MAGNAPLATE
COATINGS ENGINEERED FOR YOUR SUCCESS

BENEFITS

- Reduces wear and friction on sliding surface contacts
- Provides enhanced erosion and corrosion resistance
- Excellent abrasion resistance
- No micro cracks to affect
- performance
- Ensures design reproducibility
- Eliminates galling, seizing and high friction over a broad range of applications
- Recommended as a finishing process eliminating costly secondary operations such as grinding
- Processing does not adversely affect base material properties
- Quality is consistent for most aluminum alloys
- High temperature resistance
- Allows flexibility of design and metal choice

Magnaplate HCR®

"Synergistic" Surface Enhancement Technology Maximizes Corrosion Resistance and Hardness of Aluminum and Aluminum Alloys

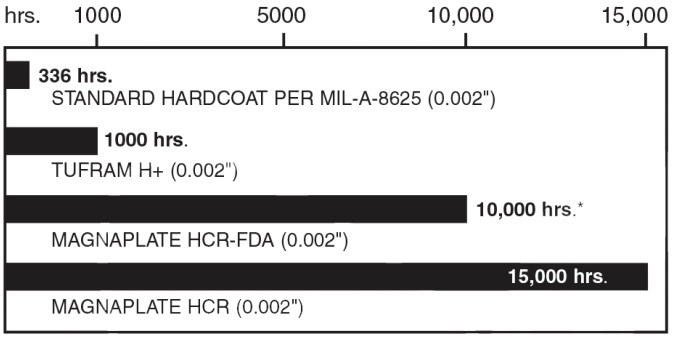
MAGNAPLATE HCR® is a proprietary surface enhancement technology that produces a harder-than-steel surface (up to the equivalent of Rc-48) on aluminum parts. In addition, it exhibits extraordinarily improved corrosion resistance over hard anodizing and withstands salt spray exposure in excess of 15,000 hours. By combining the hardness of aluminum oxide ceramic with the sealing action of metallics and proprietary polymers, it imparts previously unattainable levels of hardness, corrosion resistance, and permanent lubricity to aluminum and aluminum alloy parts.

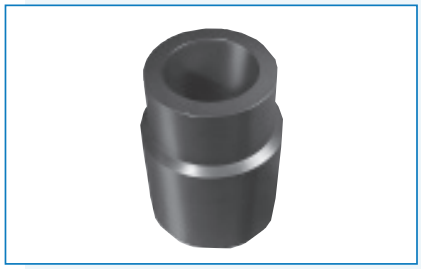
ENGINEERING DATA & PERFORMANCE CHARACTERISTICS

Corrosion Resistance. A MAGNAPLATE HCR "synergistic" coating exhibits far superior levels of salt spray resistance on aluminum than either conventional hard anodizing or even any other Magnaplate coating. A 0.002" coated surface shows no substrate decomposition due to corrosion after 15,000 hours of salt spray exposure — 44 times the MIL-SPEC of 336 hours. NASA tests1 of Shuttle parts indicate that parts coated to a thickness of 51 microns (2.0 mils) "should provide superior corrosion protection for a prolonged period of time."

SALT SPRAY TEST

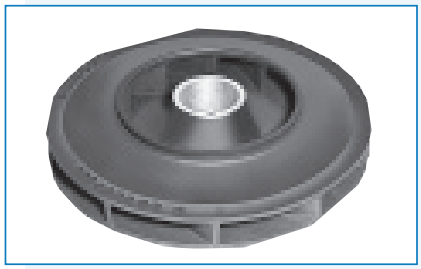
"Synergistic" Coatings vs. Standard Hardcoat Anodizing



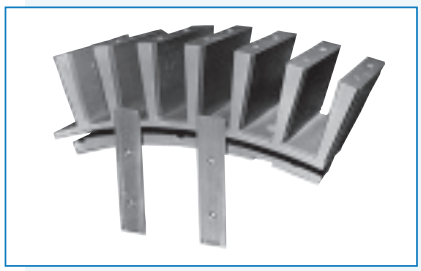


Aluminum sub-sea sonar collar is protected against salt water corrosion during oil explorations.

MAGNAPLATE HCR solved problems of wettability and of corrosion from acidic and alkaline reagents on the aluminum carousel and slide platforms on computerized immunostaining equipment.



Aluminum impeller is protected against abrasion, corrosion, friction and drag.



Severe wear caused by abrasive paper products is eliminated on fingers of a packaging machine separator.

