

Air Force Hex Chrome Strategy



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Overview



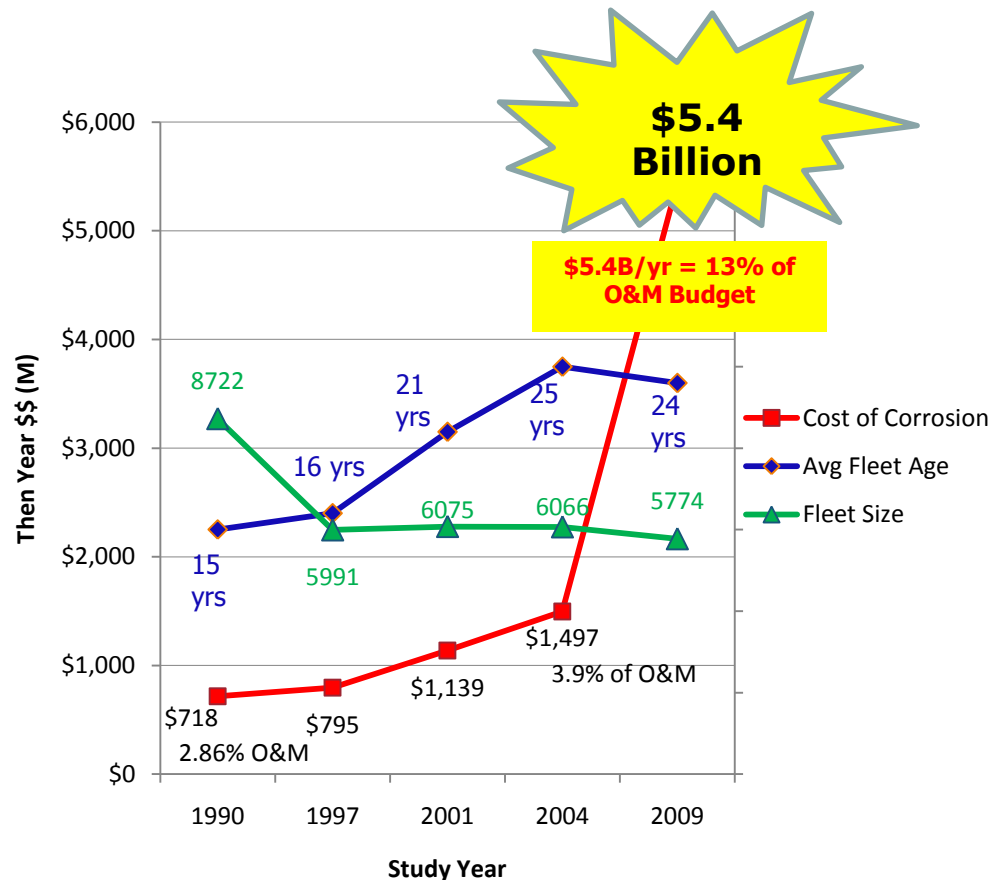
- **Cost of Corrosion**
- **Hex Chrome Pros/Cons**
- **Litigation**
- **OSD Policy**
- **REACH**
- **DoD Projects**
- **Joint Test Protocol**
- **Field Tests**



AF Cost of Corrosion



- Corrosion Costs are growing and impact all systems
- Includes Aircraft, Vehicles, Equipment, Munitions, Space Systems
- Costs Includes
 - Touch Labor
 - Mx Material Costs
- Doesn't include
 - Aircraft Availability Impacts
 - MILCON & Infrastructure Mx
 - Training



Corrosion Costs = 32% of Depot Costs

Aircraft Corrosion = \$1 M/AC



Why Use Cr(VI)?



- **Very Effective Corrosion Inhibitor**
 - Arrests surface corrosion on legacy aircraft
 - Used in most demanding applications
- **Established Track Record**
 - Used in corrosion control for 40+ years
 - Legacy Cr(VI) for years to come (interiors, residue)
- **Organizational Inertia/Resistance to Change**
 - New specs/standards, processes, training
 - Multiple new technologies to replace Cr(VI)



Hex Chrome Litigation



- **1890 - First Cr(VI) lung cancer case reported**
- **Declared carcinogen**
 - 1974: American Conference of Governmental Industrial Hygienists
 - 1980: National Toxicology Program
 - 1984: Environmental Protection Agency
 - 1990: International Agency for Research on Cancer
- **OSHA (Occupational Safety & Health Admin, established 1971)**
 - Permissible Exposure Limit originally $52 \mu\text{g}/\text{m}^3$ Cr(VI)
 - 1993: petitioned to enact temp standard of $0.5 \mu\text{g}/\text{m}^3$: OSHA studies
 - 1997: sued for unreasonable delay: court for OSHA, more data
 - 2002: sued again: court against OSHA, timetable for new rule
 - 2004: draft Cr(VI) standard, PEL of $1 \mu\text{g}/\text{m}^3$, comments
 - 2006: final rule, PEL of $5 \mu\text{g}/\text{m}^3$



OSD Policy



- **OSHA rule increased Cr(VI) visibility and regulations**
- **2009: USD AT&L (Young) issued policy calling for “extraordinary action to eliminate or minimize Cr(VI)”**
 - Invest in R&D
 - Fund the testing and qualifications of substitutes
 - Approve alternatives where performance is adequate
 - Update TOs and specs to authorize qual'd alternatives
 - Document system-specific risks
 - Share knowledge from RDT&E efforts



OSD Policy



- **2010: DFARS Clause: no Cr(VI) in new systems unless specifically approved by government**
- **Must certify that no suitable alternative exists to use Cr(VI)**
 - Is alternative...
 - cost effective?
 - technically feasible?
 - safe?
 - readily available (present and future)?
 - equal in corrosion performance?



