

AlumiPlate
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Electroplated AlumiPlate® Aluminum

DoD Metal Finishing Workshop
Chromate Alternatives for Metal Treatment and Sealing




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AlumiPlate, Inc.

- Minneapolis, MN
 - Founded 2/14/96
- Intricate Geometries
 - Throwing/Covering power
 - Supplementary Anodes
- Field Proven
- ISO-Compliant Systems
- HCP – TCP – NCP




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Wide Variety of Substrates

- Material Compatibility
 - Conductive & Non-conductive
- High Strength / Lightweight / High Temperature




Al Alloys
2024, 5052, 6061, 7075, A-356
Pure Beryllium and Alloys
AlBeMet 182
SST
303, 304, 304L, 316
17-7 PH, Specialty
High Strength Steels (No Ni Underplate)
M50, 4130, 4330V, 4340, 300M, AerMet 100
Copper and Alloys
Brass, Bronze, Be-Cu
Fe-Ni Alloys
Haynes 242, Inconel
Carbon Fiber Epoxy Composites
Rare Earth (NdFeB)
MMC's (AlSiC)
Graphite/Magnesium
Titanium

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Specification

- Custom call out
 - Lockheed Martin
 - Goodrich LG
- MIL-DTL-38999K
 - Amphenol
- MIL-DTL-83488D
 - MIL-DTL-5541F
 - Class and Type
- Electroplated aluminum



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Programs Using AlumiPlate® Al

PROGRAM	APPLICATION
B-1 Lancer	- Raytheon Radar Arrays
AH-1 Super Cobra	- M50 High Strength Steel Rotor Hub Housing
M119A Howitzer	- HSS Eyebolts
RQ-4 Global Hawk	- 6061 Al Mirrors for Targeting
"Pluto" – 'Black Prgm.'	- AlBeMet Gyro Housings
	- Missile Cone
C-5 Galaxy	- Aircraft Wheel Fuse Plugs


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Programs Using AlumiPlate® Al



PROGRAM	APPLICATION
F-16 Fighting Falcon	- Copper Grounding Straps
	- Stainless Steel Fuel Mesh Screens
F-18 Hornet	- Raytheon Stainless Steel "Carriers" for Radar Arrays
F-22 Raptor	- Raytheon Stainless Steel "Carriers" for Radar Arrays
	- AlBeMet Electronics Backplane
	- HSS Structural Applications - LG
F-35 Joint Strike Fighter	- HSS Structural Applications - LG
	- Electrical Connectors
	- Composite Electronic Enclosures
Mars Science Lab	- Thermoelectric Power Supply

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Hazardous Material Minimization

- Al as a Cd replacement
 - Dimensional drop-in equivalent
 - Highest Performing Cd Alternative
 - (better than Cd – see JCAT Data)
 - Preferred technical solution for F-35
- Hexavalent chromate replacement
 - TCP and NCP
 - NAVAIR testing (Matzendorf, Schwartz)
- 100% RoHS compliant system
 - Electroplated Al + TCP or NCP


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HSS Cd Replacement Testing


- Corrosion - Goodrich, Lockheed, JCAT, NAVAIR, DOD/DLA
 - Salt Fog : 6,000+ hrs (Cd is ~2,000 hrs)
 - SO₂ : 336+ hrs
- Hydrogen Embrittlement - Goodrich, Boeing, NAVAIR JG-PP JCAT
 - Outperforms all Cd alternatives & Ti-Cd baseline
 - Eliminate 23 hour HE Relief Bake (no nickel)
- Fatigue/Adhesion/Field Repair - Goodrich
 - No fatigue knock down
 - Adhesion passes ASTM B-571 tests
 - Same repair as IVD Al (Passes all scribe & repair tests)
- Discussions for Dem/Val in progress

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Electrical Connector Testing

- Corrosion Protection (Salt & SO₂)
 - Galvanic Protection with mating enclosures
- MIL Spec Test Regimens
 - MIL-DTL-38999K & 5015
 - AS 85049
 - Conductivity & Durability
 - Fluids (incl. Ground Runway Deicers)
 - Non-Reflective
 - EMI / Lightning Strike
 - Drop-In Alternative to Cadmium
 - Cost / Capacity




