

Cd and Cr⁶⁺ Alternatives 5-Year Strategy and Roadmap

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Overview

- The Cd and Cr⁶⁺ Challenge and Objectives
- 5-Year Strategy and Roadmap
 - Cd and Cr⁶⁺ Usage and Trends
 - Output and Infrastructure
 - Strategy and Initiatives
 - Technology Gaps
 - Implementation Plans
- Next Steps

Challenge

Why replace Cr⁶⁺ and Cd?

- Hexavalent chromium (Cr⁶⁺)
 - Known carcinogen
 - Attacks the respiratory tract, liver, kidneys, skin, and eyes
 - Exposures occur during welding, coating processes, and surface finishing processes
 - Documented 75,219 pounds of Cr⁶⁺ used in CY 2015 (5 depots); 67,173 pounds of Cr⁶⁺ used in CY2017 (14 depots)
- Cadmium (Cd)
 - Known carcinogen
 - Attacks the cardiovascular system, respiratory tract, reproductive system, neurological system, gastrointestinal system, and kidneys
 - Exposures occur during welding, coating processes, plating processes, and handling Cd coated fasteners and connectors
 - Documented 229 pounds of Cd used in CY 2015 (5 depots); 3,146 pounds of Cd used in CY 2017 (14 depots)

Challenge

Regulatory and Policy Drivers

- Clean Air Act (CAA)
- Clean Water Act (CWA)
- Emergency Planning and Community Right-to-Know Act (EPCRA)
- Resource Conservation and Recovery Act (RCRA)
- Toxic Release Inventory (TRI)
- 48 CFR Parts 223 and 252 Defense Federal Acquisition Regulation Supplement (DFARS), “Minimizing the Use of Materials Containing Hexavalent Chromium” (DFARS Case 2009–D004)
- New proposed TLV-TWA from ACGIH: **0.0002 mg/m³ Cr⁶⁺** inhalable fraction and vapor and inhalable particulate matter; **0.003 mg/m³ Cr³⁺** inhalable particulate matter
- DOD Instruction 5000.02
- Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)
- Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)
- Memorandum from John Young, USD(ALT), to Secretaries of Military Departments, “Minimizing the Use of Hexavalent Chromium”

5-Year Strategy and Roadmap *Objectives*

Demonstrate a path to reducing and/or eliminating Cr⁶⁺ and Cd from our depots in a reasonable timeframe

- Develop a strategy and roadmap to achieve >90% reduction of Cr⁶⁺ and Cd usage in maintenance processes at DoD depots in 5 years
- Develop a strategy and roadmap to achieve >90% reduction and/or containment of Cr⁶⁺ and Cd emissions, waste streams, exposure potential, and infrastructure at DoD depots in 5 years
- Generate 6 depot-specific implementation plans to translate the strategy into finite, depot-level actions