FDA compliance. MAGNAPLATE HCR-FDA is compliant for use in "food-contact involving repeated use, such as food processing equipment."2 No other surface enhancement coating can give aluminum parts 10,000 hours of salt spray corrosion resistance in food contact applications.

Weather resistance. Tests of parts which were coated with MAGNAPLATE HCR and exposed to the most severe climatic conditions confirm its weather- resistant properties. Resistance to extreme heat and to ultraviolet light is excellent.

Adherence and impact resistance. Because MAGNAPLATE HCR becomes an integral part of the parent metal, it cannot peel, chip or flake off, nor can it be nicked. That reduces problems caused by contamination from loose particles. Its impact resistance is limited only by the structural strength of the base metal to which it is applied.

Coating tolerances/thickness. With very few exceptions, a consistently uniform MAGNAPLATE HCR coating, which ranges in thickness from 0.001-0.0025" per side, can be applied to pre-balanced impellers. Precise control of finished coating thickness (±10%) permits use on close-tolerance parts such as threaded members. By undersizing the outside pitch diameter by approximately four times the coating thickness prior to coating, the original thread sizes can be maintained after coating.

The finish of the surface after MAGNAPLATE HCR application will be equal to or slightly rougher than the original surface. While not recommended, slight burnishing, lapping, or honing can be performed on a coated part, if necessary. However, removal of the surface material should be no more than 0.0002".

For machining allowances, note that overall final thickness of the coating is influenced by two factors:

A. Penetration

B. Surface Growth

The table below shows typical examples:

COATING THICKNESS	SURFACE GROWTH*
0.0008 inches	0.0004 inches
0.0010 inches	0.0005 inches
0.0020 inches	0.0010 inches

*Growth is approximately 50% of the thickness value

Hardness. Aluminum parts coated with MAGNAPLATE HCR exhibit superior hardness. Per a NASA Technical Memo- randum,1 "MAGNAPLATE with a coating thickness of 51 microns is highly recommended. It not only affords excellent corrosion protection but presents a very hard (about Rc 48), wear resistant and durable surface."

Effective temperature range. AGNAPLATE HCR coated parts exhibit strength and self lubricity down to –110°F (–79°C). Parts can also operate effectively at temperatures as high as 600°F (316°C) at intermittent operating conditions.

Wear and abrasion. Equilibrium wear rate using Taber abrasion testing method #6192 of FED STD #141 (CS-17 wheel): 0.275mg per 1000 cycles. Exceeds MIL SPEC requirements by up to 35%.

Friction properties. MAGNAPLATE HCR coatings provide smooth, slippery surfaces with permanent lubricity. This characteristic eliminates the problem of "stick-slip" in which higher breakaway friction causes undesirable vibration. The chart below shows the considerable reduction in the coefficient of friction (COF) achieved by the use of MAGNAPLATE HCR. Frictional forces were reduced 50% compared to the relationship of the COF of different materials. For additional friction data, refer to General Magnaplate's FRICTION DATA GUIDE.

FRICTION COMPARISON TEST			
Material vs. Material		COF Static	COF Kinetic
Aluminum	Aluminum	0.42	0.34
Aluminum	HCR	0.35	0.29
HCR	HCR	0.20	0.17
Teflon*	HCR	0.14	0.12

*Teflon is a registered trademark of DuPont

Dielectric properties. MAGNAPLATE HCR exhibits excellent dielectric characteristics without affecting the high conductivity of the substrate. Its performance as an insulator is excellent. The coating won't break down — even at 2,000 volts. Because the proprietary engineered polymers impregnated into the coating do not absorb water, volume resistivity values remain unchanged even after prolonged water exposure.

Thermal conductivity. Enhanced aluminum exhibits rapid heat and cold transfer. By converting an original single flat aluminum crystal into millions of surface facets, MAGNAPLATE HCR permits heat distribution within the encapsulated outer surface that surpasses that of untreated aluminum.

Design considerations. Almost all cast, forged, extruded or wrought aluminum alloys can be treated. Alloys that contain less than 5% copper and 7% silicon and do not contain lead are most suitable for the application of an HCR coating. The degree of hardness, penetration and color varies with each alloy, with the processing temperature, and with the coating thickness.

References:

1. NASA Technical Memorandum by M.D. Danford, Marshall Space Flight Center, April 1991

2. FDA Letter to General Magnaplate, May 22, 1987