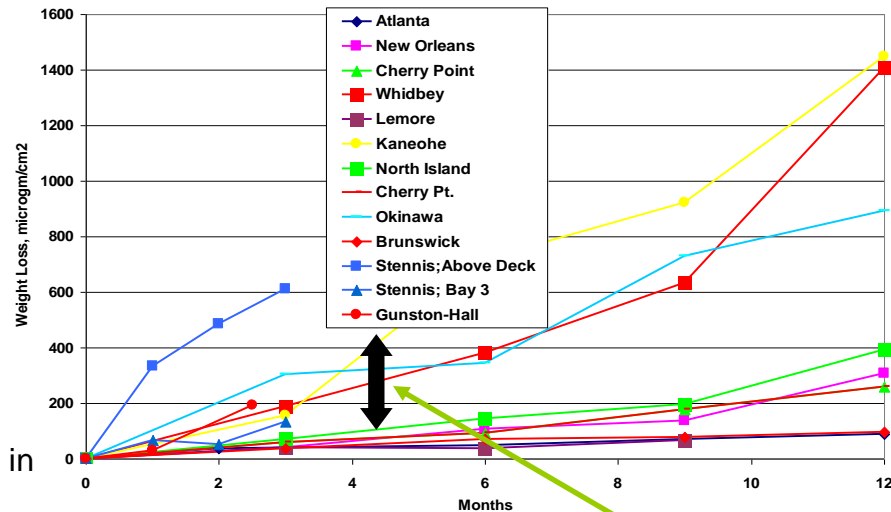
Funding: OSD Corrosion IPT and DLA Reliability Program

- 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



T-45 shelters at NAS Meridian

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

- 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



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

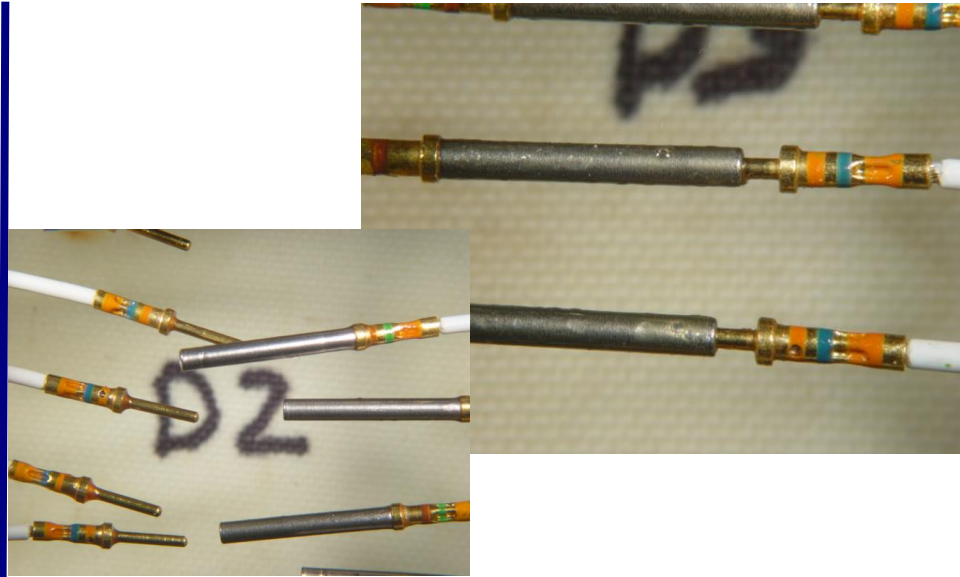
- Field Testing (on aircraft)/Mechanical Test

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

	CY 2006						CY 2007												
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Project Approved/Funded	<<<Nov 2005																		
Contract Awards Phase I, II, IIa																			
Phase I	<<<Complete																		
Phase II	<<<Complete																		
Phase IIa						Δ													
Design and Assemble Fixtures	<<<Complete																		
Testing																			
Group A																			
Group B																			
Group C																			
Group D																			
Group E																			
Group F																			
Group G																			
Data Analysis and Reporting																			