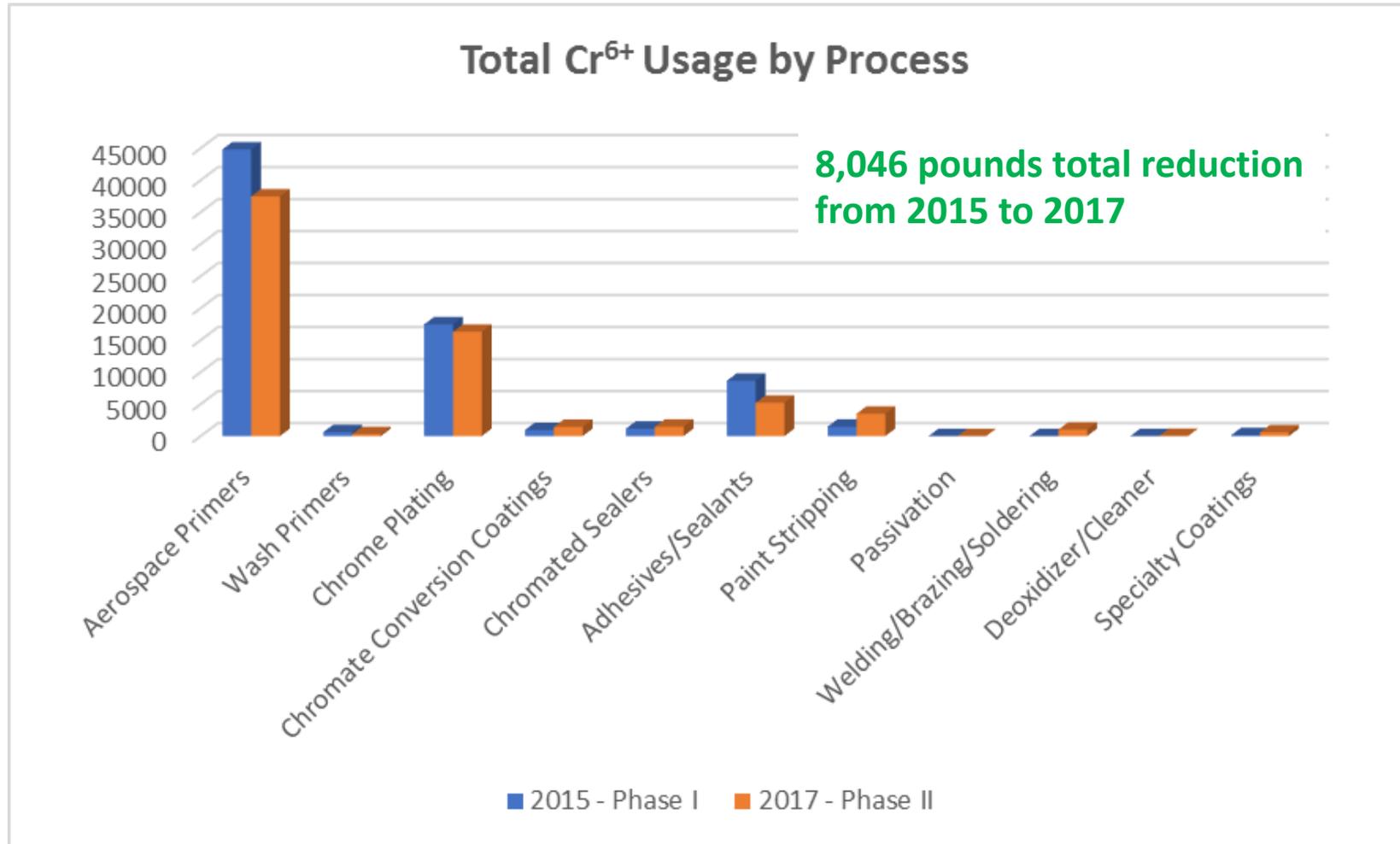
5-Year Strategy and Roadmap

Cd and Cr⁶⁺ Processes

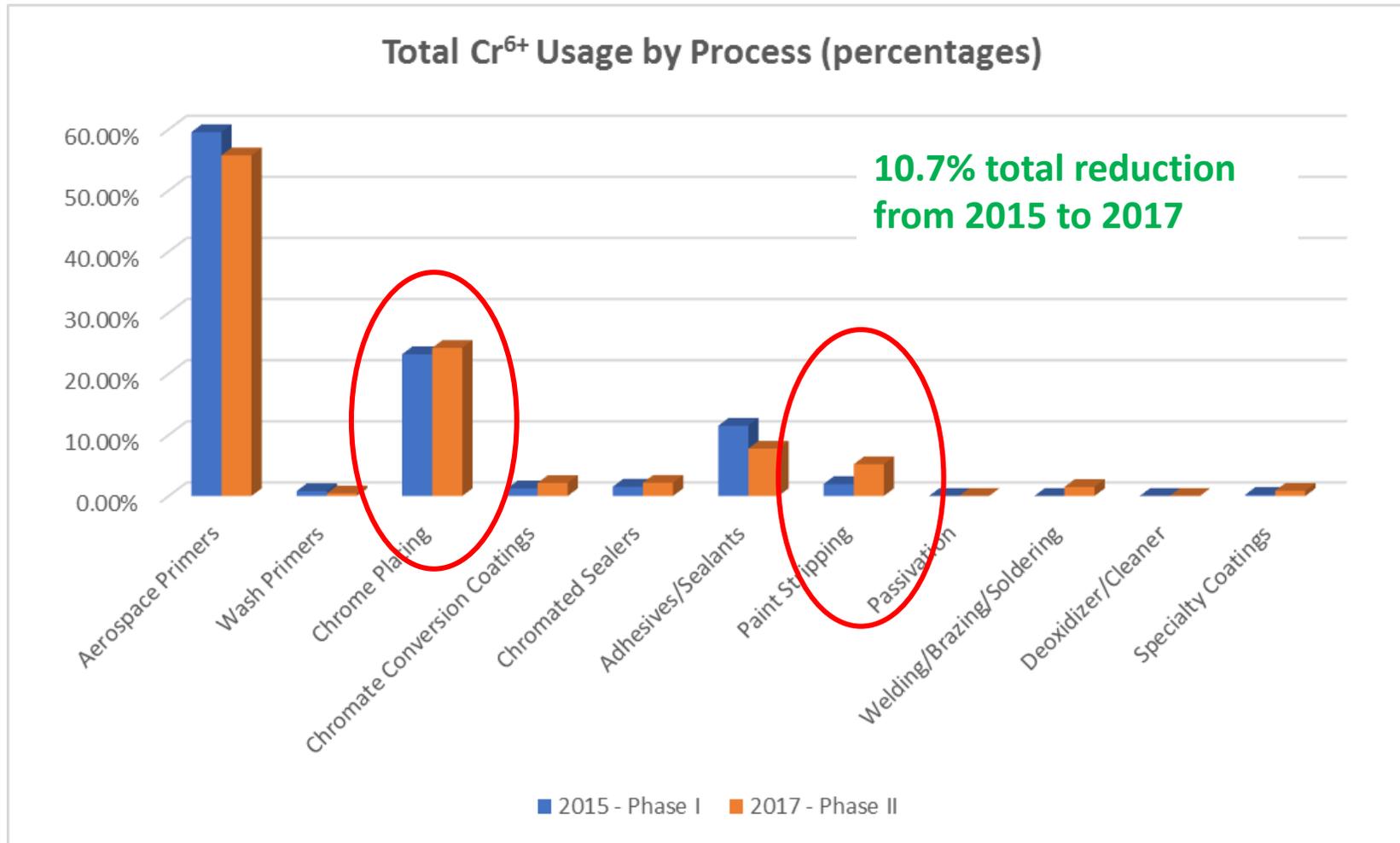
- Chromated primers
 - Aerospace primers
 - Wash primers
- Cr⁶⁺ plating
- Cd plating
- Chrome Conversion Coatings
 - Aluminum
 - Magnesium
- Stainless steel passivation
- Adhesives and sealants
- Chromic acid anodize stripping
- Cadmium brush plating
- Chromate sealers
 - Anodize
 - Phosphate coatings
 - Black oxide
 - Cadmium plating
- Topcoats and specialty coatings
- Paint stripping
- Deoxider/Desmut
- Welding/Brazing/Soldering
- Chromic acid anodizing

