

# Electroplated aluminum: The logical choice for cadmium replacement in corrosive environments.

Though once the premier coating for corrosion protection on steel parts, cadmium is no longer a viable solution for these applications due to its toxicity. In fact cadmium is on the EPA's list of hazardous materials for reduction/removal from the workplace, so it is currently being phased out across all industries worldwide.

Until recently, surface-finishing professionals have had few acceptable cadmium alternatives. Other coatings simply could not offer comparable corrosion protection, nor were they economical. Enter the AlumiPlate process – the ideal high-purity aluminum solution for many applications.

## High-purity aluminum is today's best alternative.

Surface finishing and materials professionals have long understood the many advantages and desirable physical properties of high-purity aluminum. Today, electroplating of high-purity aluminum is a well-established, commercially available substitute for cadmium, offering performance and cost advantages for a wide variety of industries and applications. The many attractive properties of electroplated high purity aluminum include:

**Corrosion resistance.** The pure aluminum layer is fully dense and pore-free at thicknesses of 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 minor 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

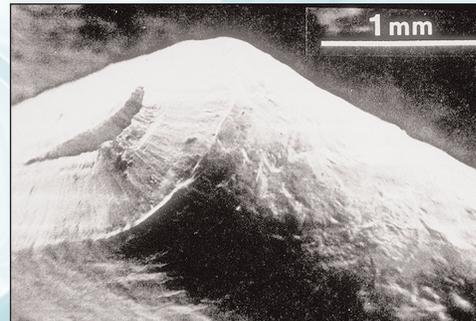


fig. 1

This photograph illustrates the formability and ductility of electroplated aluminum. Note the absence of cracks at the tightest bend radius. (bend test performed per ASTM B-489).

**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 pose few if any problems.

**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.

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

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## Evaluating other platings.

In ASTM B-117 salt-spray tests, high-purity aluminum outperforms other cadmium alternatives commonly used anti-corrosion coatings, including organics, tin or zinc alloys and IVD aluminum as indicated in the following test results summary.

	AlumiPlate® Al	Cadmium	Organic Coatings	Zn Alloy Coatings	IVD Al
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

electroplated aluminum has been tested in chloride, fluorine, nitrogen and sulfur dioxide-rich atmospheres, and it has shown excellent corrosion resistance.

**Aerospace:** Both the military and the commercial aviation industry struggle to eliminate cadmium platings as required under Executive Order 12856. This order requires suppliers to find alternatives

to cadmium for fasteners, electrical connectors, and avionics components. AlumiPlate addresses environmental and toxicity concerns and also reduces the risk of galvanic corrosion. In addition, critical high-strength components can benefit from AlumiPlate aluminum's reduced tendency toward hydrogen embrittlement and is excellent for use in electrical connectors where low electrical resistance is required. High-purity

electroplated aluminum has also proven superior to ion vapor deposited (IVD) aluminum.

## Diverse applications.

Electroplated aluminum is valuable in applications with a wide range of requirements, including corrosion resistance, temperature, galvanic or chemical compatibility, machineability and cost. Comprehensive testing of the AlumiPlate layer has proven its efficacy in several target applications:

**Heavy Equipment:** Corrosion or environmentally assisted cracking can cause high-strength bolts, springs, and connectors to fail prematurely — and in some cases catastrophically. The non-embrittling AlumiPlate aluminum coating has been tested and approved for use by major equipment builders, offering an excellent solution where superior corrosion resistance is needed.

**Marine:** Marine manufacturers are meeting with growing environmental pressure to reduce their usage of cadmium, which is still the standard plating material for components where corrosion resistance is critical. An excellent option is to plate such components with a thin, dense aluminum layer that is ductile and will withstand coastal and off-shore environments. AlumiPlate's

**Electroplated aluminum is available, effective, safe, and economical.**

The technology for electroplating aluminum is well established and commercially available in both the U.S. and Europe, and its availability is growing rapidly as plating costs continue to drop and capacity continues to expand. Since electroplating is now included in most industry and defense specifications calling for aluminum coatings — including Mil-DTL-83488 — electroplated high-purity aluminum offers an immediate drop-in replacement for cadmium.

Superior performance, significant cost savings, and applicability across a wider than ever range of products and components, make electroplated high-purity aluminum today's best coating alternative.

