

Issues With Use of Chromate Conversion Coating Alternatives

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 DoD Metal Finishing Workshop – Chromate Alternatives for Metal Treatment and Sealing
 Hilton Garden Inn – Layton, UT



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Major Decision for Non-Cr CC Users

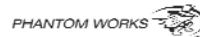


- 2 Week Salt Spray on 2024
- Paint Adhesion
- Coating Weight
- Elec. Contact Resistance



- Paint Adhesion

WHAT SIDE OF THE FENCE DO YOU SIT ON?

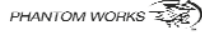


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Boeing Military Operations

- Boeing Military Aircraft Surface Treatments Must Meet MIL-S-5002
 - Unless otherwise specified, all aluminum and aluminum alloys, including clad aluminum alloy surfaces, shall be either anodized to produce coatings conforming to MIL-A-8625 or shall receive a chemical conversion treatment to produce coatings conforming to MIL-C-5541.
- MIL-DTL-5541 (MIL-C-5541)
 - The materials used to produce a chemical conversion coating shall be approved for the selected type, class, form, and application method in accordance with the qualification requirements of MIL-DTL-81706
 - Type I = Chromated, Type II = NonChromated



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Non-Cr Conversion Coating Requirements for Boeing

- Non-Chrome Conversion Coating Shall Meet MIL-DTL-81706B, Type II for Class 1a and 3
 - Applied by Immersion, Spray and Brush
 - One Tank Operation - No Heat
 - Needs to Work on Other Aluminum Alloys Besides 2024, 7075, 6061
 - Must Consistently Pass Monthly 1 Week Salt Spray Test on 2024 for Immersion Tank Operations
 - Needs to Work with Existing Aluminum Prep Line
 - Must Be Compatible with Boeing Cleaners and Etches

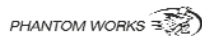


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Non-Cr CC for IVD Al (1992 – 1997)

- Selected Non-Cr Conversion Coating for IVD Aluminum (1100 Aluminum Alloy)
 - Sanchem CC Two Step Process
 - Sanchem 3300 – Permanganate Seal
 - Sanchem 3400 – Silicate Seal
 - Alodine 2000
 - Alodine 2000 – Cobalt Conversion Coating
 - TD-3095Y Seal – Vanadium Seal
- Not Implemented Because It Was Only Qualified for 1100 Aluminum Alloy
 - No Aerospace Facility Wants to Install a Special Non-Cr CC Tank Just for IVD Aluminum

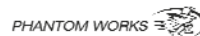


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Alodine 2000 (1997 – 1999)

- Attempt to Qualify Alodine 2000 for Aerospace Aluminum Alloys
 - Paint Adhesion and Electrical Contact Resistance Was Good, But Failed Salt Spray Corrosion Tests
 - Sensitive to Surface Prep (Cleaners and Etches)
 - Tried Different Versions of the TD-3095 Seal
 - No Success
 - Cobamine (the Boeing Commercial Version of Alodine 2000) Supposedly Performs Better
 - However Cobamine Still Not Qualified in 2007



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Sanchem CC (1997 – 1999)

- Attempts Made to Qualify Sanchem Safeguard CC-3000
 - Four Tank Immersion Process
 - Boiling Water --> Safeguard 2000 --> Safeguard CC-3000 --> Safeguard 4000
 - Too Expensive and Complex
 - SteamGard Process Reduces This to a Two Tank Process (More Productible)
 - #1 [Steam --> Safeguard 2000 (Spray) --> Safeguard CC-3000 (Spray)] --> #2 Safeguard 4000 (Immersion)
 - SteamGard Unit Made by Electro-Steam Corp.

Sanchem CC (1997 – 1999)



- SteamGard Results
 - Good Paint Adhesion
 - Poor Corrosion Resistance for 2024 and 7075
 - Results Dependent on Surface Prep
 - Cleaning, Etching and Deoxidizing

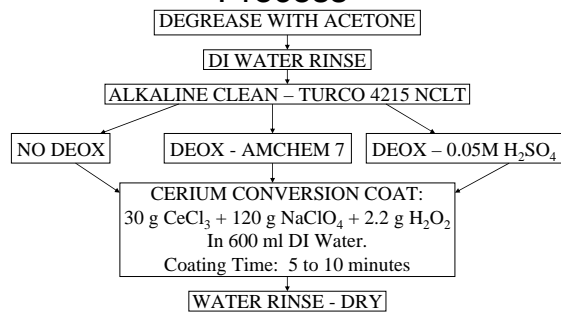
Touch-N-Prep (1999 – 2003)