5-Year Strategy and Roadmap

Cr⁶⁺ Process Usage

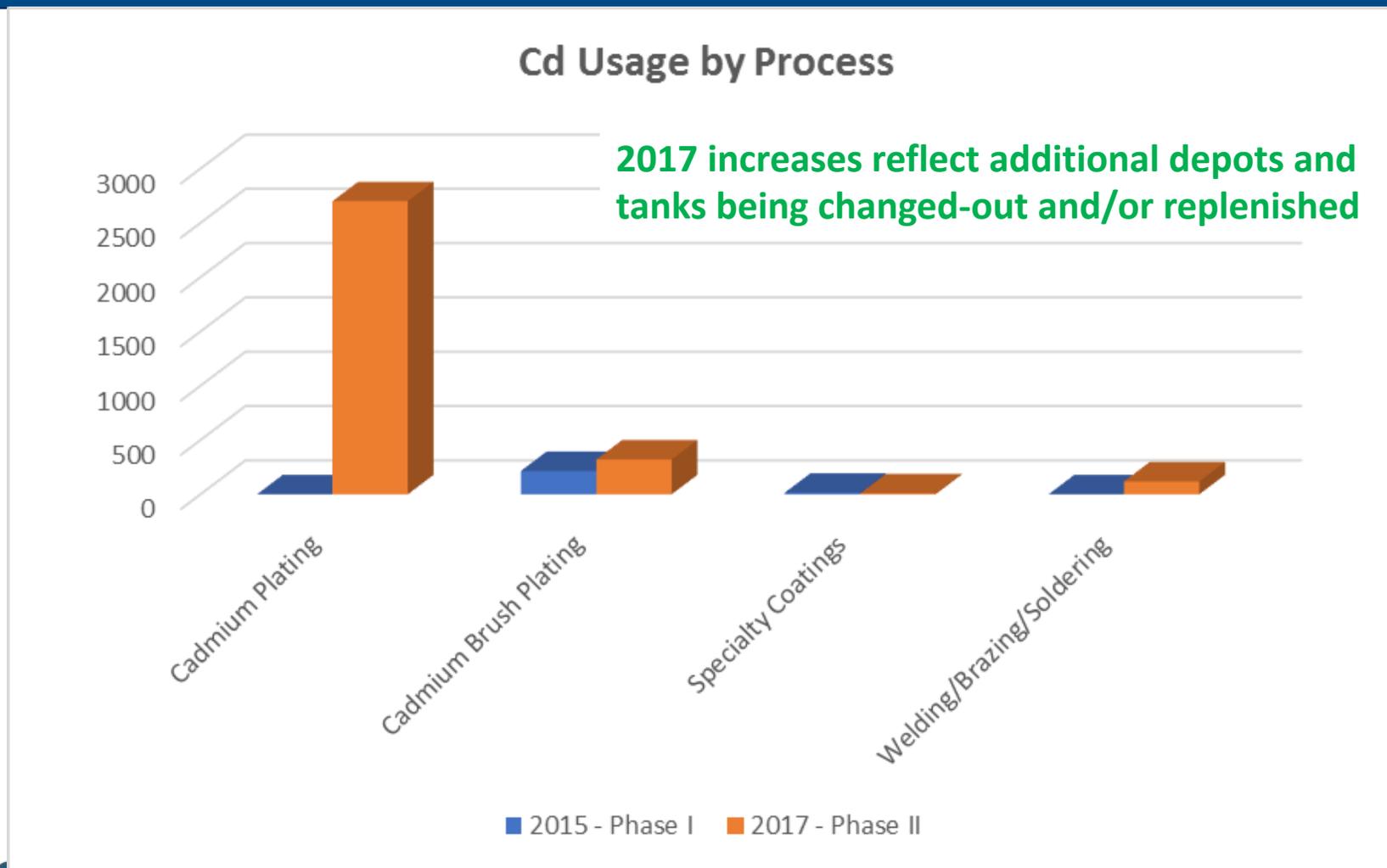


5-Year Strategy and Roadmap *Cr⁶⁺ Process Usage (cont.)*



