Overview of DoD chromate usage and database

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Same as Report (SAR)
Cr⁶⁺ usage in DoD

Cr⁶⁺ (CrVI, hexavalent chrome, chromate) is our primary corrosion control material.

- Chromate conversion coatings
- Chromate sealers
- Chromated primers
- Chromate washes
- Chromated metallic-ceramics

Cr⁶⁺ processes, non-Cr⁶⁺ coatings

- Hard chrome plating
- Chromic acid anodizing
- Chromic acid passivation

Cr⁶⁺-containing coatings are a problem for sustainment (repaint, touch-up, corrosion control).

Cr⁶⁺-containing coatings are a problem for OEMs and depots.

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# Cr⁶⁺-free coatings

<table>
<thead>
<tr>
<th>Material</th>
<th>Status of alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromate conversion coating</td>
<td>Trivalent chrome and non-Cr commercially available. Not yet as good as Cr⁶⁺. Used on cars, Boeing 777, various military systems, USAF T.O. 1-1-8 Prekote;</td>
</tr>
<tr>
<td>Chromate primers</td>
<td>Non-Cr primers commercially available. Used on F-35, AH-64 Apache. Performance good on Cr⁶⁺ conversion coating. Moving toward total non-Cr⁶⁺</td>
</tr>
<tr>
<td>Chromate finish system</td>
<td>Low temperature powder coat and UV curable finishes in validation to replace primer/topcoat for aircraft and vehicles.</td>
</tr>
<tr>
<td>Chromate conversion of Mg</td>
<td>Tagnite now used on EFV gearbox, some sumps, gearboxes for AH-64, CH-53. Performance much better than Cr⁶⁺ conversion and anodize. DoD use still very</td>
</tr>
<tr>
<td>Metallic-ceramics</td>
<td>Low-Cr and non-Cr available commercially. Performance uncertain</td>
</tr>
<tr>
<td>Chromate washes</td>
<td>Direct-to-metal used for MRAP. Poor performance</td>
</tr>
</tbody>
</table>

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Cr\textsuperscript{6+}-free processes now in use

<table>
<thead>
<tr>
<th>Material</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard chrome plating</td>
<td>HVOF on F-35 landing gear, all new commercial and military landing gear. Being implemented for</td>
</tr>
<tr>
<td>Chromic acid anodize</td>
<td>TFSAA approved by NAVAIR, BSAA by Boeing</td>
</tr>
</tbody>
</table>

[Image of Cr\textsuperscript{6+}-free processes]

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ASETSDEFENSE SOURCES OF INFORMATION

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Chromate Conversion Alternatives

Current Usage
Chromate conversion coatings and chromated sealers are used to create a self-healing conversion coating on Al and Mg alloys that is resistant to corrosion. They are also used for sealing electroplated and anodized coatings. These treatments are typically used prior to painting and finishing, since they generally improve adhesion of paints and sealants.

<table>
<thead>
<tr>
<th>Typical Applications</th>
<th>Typical Chromate Conversion Coatings</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Aircraft skins</td>
<td>• Conversion and sealing coatings for Al (e.g., Alodine, Indite, etc.)</td>
<td>• MIL-DTL-81706</td>
</tr>
<tr>
<td>• Al frames for aircraft and vehicles</td>
<td>• Conversion and sealing coatings for Mg (e.g., Dow 7, 17, 19, HAE anodize)</td>
<td>• MIL-C-5541</td>
</tr>
<tr>
<td>• Mg gearboxes</td>
<td></td>
<td>• MIL-M-45202</td>
</tr>
<tr>
<td>• Corrosion-resistant coatings (Cd, Al, ZnNi, etc.)</td>
<td></td>
<td>• AMS 3171</td>
</tr>
<tr>
<td>• Anodize sealing</td>
<td></td>
<td>• T0 1-1-8</td>
</tr>
<tr>
<td>• Fasteners and electrical connectors (Zn or Cd plated)</td>
<td></td>
<td>• MIL-A-8625</td>
</tr>
<tr>
<td>• Wash primer for steels, armor</td>
<td></td>
<td>• MIL-C-3171</td>
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<tr>
<td></td>
<td></td>
<td>• MIL-C-17711</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• MIL-M-45202</td>
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<tr>
<td></td>
<td></td>
<td>• DOD-P-15328</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• QQ-P-416</td>
</tr>
</tbody>
</table>

ESOH Issues
Cr⁶⁺ (CrVI, hexavalent chromium) is a known carcinogen that is strongly regulated under

- EPA Clean Air Act rules
- OSHA Occupational Exposure to Hexavalent Chromium (Cr⁶⁺ PEL is currently 5μg/m³)
- European rules (RoHS, WEEE, ELV)

Exposure
Personnel may be exposed during manufacture, depot overhaul, repaint, and operational level touch-up and repair.
DATABASE
Database – Simple search

Simple Search: Choose options by drop-down arrows in boxes, and click Search.

Detail Search: Click Search button to activate. Choose options in search boxes.

Alternative To:
- All
- Cadmium plate
- Chromic acid anodize

Document Category:
- All
- Composites
- Electrical
- Engines
- Fasteners
- Hydraulic systems
- Skins, structures
- Steels
- Wheels, tracks

Generic Systems:
- All

Applications:
- All
- Al and Mg alloys
- Composites
- Electrical
- Engines
- Fasteners
- Hydraulic systems
- Skins, structures
- Steels
- Wheels, tracks

Designed to answer question “What alternative to hard chrome (etc) is available (authorized, implemented, spec’d) for my type of system and application?”
U.S. DEPARTMENT
Environmental Security Technologies (EST)
Joint Group on Pollution

JOINT TEST

Validation of HVOF Thermal Sprays as Replacements for Hard Chrome Alternatives

Date: Aug
Preparers: Aug

1. Refer to 3M materials specification MIL-PF-1477E: Specifications for the Designation and Identification of Materials and their Components. This specification applies to all materials used in the manufacture of thermal spray coatings.

2. Refer to the NAVAIR technical manual for details on the thermal spray process and materials used in the HVOF method.

3. Refer to the Navy's technical manual for details on the thermal spray process and materials used in the HVOF method.

4. Refer to the Navy's technical manual for details on the thermal spray process and materials used in the HVOF method.