
CORROSION POLICY AND OVERSIGHT

**OFFICE OF THE UNDER SECRETARY OF DEFENSE
FOR ACQUISITION, TECHNOLOGY AND LOGISTICS**



Understanding Corrosion Prevention and Control

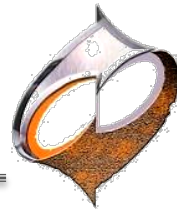
Daniel J. Dunmire

Director, Office of Corrosion Policy and Oversight



How Many Laws Govern Corrosion?

CORROSION POLICY AND OVERSIGHT



- **2nd Law of Thermodynamics**

“Every process occurring in nature proceeds in the sense in which the sum of the entropies of all bodies taking part in the process is increased. In the limit, i.e. for reversible processes, the sum of the entropies remains unchanged.”
(Planck)

- **10 U.S.C. 2228**

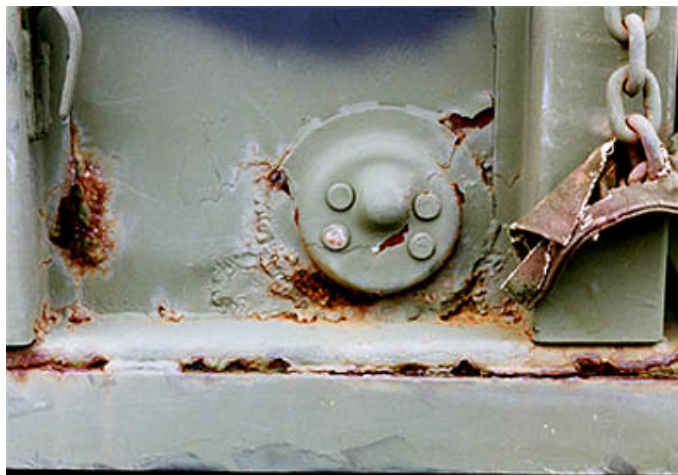
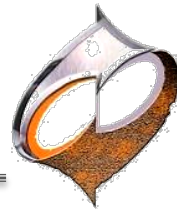
“...the deterioration of a material or its properties due to a reaction of that material with its chemical environment.”





Corrosion Examples

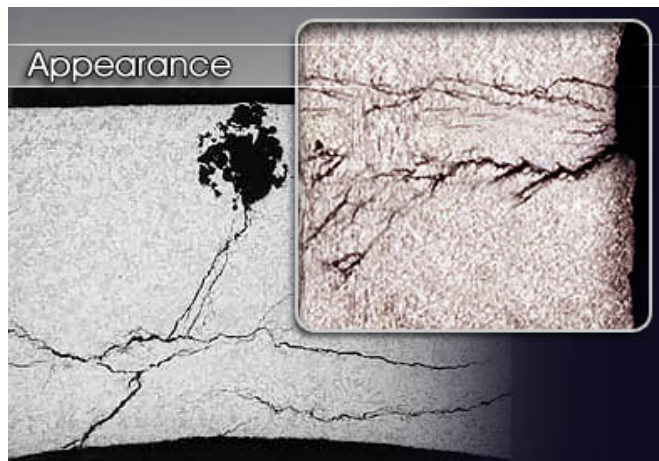
CORROSION POLICY AND OVERSIGHT



General and Crevice Corrosion of Steel



Spalling in Concrete



Environmentally Influenced Cracking



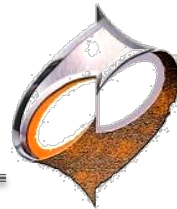
uV Degradation of Organic Coating System





Cost of Corrosion Study

CORROSION POLICY AND OVERSIGHT

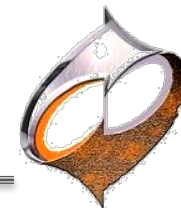


Study year baseline	Study segment	Annual cost of corrosion	Corrosion as a percentage of maintenance	Data
2009-2010	Army aviation and missiles	\$1.5	20.9%	FY2007 and FY2008
	Marine Corps ground vehicles	\$0.3	12.3%	FY2007 and FY2008
	Navy and Marine Corps aviation	\$2.7	23.0%	FY2008 and FY2009
2010-2011	Air Force aircraft and missiles	\$5.1	23.9%	FY2008 and FY2009
	Navy ships	\$3.3	21.6%	FY2008 thru FY2010
2011-2012	Army ground vehicles	\$1.7	12.3%	FY2008 thru FY2010
	Marine Corps ground vehicles	\$0.3	14.3%	FY2009 thru FY2011
2012-2013	DoD facilities and infrastructure	\$3.0	14.4%	FY2009 thru FY2011
	All other DoD segments	\$3.6	17.9%	FY2009 thru FY2011
	Army aviation and missiles	\$1.9	21.9%	FY2009 thru FY2011
2013-2014	Navy and Marine Corps aviation	\$3.6	28.2%	FY2010 thru FY2012
	Air Force aircraft and missiles	\$5.9	25.2%	FY2010 thru FY2013
	Total DoD annual corrosion cost	\$23.3 billion	20.7%	