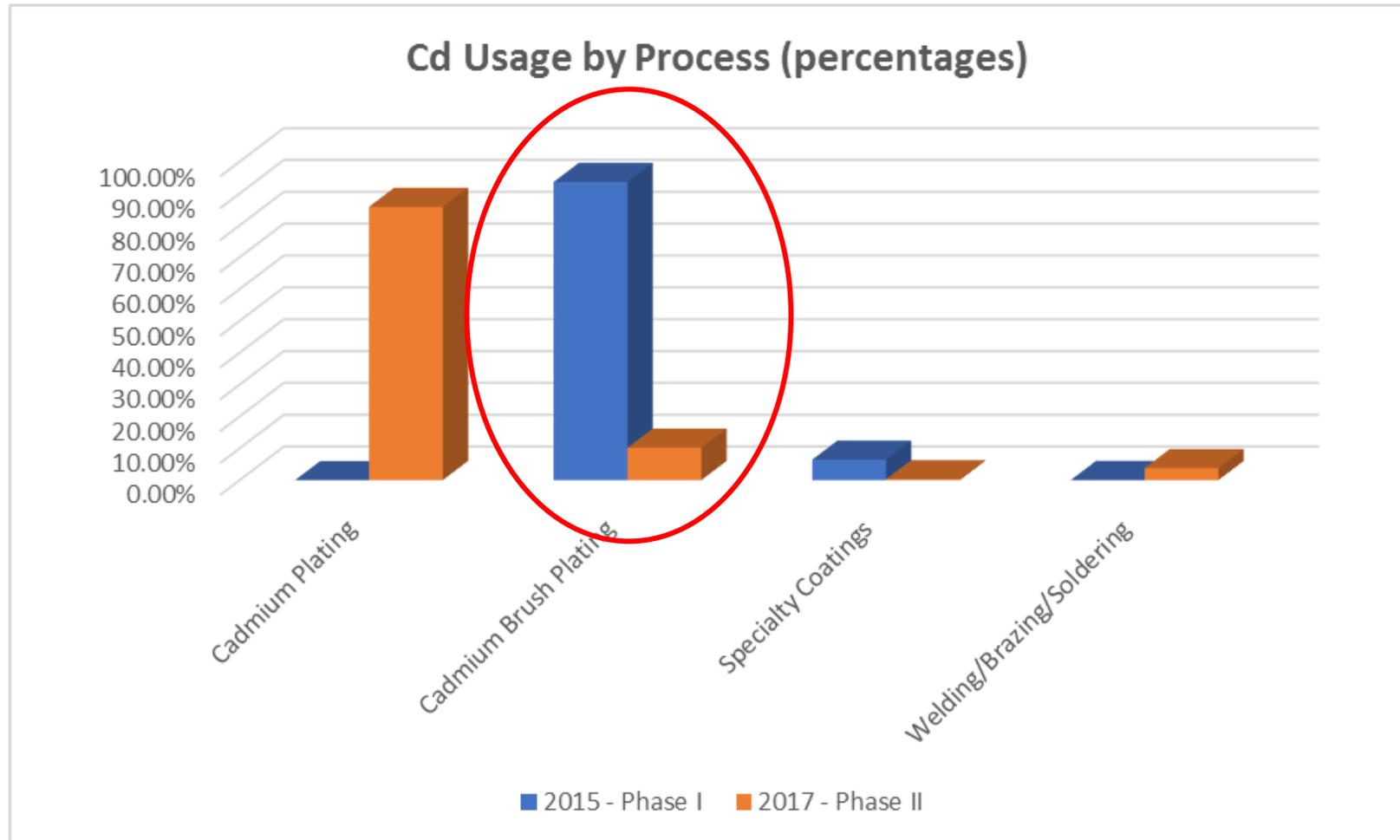
5-Year Strategy and Roadmap

Cd Process Usage



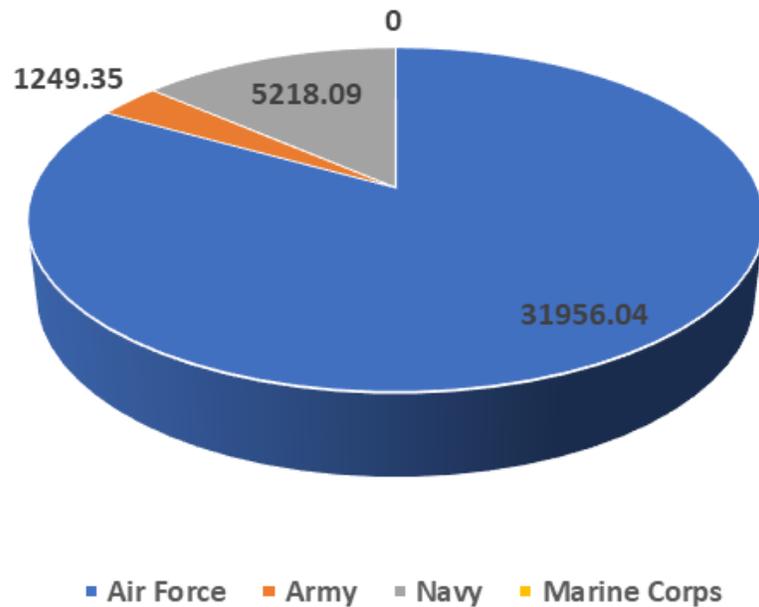
5-Year Strategy and Roadmap