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



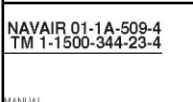
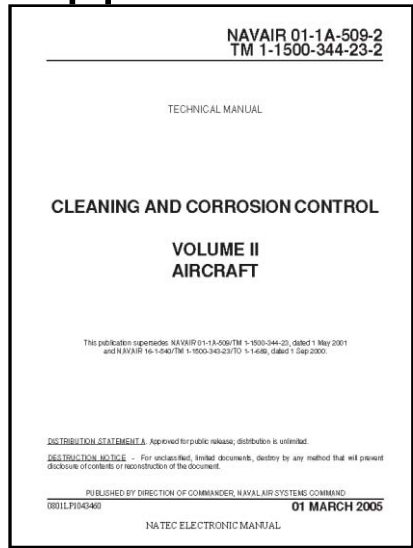
Many Products...



Multiple Applications...



"YOUR DECISION TODAY COULD AFFECT TOMORROW"





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:

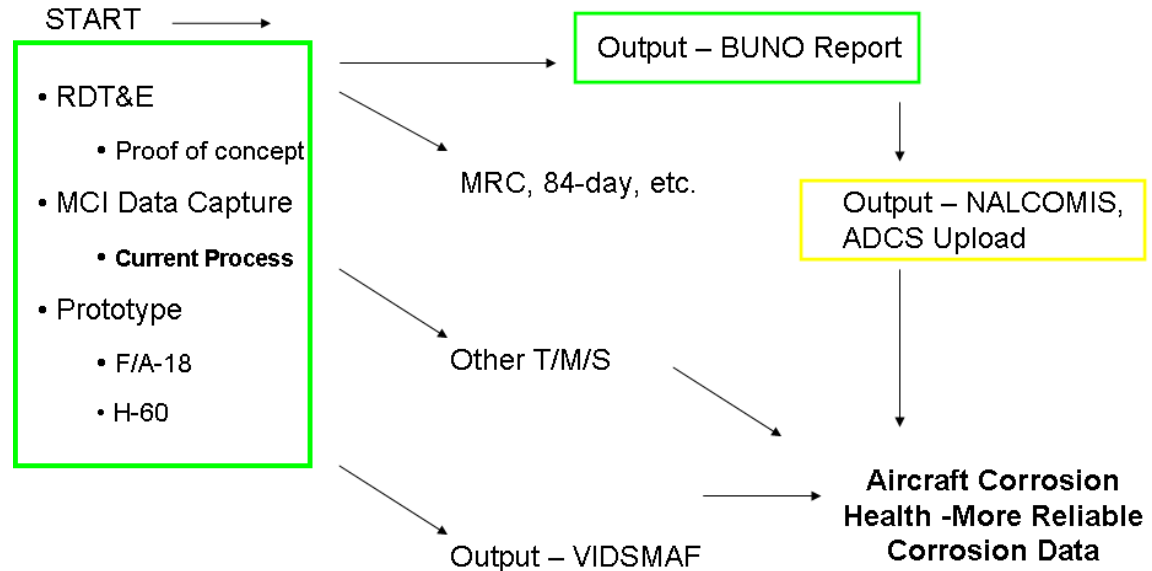
- Corrosion Scrap Rate – H-60 TGB 27/yr
- Cost – 1 TGB – \$94,400 & 57 MHrs
– \$99,530 parts and labor
- Total Annual Expense – \$2,687,310*