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NAVAIR Testing

- MIL-DTL-38999K connectors
- Aluminum and composite
- Cd vs. electroplated aluminum
- HCP vs. TCP
 - MIL-DTL-5541F Type II (non Cr +6) Class 3
- Conductivity and corrosion
 - Salt fog and SO₂
- Al + TCP outperformed Cd + Hex Cr

**Report presented Jan 2007 at JG-PP JCAT meeting
New Orleans, LA**




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MIL-SPEC Revision

- MIL-DTL-38999L
 - Class "P" for electroplated aluminum
- Revision out for comments
 - Available with HCP or TCP
 - Passes 336 hr SO₂ test
 - Compatible with fluids/ground runway de-icers




Commercially available through Amphenol

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TCP In-House Capability


- Inline process baths
- Activation procedure
 - 20 sec alkaline etch 150 F (Etch Rate 0.0001" Al per min)
 - 10 sec 10% Nitric Acid
 - 5 - 10 min TCP 50% at RT or TCP 25% at 90F
 - Air Dry
 - DI rinses in between steps



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Before ASTM B-117 Testing



4130 Steel plated with Al per MIL-DTL-83488D Class 2 Type II
Conversion Coat per MIL-DTL-5541F Class 1A
Type I (HCP) and Type II (TCP)

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ASTM B-117 168 Hours (1 week)



Hexavalent Chromate Trivalent Chromate

4130 Steel plated with Al per MIL-DTL-83488D Class 2 Type II

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ASTM B-117 336 Hours (2 weeks)



Hexavalent Chromate Trivalent Chromate

4130 Steel plated with Al per MIL-DTL-83488D Class 2 Type II

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ASTM B-117 504 Hours (3 weeks)



Hexavalent Chromate Trivalent Chromate

4130 Steel plated with Al per MIL-DTL-83488D Class 2 Type II

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ASTM B-117 672 Hours (4 weeks)



Hexavalent Chromate Trivalent Chromate

4130 Steel plated with Al per MIL-DTL-83488D Class 2 Type II

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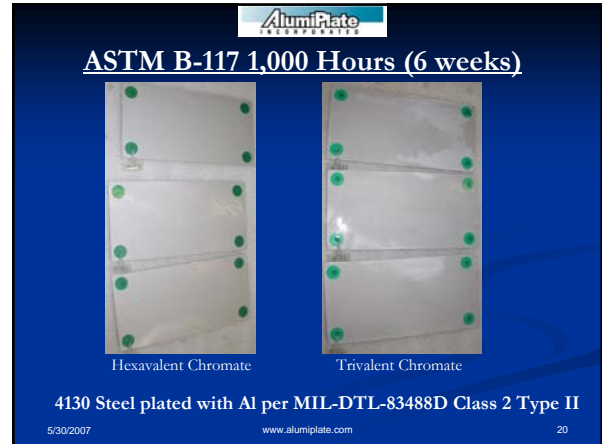
ASTM B-117 840 Hours (5 weeks)



Hexavalent Chromate Trivalent Chromate

4130 Steel plated with Al per MIL-DTL-83488D Class 2 Type II

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Summary

- Cd replacement
 - Dimensional drop-in
 - Improved corrosion resistance
 - Marine exposure and SO₂ testing
 - Lower HE and EAC risks
 - Processing advantages
 - No HE bake
 - No mask/bake for HVOF finish grind after plating
- Hex Cr replacement
 - AlumiPlate® Al + TCP or NCP
 - 100% RoHs compliant system
 - Meets NAVAIR JSF requirements
 - Commercially available

Electroplated Al + TCP vs. Cd + Hex Cr

Higher performance

Lower lifetime costs (fewer MRO cycles)

Shorter processing times

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Questions

Gus Vallejo
Technical Sales Manager

AlumiPlate, Inc.

T. 888.258.6475
C. 612-801.9603
F. 763-786-8518

info@alumiplate.com
www.alumiplate.com

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