Cd Process Usage (cont.)

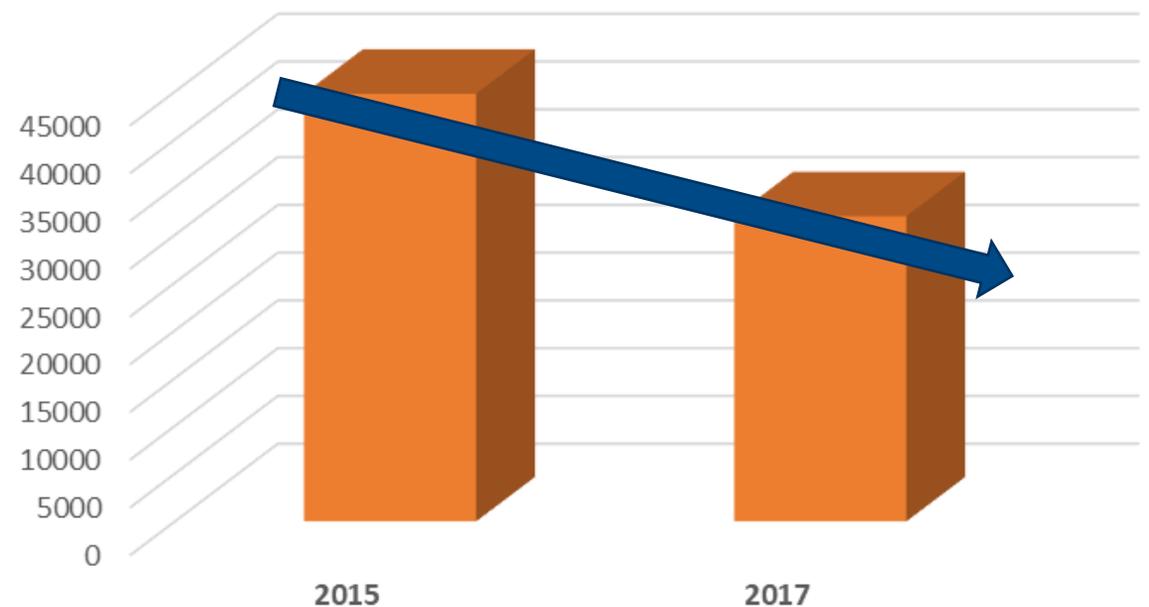


5-Year Strategy and Roadmap *Chromated Primers*

Chromated Primer Usage in DoD (2017)