Corrosion Impact on System Availability



CORROSION POLICY AND OVERSIGHT

Table 3-11. Corrosion Impact on Total NMC Hours by TMS (FY2009)

TMS	Total NMC hours—all categories	Total NMC hours related to corrosion	Percent of total NMC hours related to corrosion	Average NMC hours per aircraft related to corrosion
F-16C	2,947,890	792,880	26.9%	773
KC-135R	839,802	355,944	42.4%	983
C-130H	770,219	275,102	35.7%	997
T-38C	1,084,893	273,085	25.2%	606
F-15C	1,024,992	263,732	25.7%	811
A-10C	822,049	253,191	30.8%	1,200
T-6A	968,925	242,904	25.1%	641
F-15E	709,860	165,445	23.3%	742
A-10A	595,625	155,821	26.2%	1,105
F-16D	533,024	140,027	26.3%	800



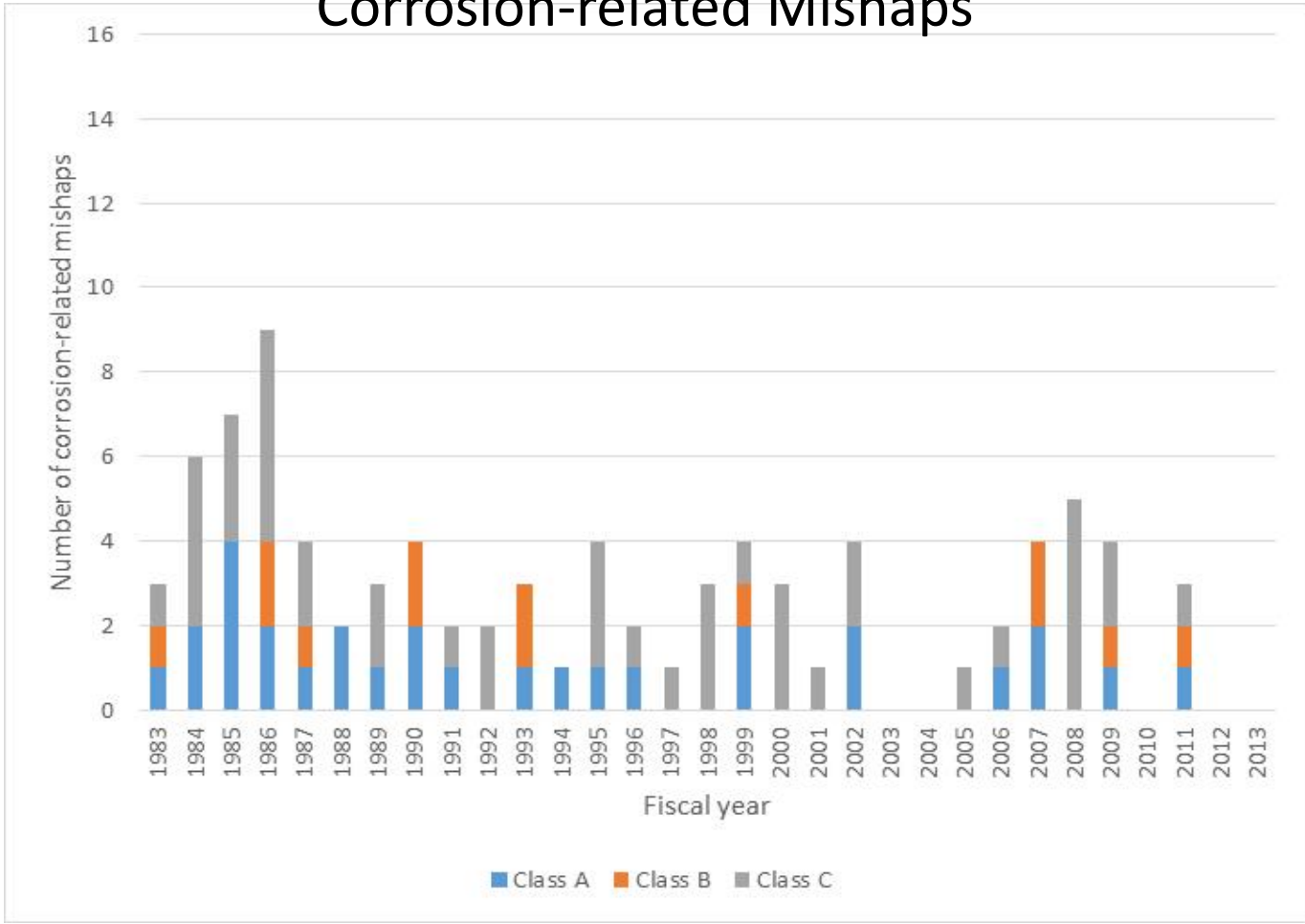


Corrosion Impact on Safety



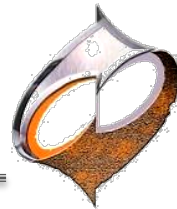
CORROSION POLICY AND OVERSIGHT

Department of Navy Aviation Corrosion-related Mishaps

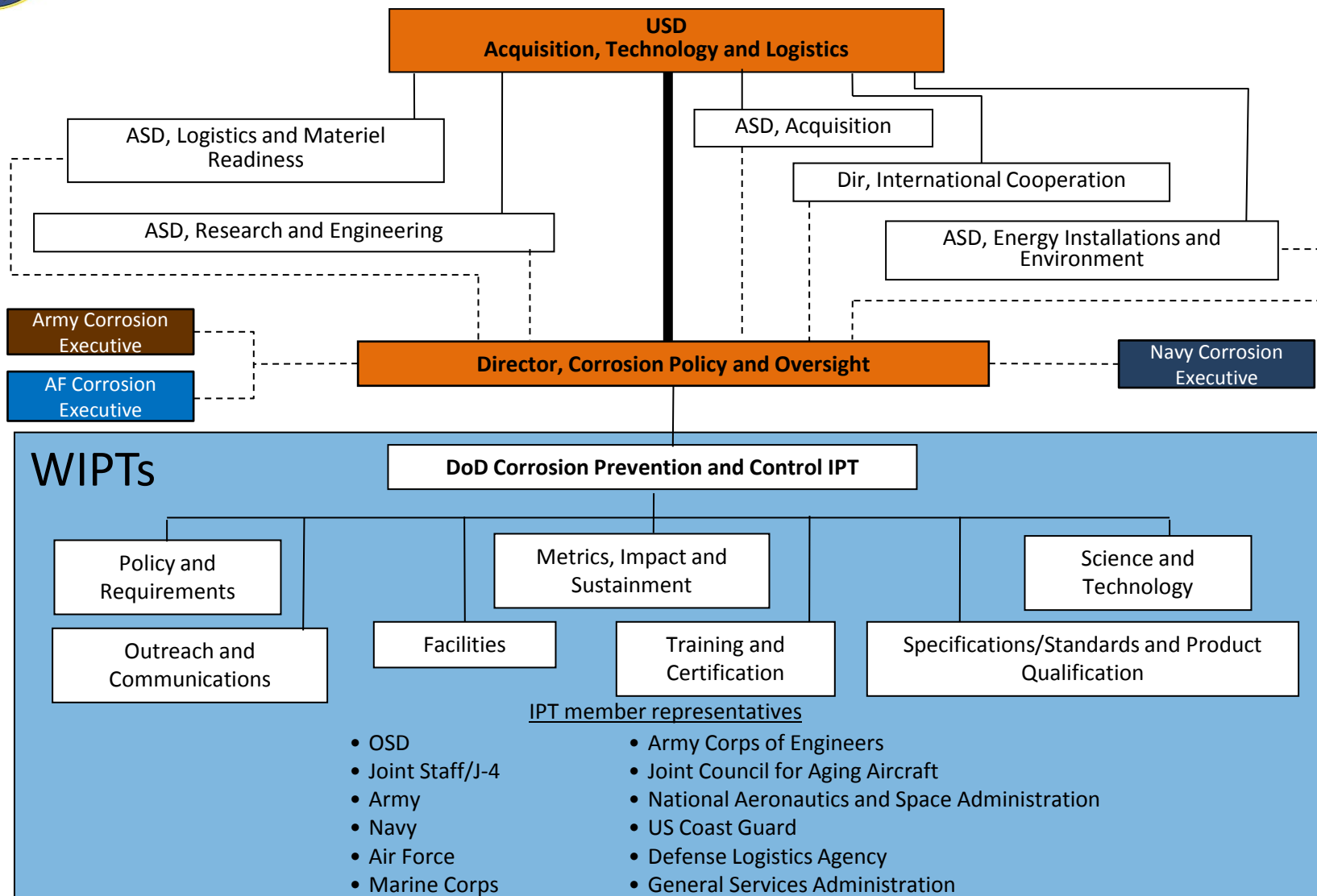




DoD Corrosion Organization



CORROSION POLICY AND OVERSIGHT





What We Do

CORROSION POLICY AND OVERSIGHT



■ Activities

- Policy Development and Implementation
- Weapon System and Major Facility Program Reviews
- Workforce Development
- Corrosion Metrics Collection and Analysis
- Specifications and Standards
- Communication and Outreach

■ Project and Research Sponsorship

- Demonstration/Implementation Projects through Military Departments
- Technical Corrosion Collaboration





Policy

CORROSION POLICY AND OVERSIGHT



