



Evaluation of Alternative Cr⁺⁶ Surface Treatments

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Alternative Cr⁺⁶ Treatments



- Hexavalent Chromate (Cr⁺⁶) Surface Treatments Being Evaluated at Boeing
 - Alternative to Cr⁺⁶ Conversion Coating for Aluminum
 - TCP Conversion Coating
 - Alternative to Cr⁺⁶ Hot Water Seal for Anodize
 - TCP Room Temperature Seal
 - Alternative to Alodine 1132 Touch-N-Prep Pen
 - Alodine 871 Touch-N-Prep Pen (Contains Cr⁺³)
 - Alternative to Cr⁺⁶ Conversion Coating for Stainless and Titanium Paint Prep
 - Boegel and Alodine 5700



TCP Conversion Coatings

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Update

TCP QPL-81706 Materials



- Five TCP (Trivalent Chromium Pretreatment) Materials Evaluated at Boeing for Conversion Coating by Immersion Process
 - Metalast: TCP-HF
 - Henkel: Alodine T-5900
 - CST SurTec: SurTec 650 ChromitAl TCP
 - Luster-On: Aluminescent
 - Metalast: TCP-HF-EPA
- All TCP Materials Passed MIL-DTL-81706 Qualification Tests at NAVAIR Material Lab and Are On QPL-81706
 - Type II, Class 1a and 3

Boeing Conversion Coat Requirements



- TCP Conversion Coat (CC) Must Meet the Following Requirements for Use at Boeing and Subcontractors
 - TCP CC Shall Be Applied by Immersion Process
 - Immersion Process Preferred for Manufacture of Detail Aircraft Parts
 - Brush Process Used for Touch-Up
 - Spray Process Used for Final Paint of Aircraft
 - TCP CC Shall be Compatible With Boeing Cleaners, Etches and Deoxidizers
 - TCP CC Shall Pass the MIL-DTL-5541 Monthly 168 Hr Salt Spray Test with 2024-T3 (< 15 pits / 150 sq.in.)
 - Too Expensive to Dump Tank or Shut-Down Production if TCP Fails Monthly Test!

TCP Sensitive to Processing



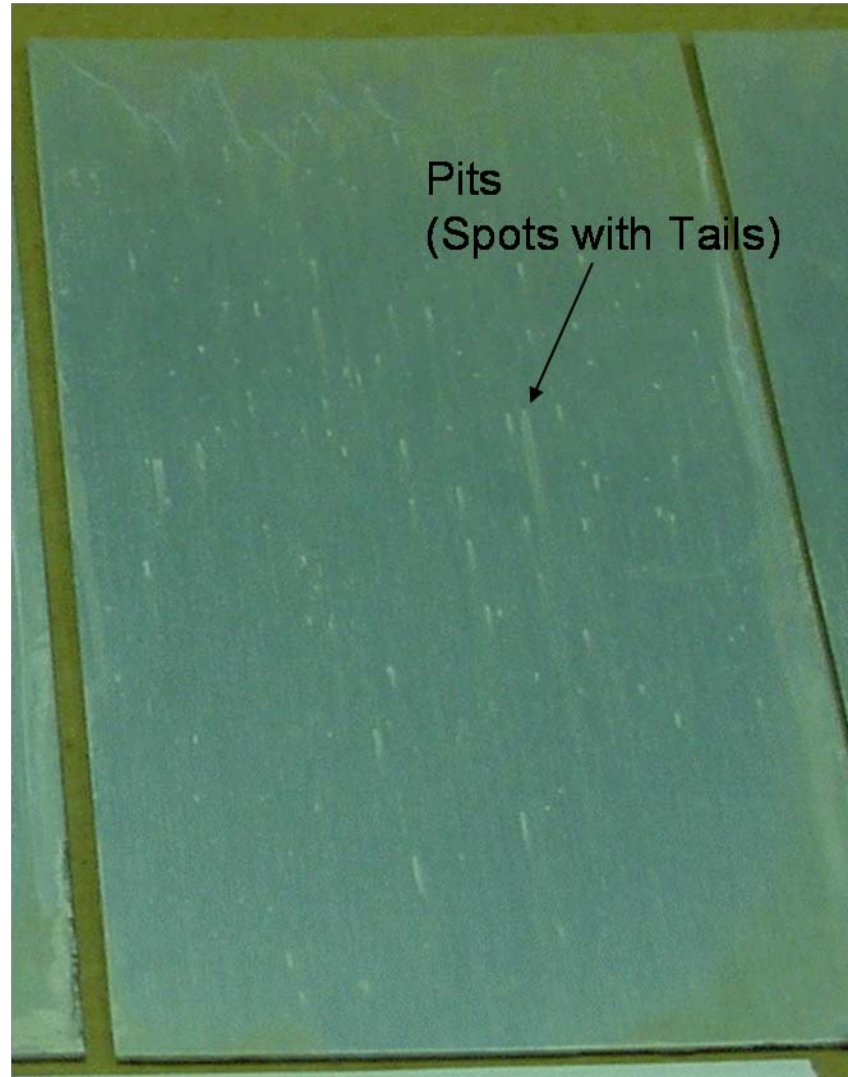
- “. . . The qualifying agency, the U.S. Navy (NAVAIR), suggested that the excessive pitting on our panels may have been due to the fact that the TCP chemistries, unlike the hexavalent chromium-based conversion coatings, were more sensitive to the cleaning and deoxidizing steps as well as the actual operating parameters of the TCP solution. . . .”
 - Plating and Surface Finishing, January 2008, “Hexavalent Chromium Reduction at U.S. Air Force Plant 44 in Tuscon, Ariozona”, Paul Fecsik (Raytheon Missile Systems, Tuscon, AZ), Jim Arthur and Leanne Debias (Concurrent Technology Corporation, Johnstown, PA)