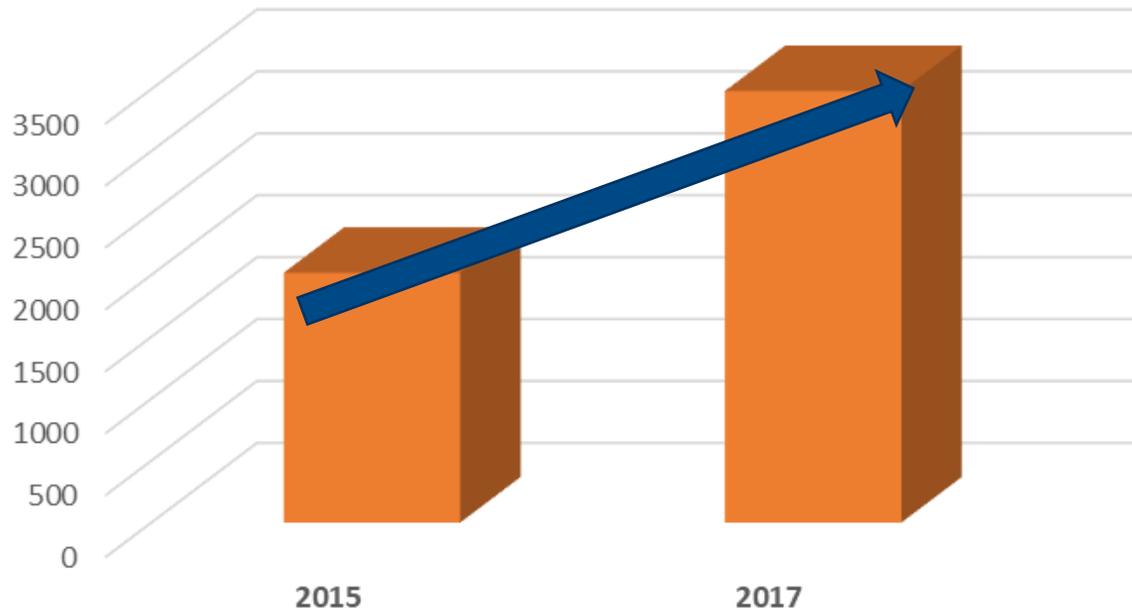
Cr⁶⁺ in Air Force Primers



5-Year Strategy and Roadmap

Chromated Paint Strippers

Cr⁶⁺ in DoD Paint Strippers



- Chromates added to methylene chloride (MeCl)/phenol-based paint strippers as corrosion inhibitors
- Several commercial products used at depots contain chromates, including:
 - Stripper 7 by Crest
 - CeeBee 295a
- Increase in MeCl-based strippers or just those with inhibitors?

5-Year Strategy and Roadmap Output and Infrastructure

- Wastes
 - Coatings removal
 - Solid and liquid hazardous wastes
- Emissions
 - Engineering controls
 - Stainless steel welding largest source of Cr⁶⁺ emissions
- Exposures
 - Engineering controls and PPE
 - Stainless steel welding
- Infrastructure
 - For some processes, a better reference than usage
 - Reflects burden or liability



5-Year Strategy and Roadmap

Strategy and Roadmap Example

Goal 1 – Reduce the use of Cd and Cr ⁶⁺ containing compounds in DoD depots by 90% in 5 years.							
Objective	Success Metric	Baseline	Actions	Depot(s)	Priority	Initiation	Alternative Technologies
1.1 Reduce the use of chromated primers in DoD depots by 90% within 5 years.	Reduction in pounds of Cr ⁶⁺ species (e.g., strontium chromate, barium chromate) as compared to the baseline established in this Strategy and Roadmap.	37,445 lb Cr ⁶⁺	1.1.1 Non-Chromate Primer on Aircraft OML	OC-ALC, OO-ALC, WR-ALC, FRCSE, FRCE, FRCSW	1	Ongoing	Rare Earth Primers <ul style="list-style-type: none"> • PPG Deft 02GN084 • Hentzen 17176KEP Mg-Rich Primers <ul style="list-style-type: none"> • Aerodur 2100 Al-Rich Primers ²
			1.1.2 Non-Chromate Primer on Aircraft non-OML Surfaces	OC-ALC, OO-ALC, WR-ALC, FRCSE, FRCE, FRCSW	1	Ongoing	Rare Earth Primers <ul style="list-style-type: none"> • PPG Deft 02GN084 • Hentzen 17176KEP Mg-Rich Primers <ul style="list-style-type: none"> • Aerodur 2100 Al-Rich Primers ²
			1.1.3 Non-Chromate Primer on Off-Aircraft Components and Commodities	OC-ALC, OO-ALC, WR-ALC, FRCSE, FRCE, FRCSW	1	Ongoing	Rare Earth Primers <ul style="list-style-type: none"> • PPG Deft 02GN084 • Hentzen 17176KEP Mg-Rich Primers <ul style="list-style-type: none"> • Aerodur 2100 Al-Rich Primers ² E-Coat