- **DoDI 5000.02** – *Operation of the Defense Acquisition System* – requires CPC planning for all systems (including MAIS, COTS, and GOTS) throughout the lifecycle
 - “.....planning for and establishing 1) a management structure for CPC, and 2) the technical considerations and requirements in order to implement an effective CPC regime throughout the life cycle of a program.”
 - Planning documented in the Systems Engineering Plan and the Life Cycle Sustainment Plan
- **DoDI 5000.67** - *Prevention and Mitigation of Corrosion on DoD Military Equipment and Infrastructure* – establishes structure of DoD Corrosion Program and responsibilities
- **DoDD 4151.18** - *Maintenance of Military Materiel* – requires that corrosion prevention and control programs and preservation techniques be established throughout the system life cycle.

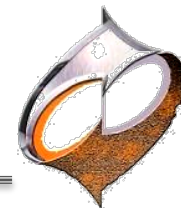
70% of sustainment costs are locked in by initial design





Oversight of Major Acquisition Programs

CORROSION POLICY AND OVERSIGHT





Specifications and Standards

CORROSION POLICY AND OVERSIGHT



- **Most corrosion-related specs and standards eliminated during acquisition reform in the 1990's**
 - Causes corrosion requirements to be negotiated individually during acquisition
- **Working with MilDeps to reestablish some needed Specs & Stds**
 - MIL-STD-1568C, *Materials and Processes for Corrosion Prevention and Control in Aerospace Weapon Systems* – newly reinstituted as a Mil Std
