

Surface Finishing Solutions Using High-Purity Aluminum

# Electroplating with High Purity Aluminum

Why coat with high purity aluminum? Purity means protection.

Imagine being able to combine the physical properties of any basis metal with a coating as impermeable to the elements as pure aluminum.

Surface finishing and materials professionals have long known the desirable physical properties of high purity aluminum. It has not been until recently that electrodeposited aluminum coating has become commercially available and economically attractive, and has offered designers the ability to capture the surface properties of high purity aluminum on virtually any substrate.

By using aluminum that is more than 99.9% pure, any conductive surface can be coated with outstanding results. High-purity aluminum can be anodized, and its high electrical and thermal conductivity and excellent reflectivity are useful in many high-tech applications.

> AlumiPlate, Inc., is committed to a healthier, safer, less toxic environment by helping manufacturers eliminate the use of hazardous materials. Our environmentally safe processes produce products that meet the highest quality standards.



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alumiplate

## Achieve the properties of High Purity Electroplated Aluminum on virtually any surface.

The many attractive properties of electroplated high purity aluminum include:

**Corrosion resistance.** The pure aluminum layer is fully dense and pore-free at thicknesses as low as 0.0003" inches (~8 micrometers) to provide a naturally corrosion-resistant barrier. The tenacious, non-degenerating oxide surface acts as a barrier layer, and the metallic high-purity aluminum layer serves as a sacrificial anode to nearly any basis metal substrate, even when abrasions or scratches occur in the layer. The aluminum layer does not require a chromate conversion coating in order to achieve its superior corrosion resistance, adding to its attractiveness as a non polluting alternative. In an ASTM B117 salt spray test, an electroplated aluminum layer of 0.0003" inches thickness provides excellent corrosion protection in excess of 1,000 hours. In test after test, the AlumiPlate® high purity aluminum coating surpasses the corrosion resistance of cadmium, nickel, zinc nickel, zinc and other specialty metallic and organic anti corrosive elements such as sulfur dioxide, fluorine, chlorine, and nitrogen. The coating survives 20 cycles in the Kesternich (DIN 50018) test.

**Useful in high-temperature applications.** With a functional temperature range of up to 1000° F, aluminum can be used in many high-temperature applications.

*Environmentally superior.* Aluminum is non-toxic and poses little threat to the environment. Handling and disposal is easy and safe.

*Low risk of hydrogen embrittlement.* The patented AlumiPlate aluminum-plating process is non-aqueous and instead uses an aprotic (proton-free) electrolyte. This greatly reduces the potential for hydrogen embrittlement, and the process has been certified as non-embrittling based on tensile, fatigue, and field-customer test data. Coated high-strength components do not require a post-plating heat treatment for hydrogen relief, and the coating minimizes environmentally assisted cracking (EAC) of installed parts.

**Electrical applications.** Because aluminum is electrically conductive, it is ideal for electrical applications across many industries.

**Ductility.** Electroplated aluminum is highly ductile, allowing for post plating forming or crimping operations on the plated part, without creating voids for corrosion attack. This is also an important consideration for parts that flex, such as springs.

**Aluminum can be anodized.** Anodization offers enhanced corrosion resistance and surface durability, as well as various cosmetic options.

**Thermal conductivity and tailored insulation.** The thermal conductivity properties of the aluminum layer prove valuable in many heat removing applications. The anodized coating can provide extraordinary electrical insulation in the range of 1000 v/mil.



## Comparison to other "High Performance" coatings

As the table illustrates, not only does high purity aluminum plating offer a better performing metal coating solution than cadmium, it also provides a superior solution to organic coatings. Electroplated aluminum is also compatible with more manufacturing operations.