Boeing TCP Test Plan (Phase I)



- Phase I (Vendor Supplied TCP Test Panels)
 - Boeing Sent 2024-T3 to TCP Vendors
 - Vendors Used Preferred Clean-Etch-Deox and TCP Process
 - TCP Test Panels Sent to Boeing for Salt Spray Test
- Phase I - Results of 168 Hour Salt Spray Corrosion
 - 2 of the 4 Vendors Could Not Pass the MIL-DTL-5541 Test
 - Other Two Vendors Could Pass the MIL-DTL-5541 But Only if Aluminum was Alkaline Cleaned Only or Cleaned Followed By a Mild Deoxidizing Treatment
 - Etching of 2024 Aluminum (to remove 0.2 mils) Was Not Attempted By Any Vendor

Pitting on TCP Test Panel



Pits
(Spots with Tails)

Boeing TCP Test Plan (Phase II)



- Phase II Determine Optimum Clean, Etch and Deox to Pass ASTM B 117 with 2024 Aluminum
 - 7 Boeing Cleaning Methods Evaluated with 5 TCP Materials

HEAVY
ETCH



- Hot Alk. Clean + Acid Etch + Deox
- Hot Alk. Clean + Caustic etch + Deox
- Hot Alk. Clean + Deox
- Hot Alk. Clean + Light Deox
- Low Temp Alk. Clean + Light Deox
- Low Temp Alk. Clean + Desmut
- Low Temp Alk. Clean Only

MILD
ETCH

MORE
PITTING



LESS
PITTING

Boeing TCP Test Plan (Phase III)



- Phase III Qualfy TCP to Boeing Process Specifications
 - Corrosion, Coating Weight, Contact Resistance, Paint Adhesion, Scribed Paint Salt Spray Corrosion
 - Chromated and Non-Cr Primers Tested with TCP
- All 5 QPL 81706 TCP Formulas Applied with a Mild Boeing Cleaner and Mild Deox (No Etch)
 - All 5 Passed Coating Weight, Contact Resistance, Paint Adhesion, and Scribed Paint Corrosion Salt Spray with Chromated Primers
 - All 5 Could Pass Corrosion Tests with 7075 and 6061
 - All 4 of 5 Could Not Consistently Pass Corrosion Tests with 2024 and This Mild Clean-Deox process