 - Supported by DI-MFFP-81403, *Corrosion Prevention and Control Plan*, and DI-MFFP-81402, *Metal Finishes and Finishing Processes and Procedures* (a.k.a. finish specification)
 - MIL-HDBK-502A, *Product Support Analysis* – includes CPC planning
- **Migrating some requirements to commercial standards**
 - Developing new standards with non-governmental standards bodies (e.g. SAE AS12500 *Corrosion Prevention and Deterioration Control in Electronic Components and Assemblies*)
 - TA-STD-0017, *Product Support Analysis* (previously LSA)
 - Assisting in development of Joint SSPC-NACE Std for CPC Planning





Workforce Development

CORROSION POLICY AND OVERSIGHT



- **DAU CLM-038**, *Corrosion Prevention and Control Overview*
- **DAU CLE-070**, *Corrosion and Polymeric Coatings*
- **Web-based training modules** (www.corrconnect.org)
- **Strategic partnership with NACE and SSPC** – delivering training to active duty military and government employees
- **University of Akron** – BSc. in Corrosion Engineering
 - Inaugural class of 11 graduated in May; all have jobs
- **University of Florida** – developing Distance Learning Course





Communication and Outreach



CORROSION POLICY AND OVERSIGHT

- www.CorrDefense.org – program and technical information
- DoD and Allied Nations Corrosion Conference
- Series of “awareness” videos for leadership and general public
- Educational gaming – “*CorrSim*”
- CorrDefense e-magazine
- www.CorrConnect.org – web-based training