- Alodine 1132 Touch-N-Prep Pens Qualified
 - Contains Chromates But Reduces Chromate Exposure of Workers and Hazardous Waste
 - Pen Applicator Safer Than Brush Application
 - Mil Spec Qualified
 - Added to Boeing Process Specs
- Note – Work Beginning to Qualify Alodine 871 Touch-N-Prep Pens
 - TriChrome Conversion Coating

Cerium Conversion Coating (1999 – Present)

- Boeing Working with University of Missouri – Rolla to Develop Cerium Conversion Coating
 - Electrodeposited Version Works Very Good But Needed Non-Electro Version for Aerospace
 - Developing Spray and Immersion Process
 - Spray Is Most Promising
 - Surface Prep is Critical Step
 - Cleaning, Etching and Deoxidizing (See Next Slide)
 - Work is Continuing
- See Dr. Matt O'Keefe's Presentation

Cerium Conversion Coating Process*



INASMET Non-Cr Conversion Coating (2003 – Present)

- Boeing R&D Center in Madrid, Spain Working with INASMET to Develop a Non-Cr Conversion Coating
 - INASMET is a Non-Profit R&D Facility in San Sebastian, Spain
 - INASMET is Familiar With European Non-Cr Coating Technologies
 - Investigating Conversion Coatings Containing Zr, Mn, Mo, and Ti Compounds
 - Work is Continuing
 - Surface Prep is Critical (Clean, Etch, Deox)

TCP Qualification (2005 – Present)

- Conducting Tests to Qualify Trivalent Chrome Conversion Coating at Boeing – St. Louis
 - Boeing Test Requirements: PS 13209, MMS 423, PS 17421
- Evaluating TCP Material from Four Vendors
 - Luster-On: Aluminoscent (1-3 oz/gal powder)
 - Henkel: Alodine T 5900 (5% by Volume)
 - CST-SurTec: SurTec 650 – chromitAL TCP (20% by Volume)
 - Metalast (Pavco → Chemetall Oakite): TCP – HF (25 - 50% by Volume)
- Surface Prep Is Critical Step
 - Acceptable Cleaning and Etching Procedures for Each TCP Version Were Established

TCP Qualification (2005 – 2006)

- Tests Used Boeing Optimized Cleaning Procedures for All 4 TCP Suppliers
 - Paint Adhesion and Electrical Resistance – Very Good
 - 2024 Corrosion Resistance – Poor
 - 6061 and 7075 Performed Better
 - Vendors Applied TCP to Boeing Test Panels
 - Only One Vendor Was Able to Pass 1 Week Salt Spray with Their Clean – Deox – TCP Process

TCP – II (2007 - ???)

- Boeing Will Evaluate TCP with Improved Corrosion Inhibitor Package
 - Navy – Pax River Developed Additive and Provided it to TCP Licensed Vendors
- Metalast TCP-HFEPA Additive Received
 - Boeing Working Closely with Metalast and Chemetall Oakite to Evaluate this Additive with Boeing Cleaning and Etching Procedures
 - Cleaners and Etches Can Be Modified or Changed to Improve Corrosion Performance

Conclusions & Recommendations

- Corrosion Performance of Non-Chrome CC Affected by Surface Prep
- MIL-DTL-5541 Monthly Corrosion Test with 2024 Difficult to Pass with NonCr CC
 - Need to Consider Changing to an Easier Alloy (1100) to Pass Monthly Salt Spray Test
- Need to Consider a Coating Systems Approach to Approve Non-Cr CC
 - Paint + NonCr CC Shall Pass 3000 hr Salt Spray
 - Not Sure if Non-Cr Paint + NonCr CC Will Pass

Chromate Alternatives for Passivation of Stainless Steel

Citric Acid Passivation

- Boeing Test Results Have Shown that Citric Acid Passivation Solutions Are As Good As or Better Than Nitric Acid Formulations
 - Nitric / Dichromate Performed the Poorest
 - Citric Acid Solutions Can Be Used on ALL Wrought, Cast, and Forged Stainless Steel Alloys
 - Includes Free Machining (303), Stabilized (321), PH (17-7PH), Austenitic (304), Martensitic (440C), Ferritic (430)
- Appears That Non-Aerospace (Food and Pharmaceutical) Have Been Using Citric Acid Solutions for a While
- Boeing PS 13001 Changed To Allow Citric Acid