EU Actions – REACH



- **Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH)**
 - **Strictest law ever passed to protect health/environment** - covers production and use of all chemicals
 - **Substances of Very High Concern (SVHC)**
 - **Carcinogenic, Mutagenic or Toxic to Reproduction**
 - **Persistent, Bioaccumulative, and Toxic**
 - **Phased out unless authorized**
 - **Cr(VI) is a SVHC**



Why Eliminate Cr(VI)?



- **Long Known to be a Carcinogen**
- **Increasingly Stricter OSHA regulations**
- **OSD Policy (Young Memo)**
- **DFARS Clause (new acquisitions)**
- **International Pressure – REACH**
- **Diminished Manufacturing**

**Change is coming
prepare for a world without hex chrome**



DoD Projects



- **Hex Cr Steering Group**
 - Coordination, Information Sharing
 - Hex Cr Primer Quantities
- ***Comprehensive Evaluation and Transition of Non-chromated Paint Primers***
 - Evaluate current applications and requirements for hex chrome
 - Characterize performance and maturity of alternatives
 - Recommendations (w/ data) for development, optimization, and demonstration/validation of alternatives
- ***AFRL-Wright-Patt (Dr. Berman) Hex Cr Elimination Projects***



AFCPCO Projects - JTP



- **Joint Test Protocol – *Qualification of Non-Chrome Coating Systems and Issues Specific to Legacy Weapons Systems***
 - QPL for MIL-PRF-32239 *Advanced Performance Coating System Specification*
 - C-5 Concerns
 - Anodized Clad, Cr Conversion, Pitting, Sealant Adhesion
 - Pretreatment/Primer Only Testing
 - AFCPCO Tyndall AFB Exposure Test Site
 - Battelle Daytona/Tyndall duplicate test sets
 - Corrosion Cards



AFCPCO Projects - JTP



- Non-chrome**

System	Pretreatment	Primer	Topcoat
1	PreKote	Aerodur 2100 (Mg-rich)	Aerodur 5000 (MIL-PRF-85285 Ty IV)
2	PreKote	Aerodur 2100 (Mg-rich)	Deft 99GY001 ELT
3	RECC 1015/3021	Deft 02GN093	Deft 99GY001 ELT
4	Alodine 5200	Hentzen 53055GEP-17036CEH	Hentzen 35515APX-35502CMU
5	EAP9 (Boegel)	PRC CA7236	PRC CA9311
6	EAP9	Aerodur 2100	Aerodur 5000
7	EAP9	Aerodur 2111 (MgO)	Aerodur 5000
8	Deft TBD	Deft TBD	Deft TBD



AFCPCO Projects - JTP



- **Chrome (control)**

System	Pretreatment	Primer	Topcoat
1	PreKote	Deft 02Y040	Deft 99GY001 ELT
2	Alodine 1200	Deft 02Y040	Deft 99GY001 ELT



AFCPCO Projects - JTP



- **Test Samples (2 sets)**
 - Panels
 - 3"X6" Al (2024-T3 and 7075-T6)
 - Coated, X scribe
 - Fasteners
 - 3 different types (2 ea) installed in Al panel
 - Coated and scribed across one of each fastener
 - Sea Water Spray (10 min each hour)





AFCPCO Projects – Field Tests



- ***C-130 Non-Chrome System Field Test: Operational Test and Evaluation***
 - Full OML paint
 - Pretreatment: Pantheon PreKote
 - Primer: Akzo Nobel Mg-Rich (Aerodur 2100)
 - Topcoat: MIL-PRF-85285 Ty IV (Aerodur 5000)
 - Mg-rich well characterized in lab and on beach
 - Test will run until first ISO inspection (455 days)





Summary



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Questions?



Back-up Slides



Apples to Apples



- **Latest CoC study funded by OSD, released in June 2009**
 - Total AF Cost of Corrosion for a/c & missiles (FY 2007): \$5.43B
 - \$3.93B difference bw last AF-funded study and OSD-funded study
- **Cost of Corrosion under-reported in first 4 studies**
 - AF-funded studies did not include:
 - Commercial depot costs (\$1.33B)
 - Indirect labor costs (\$1.62B)
 - Growth of labor rates (\$.65B)
 - Top 3 areas account for \$3.44B or 88% of the \$3.93B difference.
- **Corrosion/fatigue are main issues for a/c retirement**