PEDS Inspection Tool



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



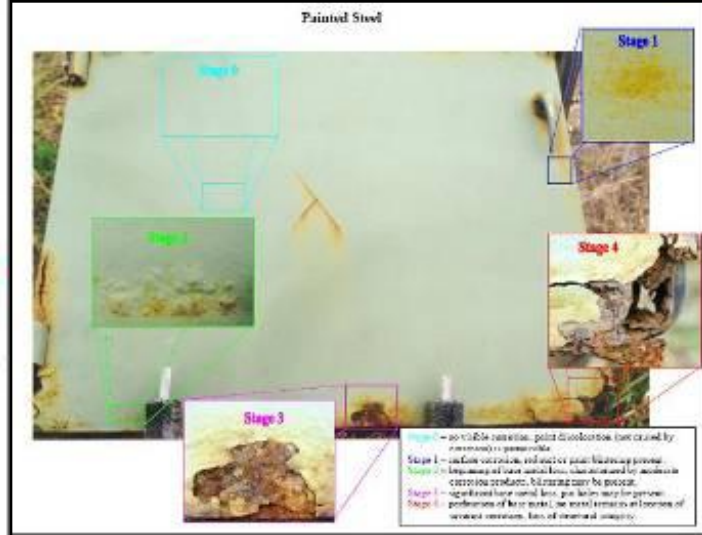
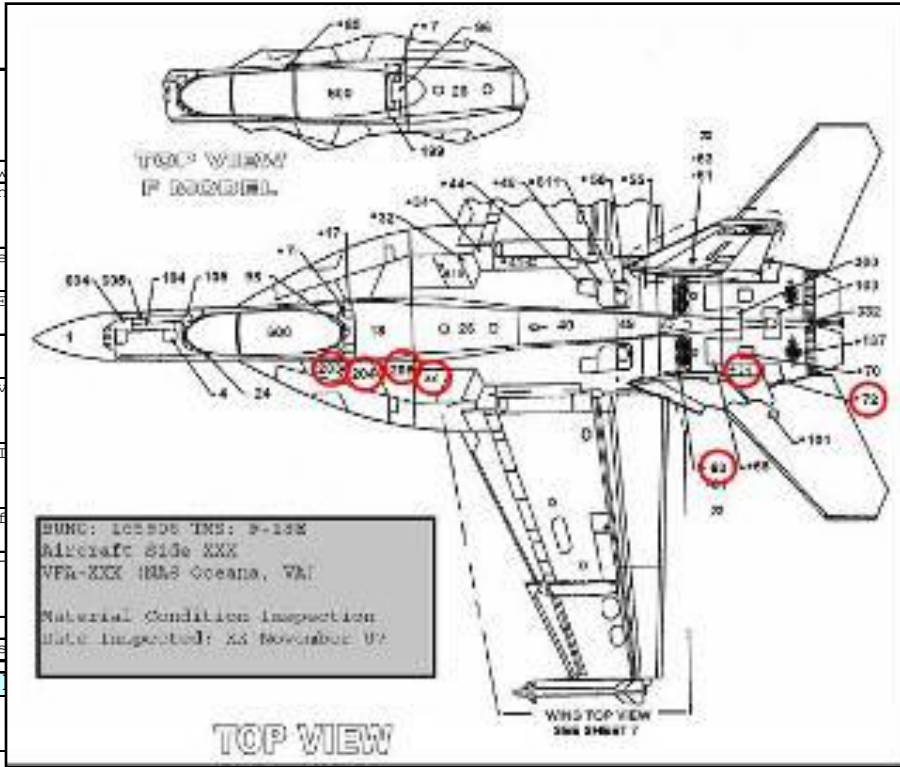
- Phase I – Initial focus on MCIVisual reference tool, MRC’s, 509

- Electronic data capture, WUC’s embedded behind interface
- Report format output/VIDSMAF

- Phase II – Transition Goal ADCS/NALCOMIS Upload



Task ID	Task
1	Initial Mtg w
2	Prototype Wir
2.1	MCI/Depot Spe
2.2	Conduct MCI/E
2.3	Develop JQR
2.4	Develop MCI v
2.5	Develop MCI I
3	Provide ROM f integration
4	TypeWing out-
5	Update brief
6	MCI/EE Propo