Boeing TCP Work for 2008



- Continue to Work with NAVAIR and Vendors to Evaluate TCP
 - Continue to Look at TCP Formulas Containing New Additives to Improve Corrosion Resistance of 2024
 - Initial Tests Show Additive Appears to Help 2024
 - Optimize TCP to Work with Boeing's Clean-Etch-Deox Processes
 - Investigate Allowing TCP for Immersion Processes That Conversion Coat non-2000 Series Aluminum Alloys and Tempers (such as 6000 and 7000 Series)
 - Invoke MIL-DTL-5541F, Option 1 (section 4.2.2)



TCP Room Temperature Seal for Anodize ~ Update

TCP QPL-81706 Materials



- Four TCP Materials Evaluated at Boeing for Sealing Anodized Aluminum
 - Metalast: TCP-HF
 - Henkel: Alodine T-5900
 - CST SurTec: SurTec 650 ChromitAl TCP
 - Luster-On: Aluminescent
- Present Method: 5% Dichromate at 210°F
- Proposed Method: TCP Room Temperature Seal
 - Non-Hazardous (No Cr⁺⁶)
 - Non-Global Warming
 - Reduced Energy Consumption

Results of TCP RT Seal



- All Four TCP Materials Pass MIL-A-8625 Requirements
 - Corrosion Resistance Very Good
 - Exceeds 336 Hour Requirement (Up to 1000 Hours)
 - Good Paint Adhesion
- Some Failed the Primer Mandrel Bend Flexibility Test
 - Could Be Caused By Primer
 - Will Repeat This Test in 2008
- Working on Implementation of RT TCP as an Alternative Seal Method for Anodized Aluminum



Alodine 871 Touch-N-Prep Pen

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Update

Alodine 871 Touch-N-Prep



- Alodine 871 Touch-N-Prep Pen is the TCP Version of Alodine 1132 (Contains Cr⁺⁶)
 - Alodine 1132 Touch-N-Prep Pens Implemented at Boeing to Eliminate 1000s of Bottles of Hexavalent Chromate Liquid on Shop Floor
 - Hazardous Waste and Exposure Greatly Reduced
- Tests Conducted to Determine if Alodine 871 Pens are Equivalent or Better than Alodine 1132 Pens
 - Corrosion – 168 Hrs in ASTM B 117
 - Wet Scribed Paint Tape Adhesion
 - Electrical Contact Resistance

Results Alodine 871 Tests



- Alodine 871 Met Requirements in Boeing Process Specification
 - Passed 168 Hour Corrosion Resistance Test
 - Some Even Passed after 336 Hours
 - Good Paint Adhesion
 - Passed Electrical Contact Resistance Test
- Working on Implementation of Alodine 871 Touch-N-Prep Pens as an Alternative to Alodine 1132 Pens
 - Waiting for Alodine 871 to Be Approved by NAVAIR and Put on QPL-81706



Non-Chromate Paint Prep for Titanium and Stainless Steel

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Update

Paint Prep of Titanium and CRES



- Two Non-Chrome Materials Evaluated at Boeing for Preparing Titanium and Stainless Steel (CRES) for Paint
 - Alodine 5700
 - BoeGel
- Present Method: Alodine 1201 (Contains Cr⁺⁶)
 - 1201 Soaked on Parts for 30 to 45 minutes → Rinse → Dry
- Proposed Method: Non-Chromate Surface Treatment
 - Apply Non-Cr ST → Short Dwell Time → Rinse → Dry
 - Less Hazardous and Faster

Non-Chrome Paint Prep Test Results



- Non-Chromate Surface Treatments Work As Good As Chromate Surface Treatments
 - Passes Wet Scribed Paint Tape Adhesion Tests
- Boegel Treatments are Best for Titanium
 - AC131BB Already Implemented for Painting F-15 Titanium Parts
- Boegel and Alodine 5700 are Equivalent to Alodine 1201 for CRES Parts
- Work Continues in 2008 to Implement These Non-Chromate Surface Treatments

Questions?



Gifu, Japan, February 20, 2008



DESIGNED, BUILT, TESTED, FLOWN AND DELIVERED.