	AlumiPlate <sup>®</sup> Al	Cadmium	Organic Coatings	Zn Alloy Coatings	IVD AI
Nominal Recommended Thickness	0.3 mils	0.3 mils	1-2 mils	0.3 mils	0.3 mils
Salt Spray (B-117) Performance	1000+ hrs	1000 hrs	500 hrs	400-1000 hrs	500 hrs
Non-Embrittling	Yes	No	Yes	No	Yes
Fully Dense and Pore Free	Yes	Yes	Yes	Yes	No
Sacrificial Protection	Yes	Yes	Partial	Yes	Yes
No galvanic reaction with Al parts	Yes	Yes	Partial	No	Yes
Complex Geometries and ID's	Yes	No	No	Yes	No
Tightly Adhering	Yes	Yes	No	Yes	No
Environmentally Friendly	Yes	No	Yes	No	Yes
High Temp. Applicability	Up to 1000° F	Up to 500° F	Up to 500° F	Up to 500° F	Up to 1000° F
Drop-In Cad Replacement	Yes	-	No	No	No
No peening required	Yes	Yes	Yes	Yes	No
Ductile, Formable and Stampable	Yes	Partial	No	No	No
Low Process Temperature	Yes	Yes	Yes	Yes	No
Anodizeable	Yes	No	No	No	No

## Where Aluminum plating shines

#### AeroSpace

Application	Unique Value	
Cadmium replacement	Performance improvement Elimination of hazardous material Comply with executive order 12856	
Electrical connectors	Corrosion resistance with electri	cal conductivity
High strength fasteners	Avoid creation of galvanic cell No Hydrogen embrittlement	
Rivets	Galvanic compatibility	A
Drop-in replacement for IVD	Performance improvement Cost reduction	



#### 🗕 Heavy Equipment

Application	Unique Value
Coating of high strength fasteners	Performance improvement Diminished threat of Hydrogen embrittlement Elimination of hazardous material

#### Agricultural Equipment

Application	Unique Value	
Coating of hydraulic hose hardware	Resistance against fertilizers/ urea	
	3x increase in	COMPLY NAME

### High Strength Fasteners in Critical Applications

Application	Unique Value
High strength fasteners	Avoid creation of galvanic cell No Hydrogen embrittlement Very thin coating Maintain torque/tension specs Physical barrier to EAC No bake-out required Higher confidence in integrity of fatigue life



#### **Construction Industry**

1.	Application	Unique Value
	High strength fasteners	Anti-corrosion coating without the threat of Hydrogen embrittlement
	Window hardware	Long service life Hardware can be painted or anodized

#### Semiconductor Production Equipment

Application	Unique Value	
Chemical vapor deposition chamber interior	Resistance to hot fluorine gas High working temperature range Anodized coating is highly durable	
Fasteners	Resistance to hot fluorine gas High working temperature range	

#### **Specialty Optics Applications**

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and the state	Application	Unique Value
	Reflective coating on mirror surfaces	Diamond turnable Excellent surface finish Low scatter Ideal for extended temp stability and Cryogenic applications on aluminum alloy substrates (eliminates CTE mismatch)

#### Marine and Offshore applications

Application	Unique Value
Deck Hardware	Resistance to salt water environment Priced lower than stainless steel
Lighting and cabin fixtures	Highly salt corrosion resistant
Hull fitting to Aluminum structures	Elimination of corrosive galvanic cell
Off shore rig decks	Resistance to UV degredation
Hydraulic fittings and hoses	Resistance to salt corrosion

## The AlumiPlate Process

In principle, the electrolytic deposition of aluminum does not differ from conventional electroplating processes using soluble anode materials and electrolytes. However, due to its negative standard potential, aluminum can only be electrodeposited out of an absolutely water-free electrolyte, otherwise electrolysis would occur causing the formation of hydrogen and oxygen.

Plating takes place in an inert gas environment and in an electrolyte where hydrogen

embrittlement of the plated parts cannot occur. Following plating with aluminum, a variety of post treatment finishes, e.g. anodizing, can be applied to impart additional coating performance features to the coating.



The AlumiPlate process is fully automated and tightly controlled by the strictest quality control guidelines to provide our customers with consistent quality results.

## Your needs, our expertise.

At AlumiPlate, we offer technical design/engineering assistance, sample processing for evaluation, and applications engineering aimed at providing targeted solutions that go beyond mere plating. We believe in uncovering solutions that are tailored to your specific application, based on materials, design, and objectives.

### Visit us on the Web.

For additional information about AlumiPlate, go to **www.alumiplate.com** or call us at 1-888-258-6475. Our sales and technical staff are at the ready to partner with you and to establish the most effective solutions for your application.

Whatever your needs, we are committed to meeting them with a consultative approach and an eye toward your success — success as strong and long-lasting as our high-purity aluminum coating.