CorrDefense DoD News about Preserving Military Assets





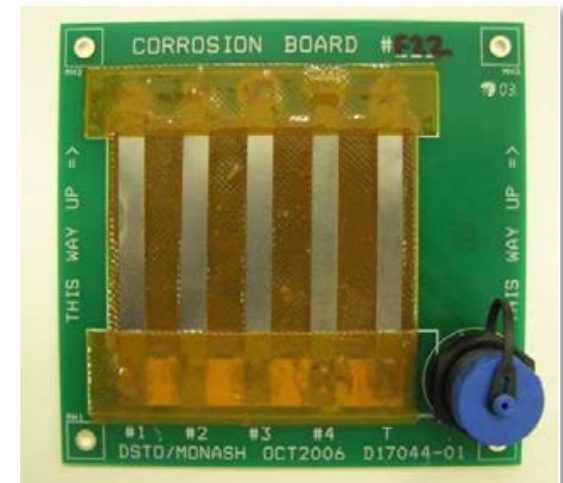
Technology Demonstration/Implementation Projects

CORROSION POLICY AND OVERSIGHT



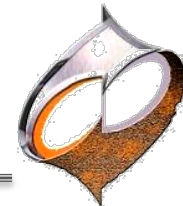
Objective – Implement mature corrosion control technologies in new and existing weapon systems and facilities

- Military Department-generated projects to qualify products and processes
- Demonstrate effectiveness in operational systems
- Update technical and logistics documentation





Technical Corrosion Collaboration (TCC)



CORROSION POLICY AND OVERSIGHT

Objectives

- Produce solutions (knowledge, technologies, processes, materials, etc.) that tangibly reduce the impact of corrosion on DoD weapons systems and infrastructure.
- Produce individuals with education, training and experience, who will form the future core of the corrosion prevention and control technical community within DoD, its support network, and its suppliers.



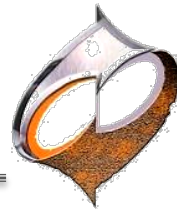
>\$90M Investment Since 2008



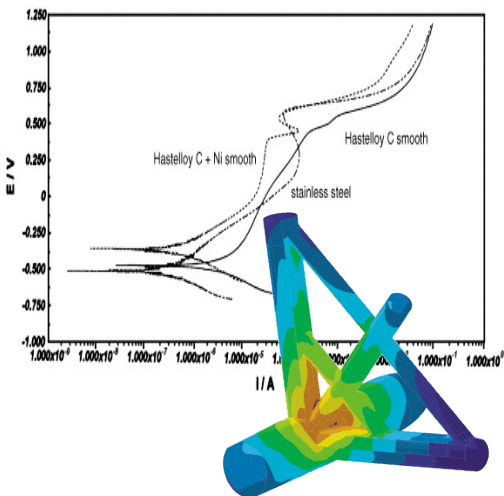


TCC Technology Investment Categories

CORROSION POLICY AND OVERSIGHT



Performance Prediction



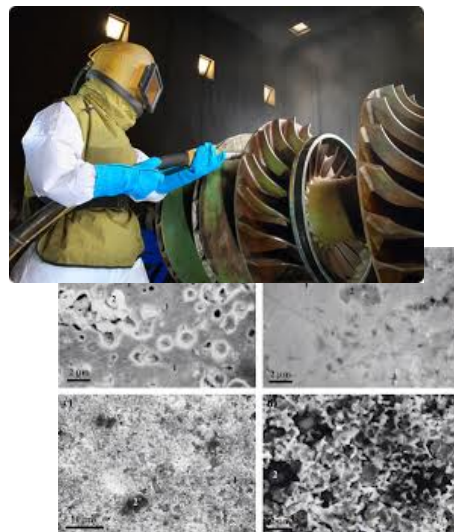
- Models
- Accelerated Testing
- Validation
- Design Tools

Assessment of Finish



- Mechanical Properties
- Integrity
- Galvanic Interaction
- Degradation Mechanisms

Surface Engineering



- Mechanical
 - Coating removal
 - Substrate damage
- Adhesion Promotion
- Sacrificial
- Cleanliness Requirements

Product Support



- Packaging/Storage
- Shelf-life
- Energy
- Maintenance





CPC Planning During System Acquisition



CORROSION POLICY AND OVERSIGHT

- **CPC performance has notoriously been traded for cost, schedule, and performance reasons during acquisition**
- **Why?**
 - Lack of awareness of, focus on long-term impact
 - No corrosion KSA, KPP, etc.
 - Difficult to quantitatively measure long term corrosion performance with short term tests
 - Increased corrosion performance often requires an investment (e.g. cost, weight, signature, etc.)
 - Cultural