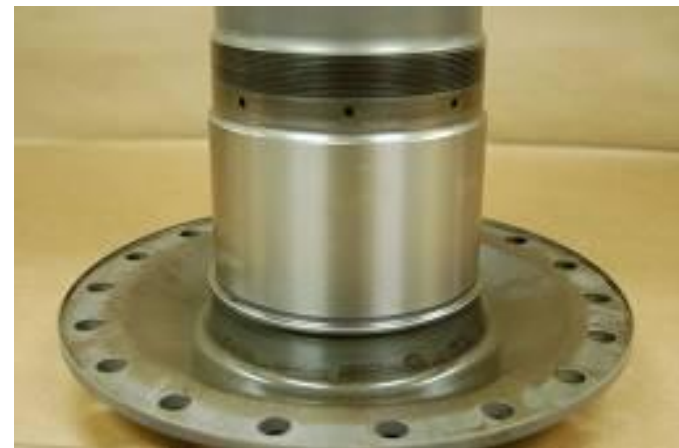


Location				Action	NLT
203L				Remove and Treat as Req	84 Day
203L	Internal	5	4 1/2 in Cannon Plug on XXX Corroded	Clean and Treat IAW NA01-1A-509	Immediately
203L	External	NFC	Working Rivet	Remove and replace	84-Day
204L	Internal	1	3 Pin Cannon Plug on XXX needs CPC	Apply Corr Preventative Compound ASAP	Prior to Closure
204L	External	NFC	Safety Wire loose	Remove and reinstall	Prior to Closure
205L	Internal	2	Fastners and Fastner Holes Corroded	R&R Fastners Remove Corr Clean and Treat Fastner Holes as Req	84 Day
205L	External	1	FIP Seal Torn and Missing Pieces	Clean and Treat Area Replace FIP IAW Applicable TM	Immediately
22L	Internal	FC	MLG Door Delaminated	Remove and repair per SRM	Immediately
22L	External	2	Panel LE Inbd Corner has Surface Corrosion	Remove Corr Clean and Treat as Req	84 Day
63L	Internal	4	Fwd Bulkhead Inboard Frame Exfoliation	Beyond capability IAW SRM request E&E for FRC Repair	Immediately
Total Score		1 FC/2 NFC/14			



NAV AIR *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.





- 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



MIL-PRF-85570 Type I Pre-saturated Wipes – Foil Pouch & Plastic Tub



Unauthorized MIL-C-43616 aerosol (L) with candidate MIL-PRF-85570 TY I Aerosols (R)

