



Effect of Environmental Regulations on DoD Aviation Coating System Technology Transition

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Chromium Regulations

- 2006 - OSHA 1910.1026, “Chromium (VI)”¹
 - ...a material...a specific process, operation, or activity involving chromium **cannot** release dusts, fumes, or mists of chromium (VI) in concentrations at or above 0.5 µg/m³ as an 8-hour time-weighted average (TWA) under any expected conditions of use.
- 2009 – DoD AT&L Memorandum. “Minimizing the Use of Hexavalent Chromium (Cr⁶⁺)”, 8 April 2009.
- 2013 –DFARS Subpart 223.73 (Law)

All previous restrictions focus on Cr(VI)



Chromium (VI) Alternative Technologies: Coating Systems

- MIL-DTL-81706 Type I & II under qualified MIL-PRF-23377 Class N primers
- RECC under Deft 093
- Prekote under Mg-rich Primer
- Zirconium pretreatments under qualified MIL-PRF-23377 Class N primers
- Aluminum-rich primer over qualified conversion coatings



All Cr(VI) coatings and coating system alternatives focused on outer moldline application only.

Chromium (VI) Alternative Technologies: Cr(III)



Technology transition towards Chromium (III) technologies for conversion coatings, anodize sealers, and hard chromium plating alternatives to ensure current corrosion protection standards were met, while complying with federal regulations.

Non-chromium materials alone do not meet current corrosion protection gold standard set by Chromium (VI) technologies.

ACGIH 2018 Recommendations

In March 2018, ACGIH announced the adoption of new TLVs for Cr (VI), Cr (III), metallic chromium and chromyl chloride.

Chromium & Its Compounds	Legacy Cr TLVs	2018 ACGIH Cr TLVs
Cr(VI) (Inhalable TWA)	0.05 mg/m ³	0.0002 mg/m ³ (0.2 µg/m ³)
Cr(VI) (Inhalable STEL)	---	0.5 µg/m ³
Cr (III) (Inhalable TWA)	0.5 mg/m ³	0.003 mg/m ³ (3.0 µg/m ³)
Metallic Chromium (Inhalable TWA)	0.5 mg/m ³ (500 µg/m ³)	0.5 mg/m ³ (500 µg/m ³)
Chromyl Chloride (Inhalable TWA)	0.025 ppm total	0.0001 ppm
Chromyl Chloride (Inhalaable STEL)	---	0.0001 ppm

*Threshold Limit Value
(TLV®)
Short-Term Exposure Limit
(STEL)
Time Weighted Average
(TWA)
Occupational Exposure Limit
(OEL)*



International Hexavalent Chromium Exposure Standards²

Country or Advisory Organization	8-Hour TWA Limit mg/m ³	Short-Term Exposure Limit mg/m ³
US - New ACGIH TLVs [®] (water-soluble compounds)	0.0002 as Inhalable	0.0005 as Inhalable
US – Current OSHA PEL	0.005 as Total	
Australia	0.05 as Total	
Canada	0.05 as Total	
Switzerland	0.005 Inhalable aerosol	
United Kingdom	0.05 as Total	



Processes involving Chromium Exposure within the DoD

- US Navy²
 - Over 2600 processes sampled for chromium species
 - Of those – 1600+ sampled specifically for hexavalent chromium
- USAF³
 - Approximately 1000 processes utilize chromium
 - Less than 5% of these processes will require extensive mitigation



Readiness

- Readiness refers to the availability, capability and responsiveness of our military.
- Readiness is impacted by:
 - Acquisition Schedule
 - Maintenance (scheduled and unscheduled)
 - Material Availability
 - Environmental Regulations



<https://www.navair.navy.mil/organization/PMA-231>



Readiness

Per LMI Cost of Corrosion Study published in 2014.....

Corrosion accounts for over 27% of total maintenance costs within Navy and Marine Corps Aviation

- Over 116,000 total non-available days per year or approximately 30 days of non-availability per active status aircraft per year due to corrosion

Corrosion costs Navy Marine Corps Aviation
\$3,600,000,000
(3.6 billion) per year!!!

(Remember: this estimate permits the usage of hexavalent chromium materials in accordance with the DoD memo, Cr (VI) DFARs and OSHA PEL.)



How do the new ACGIH regulations affect DoD community?

- All airborne chromium processes exceed the ACGIH TLVs.
- Unable to comply AND maintain corrosion prevention and control with current materials and processes.

Each Service has a choice of one or more of the following:

1. Improve PPE/facilities mitigation strategies
2. Pay Increased fines
3. Implement chromium-free technologies



Improve Exposure Mitigation Strategies

- Such improvements include:
 - Switch to Air-fed respirators
 - Housecleaning procedures to eliminate secondary chromium exposure
 - Assess existing ventilation efficiency
- Takes funding and time away from aircraft maintenance
- Most improvements not possible to implement on existing Naval surface ship structure



Failure to comply Fines

- Navy-Marine Corps expects significant fines, if ACGIH recommendations are adopted and enforced by OSHA.
 - Currently – each FRC pays approximately \$1.0 Million per year to comply with current Cr(VI) OSHA regulations
 - Navy-Marine Corps operational environment demands top performing corrosion mitigations technologies and will continue to use Cr(VI) materials in some capacity
- Expect higher financial burden associated with ACGIH TLV compliance
 - Facilities
 - Programmatic Changes to implement new technologies, processes, etc.
 - Additional engineering and logistics support (man-hours)



Implement Chromium-free Technologies

- Decades of research has occurred evaluating Cr(VI) alternatives, in search for the holy grail...environmentally friendly products that perform as well as Cr (VI) universally.
- The closest materials to Cr(VI) are Cr(III)...but now the definition of environmentally friendly is changing.
- Few non-chromium technologies perform as well as Cr(VI) materials in less aggressive operational environments; those that do, only work in limited applications.
- Using current non-chromium technologies is a choice to accept reduced corrosion performance, which translates to increased unscheduled maintenance, increased cost of corrosion and increased aircraft unavailability.



Final Thoughts....

- ACGIH TLVs are recommendations; although, expect a response from OSHA within calendar year 2020.
- Eliminating Cr(VI) from production/maintenance will not eliminate artisan/military exposure.
- It is imperative that we move forward with non-chromium research; our military is depending on us to maintain readiness, availability and responsiveness.





Thank you!

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References

1. Occupational Safety and Health Standards Number 1910.1026, “Chromium (VI)” Occupational Safety and Health Administration (OSHA); 2006 <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1026>
2. “Navy and Marine Corps Impact Assessment for the Proposed Adoption of the American Conference of Governmental Industrial Hygienists’ 2018 Chromium Threshold Limit Values®”. Navy Marine Corps Public Health Center, Portsmouth, VA. December 2018.
3. “Air Force (AF) Proposed Phased Implementation for Using the American Conference of Governmental Industrial Hygienists (ACGIH) new Threshold Limit Values (TLV) for chromium compounds as an Occupational Exposure Limit (OEL)” MEMORANDUM, DEPARTMENT OF THE AIR FORCE. 8 JUL 2019