5-Year Strategy and Roadmap

Tier 1 Initiatives

- Non-chromate primer on aircraft outer mold line (OML)
- Non-chromate primer on aircraft non-OML surfaces
- Non-chromate primer on off-aircraft components and commodities
- Alternative to chrome plating
- Non-chromated structural adhesives and sealants
- Non-chromated paint strippers
- Alternative coatings removal processes to reduce Cr⁶⁺-containing waste streams
- Implementation of engineering controls for stainless steel welding operations

- Alternative to cadmium plating
- Alternative to cadmium brush plating

5-Year Strategy and Roadmap

Technology Gaps

- **Chromated adhesives and sealants**
 - no commercially-available alternatives that meet DoD requirements for many applications
 - largest DoD uses are integral fuel tank sealants (e.g., PR-1422, PR-1436) and Pro-Seal 870.
- **Chromated paint strippers**
- **Dichromate sealer**
 - identified alternatives to chromated sealers for anodizing, Cd plating, zinc (Zn) phosphate, and black oxide applications
 - alternatives include the trivalent chromium process (TCP), permanganates, and zirconium (Zr)-based materials
 - SERDP SON to address remaining application with totally chrome-free technologies
- **Chromic acid anodize stripping for small and tight-tolerance components (e.g., small arms parts)**
- **Stainless steel welding consumables**
 - most SS welding is done using metal inert gas (MIG) and tungsten inert gas (TIG) welding, which greatly reduces emissions and exposure potential
 - some “stick” welding is still performed, requiring extensive personal protective equipment (PPE) and cordoned areas
 - past research has focused on rods based on ruthenium (Ru) and palladium, but the costs were not feasible.
- **Non-line-of-sight (NLOS) hard chrome plating**
 - currently no commercially-available alternative to address NLOS hard chrome plating applications
 - nanocrystalline cobalt phosphorus (nCoP) and trivalent chrome plating show promise, but both have limitations

Depot-Specific Implementation Plans *Overview*

- Letterkenny Army Depot (LEAD)
- Fleet Readiness Center Southeast (FRCSE)
- Oklahoma City Air Logistics Complex (OC-ALC)
- Fleet Readiness Center East (FRCE)
- Norfolk Naval Shipyard (NNSY)
- Marine Corps Logistics Base (MCLB) Albany



Next Steps

Phase III

- Phase III initiated on 1 August 2019
- Update the Strategy and Roadmap
 - Requests for updated HAZMAT data from the depots have already gone out
 - Updating information on processes, alternatives, and actions/initiatives to capture most up to date progress
- Including information from Original Equipment Manufacturers (OEM) to capture the acquisition side
- Sustainability Analysis of TagNite™ implementation
 - Multiple scenarios
 - Baseline Cr⁶⁺ process versus full implementation versus regional implementation
- Outreach materials to communicate the strategy and how to use it...
 - Briefing at the SERDP/ESTCP Symposium
 - Briefing at ASETSDefense 2020
 - Technical Interchange Meetings (TIM) on technology gaps

Questions?