Micro Mesh Cloths for Non Chemical Canopy and Optics Cleaning

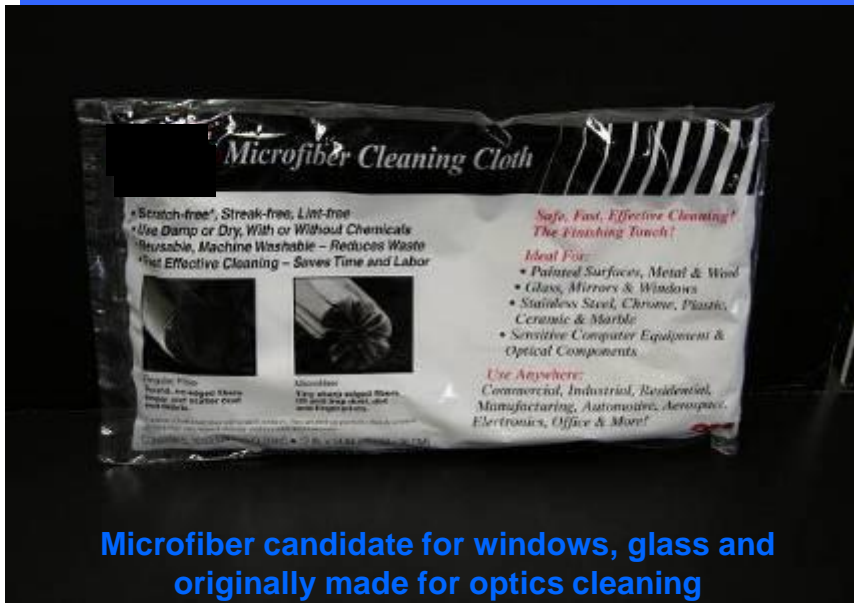


Description

- 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



Microfiber candidate for windows, glass and originally made for optics cleaning

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

Meeting the needs of the fleet

Environmental needs

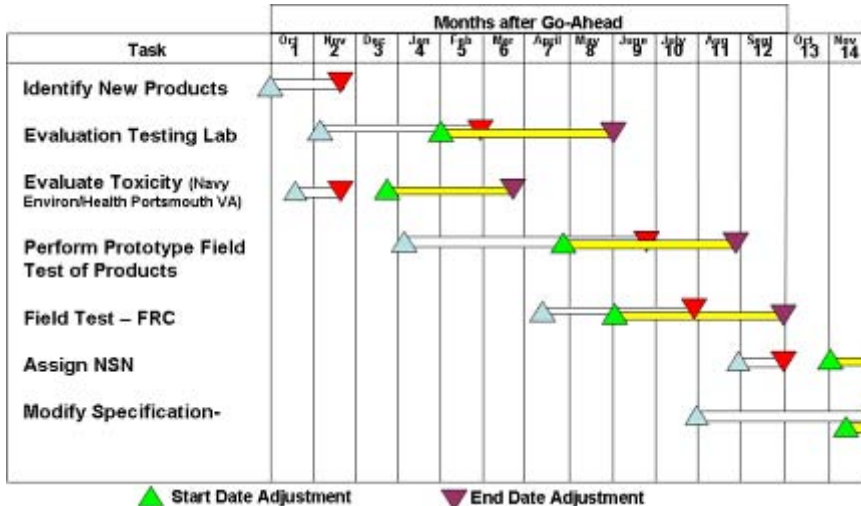


- Each of the following projects address current environmental needs
 - Comply with current legislated regulations
 - HAPS/VOC issues with paint strippers
 - Chrome VI elimination
 - HAPS compliance – fluorinated propellant.

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.

Schedule



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



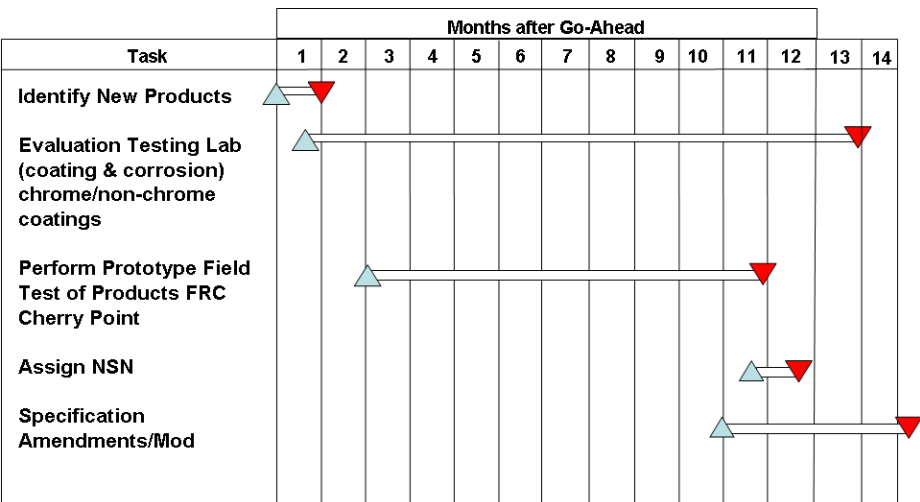
Description

- 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.

Schedule



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)

Task Name	Duration	08			09				10		
		4	1	2	3	4	1	2	3		
Project Kick-off	30 days										
Establish testing requirements (JTP Development)	45 days										
COTS product identification	30 days										
Formulation	30 days										
Perform evaluation / lab tests	360 days										
Interim report	90 days										
Field tests	270 days										
Specification revision	180 days										
Technical manual id / update	180 days										
Final & Cost and Performance Summary Reports	60 days										

Issues & Actions

- Formulation of a new product will be initiated in the first quarter of 2009
- Performance testing of MS-738 will be conducted in the first quarter of 2009