CPC Planning Best Practices

CORROSION POLICY AND OVERSIGHT



- **Objective of a good CPC program is to maximize system availability and safety at the lowest cost – not to produce a “corrosion free” system**
 - Investigate corrosion performance of legacy systems
- **Establish a management process to review design decisions from a corrosion performance perspective**
 - Corrosion Prevention Advisory Team (CPAT)
- **Involve subject matter experts**
 - There are often multiple solutions to a corrosion problem
 - Bad decisions can have huge implications





CPC Planning Best Practices



CORROSION POLICY AND OVERSIGHT

- **Consider corrosion performance early in the design phase**
 - Usage profile
 - Materials selection
 - Joining processes
 - Coatings
 - Geometries
 - Storage
 - Maintenance processes
- **Require corrosion performance to be addressed in contracts**





CPC Resources

CORROSION POLICY AND OVERSIGHT



- **Corrosion Prevention and Control Guidebook for Military Systems and Equipment**
 - Guidance for all military systems and equipment – including MAIS and COTS/modified-COTS
 - Beyond general guidance, provides more specific assistance prior to each acquisition phase milestone for six areas of emphasis:
 - Management
 - Systems Engineering
 - Life Cycle Logistics
 - Test & Evaluation
 - Contracting
 - Cost Estimating and Budget
- **SEP and LCSP Outlines**
- **DAG CH 4 and CH 5**
- **Military Department Corrosion Control and Prevention Executives (CCPE's)**





Some Final Thoughts

CORROSION POLICY AND OVERSIGHT



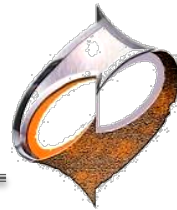
- **Corrosion is rarely just a technical problem**
 - Prevent
 - Detect
 - Mitigate
 - Manage
- **Corrosion doesn't hurt today but it hurts tomorrow**
 - Easier to invest in corrective than preventive maintenance
- **Corrosion is often a “people” problem**
 - Hard to maintain leadership focus
- **Successful corrosion control requires**
 - Awareness and buy-in from leadership
 - Teamwork between subject matter experts, designers, and maintainers – “Corrosion control is not the most important thing we do.”
 - Tools, training, and time for the personnel implementing the processes





Next Major CPO Event

CORROSION POLICY AND OVERSIGHT



2015 DoD - Allied Nations Technical Corrosion Conference

Who: DoD, Allies, Industry, Academia and Government agencies

What: An event that has been reviewed and approved by the DoD as a DoD sponsored event and accordingly, meets Departmental guidelines for attendance by all Services, Agencies and Industry

When: November 15 – 19, 2015

Where: Wyndam Grand (at the confluence of the three rivers), Pittsburgh, Pennsylvania

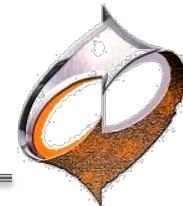
Why: Resources directed toward corrosion prevention, degradation and materiel sustainment are increasingly constrained interactions between technical and management communities are critical.

How: <http://dod.nace.org/> and anyway you can get there!





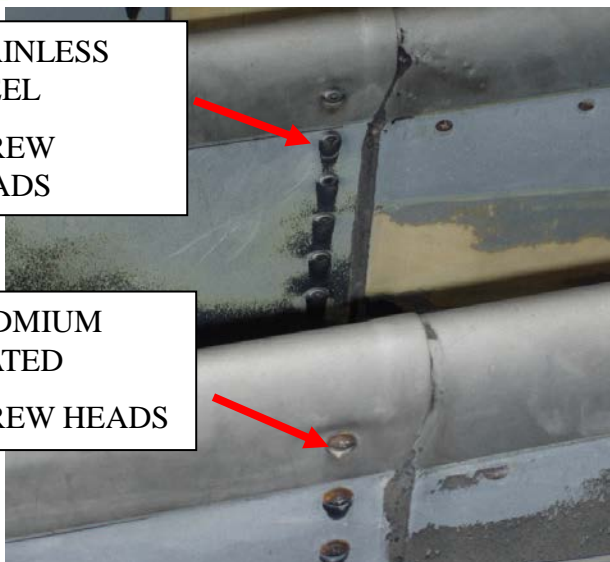
Questions?



CORROSION POLICY AND OVERSIGHT

STAINLESS
STEEL
SCREW
HEADS

CADMIUM
PLATED
SCREW HEADS



Magnesium Engine Housing



Rotor Blades



Trunion Bearings



Main Landing Gear Brake Assembly

