

## Sulfuric Acid Anodic Oxide Coating

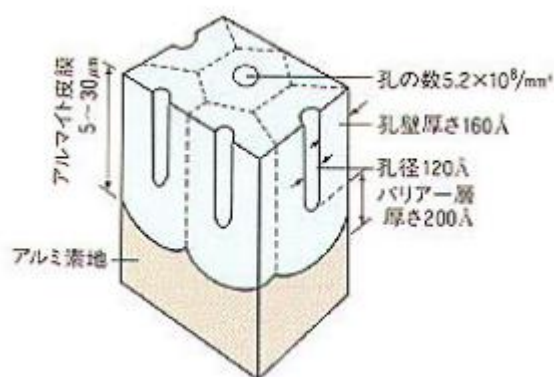
(Sulfuric Acid Alumite)

NODIZE

(Anodic Coatings for Aluminum and Aluminum Alloys)

Sulfuric acid alumite is the most popular type of alumite, which is a coating produced by anodizing of aluminum in a sulfuric acid aqueous solution. Since sulfuric acid alumite is produced with a simple technique, even small-scale facilities can produce sulfuric acid alumite having a reasonable finish without applying any special quality control. Nonetheless, as a matter of course, quality control is essential in supplying products of stable quality. You can rest assured in this respect. Our company has supplied products of stable quality through ensuring solution management and temperature control and utilizing the know-how we have accumulated until now. We have applied not only pure water (deionized water) for preparation of treatment solution but also reverse osmosis (RO) water for rinsing which is produced by removing salt from water with a reverse osmosis technique. We have one of the largest processing lines among specialized manufacturers, allowing us to handle large-sized components. Regarding pore-sealing treatment, we offer various types of sealing such as dichromate, steam, hot water, and cold sealings in addition to nickel acetate sealing. It is possible to select the most appropriate sealing according to the product's intended application.

\*Other types of sealing besides the above-mentioned sealings are also available. Please contact our sales staff for more information.



図中語句	
日本語	英語
アルマイト皮膜	Anodic oxide coating (alumite)
アルミ素地	Aluminum substrate
孔の数	Number of pores
孔壁厚さ	Pore wall thickness

孔径	Pore size
バリアー層厚さ	Barrier layer thickness

Pore wall thickness = 16 nm

Pore size = 12 nm

Barrier layer thickness= 20 nm

Features -----

◎Appearance: For corrosion-resistant alloys, the transparent coating of sulfuric acid alumite provides a silver-white appearance while maximizing the metallic texture of aluminum. Integral colors may be sometimes observed depending on the type of alloy and the thickness of coating (refer to Table 1).

Table 1: Major types of aluminum alloy and their spontaneous

Type of Alloy (Wrought Alloy)		Color of Coating	Type of Alloy (Casting/Die Casting)		Color of Coating
1000 Series	Pure aluminum for industrial use	Silver white	AC1A/AC1B	Al-Cu series	Gray white
2000 Series	Al-Cu series	Gray white	AC2A/B AC4A/B/C/D AC8A/B	Al-Si series	Gray
3000 Series	Al-Mg series	Silver white			
4000 Series	Al-Si series	Grayish black			
5000 Series	Al-Mg series	Silver white	AC7A	Al-Mg series	Silver white
6000 Series	Al-Mg-Si series	Silver white	ADC10/ADC12	Si series	Brown or charcoal gray
7000 Series	Al-Zn-Mg(-Cu) series	Silver white or light yellow	ADC5/ADC6	Mg series	Silver white

◎Dye-affinity: Sulfuric acid anodic oxide coating allows colorful dyeing because of its clearness and good adsorption property. Abrasion resistance: Sulfuric acid anodic oxide coating is especially excellent in sliding wear resistance with a good galling resistance.

◎Corrosion resistance: In general, the thicker the coating, the better the corrosion resistance. However, when used without painting, excessively thick coating may develop cracks leading to reduction in corrosion resistance. The optimum coating thickness to prevent corrosion is 15 to 20µm. Depending on the type of alloy, coating of 30µm or greater in thickness is also available.

◎Protection of products: Sulfuric acid alumite protects products from scratch, abrasion, and corrosion in general applications. For products used under harsh environments, please consider applying hard alumite or oxalic acid alumite .

Table 2: Performance of anodic oxide coating by aluminum material

Wrought Alloy	Performance of Anodic Oxide Coating				Casting /Die Casting	Performance of Anodic Oxide Coating			
	Corrosion Protection	Coloring	Luster	Abrasion Resistance		Corrosion Protection	Coloring	Luster	Abrasion Resistance
1000 Series	A	A	A	A	AC2A	△	×	×	△
3000 Series	C	B	D	C	AC4C	○	×	×	△
3000 Series	A	B	c	A	AC7A	○	○	○	○
4000 Series	B	C to D	D	B	AC8A	△	×	×	△
5052 5056 5083	◎	◎	○	◎	ADC10 ADC12	△	×	×	△
	◎	◎	○	◎					
	◎	○	△	◎					
6061 6063	◎	◎	△	◎	ADC5 ADC6	○	○	○	○
	◎	◎	○	◎					
7000 Series	△	○	△	v					

Standard performance and quality assurance -----

◎Meets the performance requirements of the U.S. military specification MIL-A-8625 Type II (Guaranteed by salt spray test (ASTM B117) for 336 hours using material 2024-T3 with a coating thickness of 10 to 15µm; coating weight 1000mg or greater/ft<sup>2</sup> [10.75g or greater/m<sup>2</sup>])

◎Meets JIS H8601:1999 Class A (With the exception of the coating thickness test, any of the following coating performance tests, when required, will be outsourced.)

Table 3: Coating thickness grade and coating performance (JIS H8603:1999 Anodic Oxide Coatings for Aluminum and Aluminum Alloys)

Grade	Coating Thickness (µm)		Corrosion Resistance			Abrasion Resistance JIS H8682		
	Minimum Local Thickness	Average Minimum Thickness	Alkaline Corrosion Resistance JIS H8681-1		CASS Test JIS H8681-2	Sand-Falling Abrasion Resistance Test	Abrasive Jet Test	Abrasive Wheel Wear Test
			Class A	Class B				
AA3	2.4	3.0	-		-	-	-	-
AA5	4.0	5.0	-		-	-	-	-
AA6	4.8	6.0	30 sec or longer	90 sec or longer	8 h	150 sec or longer	-	30 cycles or more ----- Coating wear (µm)
AA10	8.0	10.0	50 sec or longer	150 sec or longer	16 h	500 sec or longer	24 sec or longer	
AA15	12.0	15.0	75 sec or longer	225 sec or longer	32 h	750 sec or longer	36 sec or longer	
AA20	16.0	20.0	100 sec or longer	300 sec or longer	56 h	1000 sec or longer	48 sec or longer	
AA25	20.0	25.0	125 sec or longer	375 sec or longer	72 h	1250 sec or longer	60 sec or longer	

(RN9.0 or greater)

Note: When high-pressure steam sealing treatment is applied, the conditions shown for Class B in the table above are also applicable. The conditions shown in the above table are exclusively applicable to quality assurance of corrosion-resistant wrought alloys.

Applicable Standards -----

MIL-A-8625 Type II Classes 1 and 2 (the latest version: F Amendment 1)

SAE-AMS 2471&2472, and other aeronautical standards

Sealing -----

Hot water sealing and steam sealing are pore-sealing treatments utilizing hydration reactions of anodic oxide coating. With the hydration reactions, microscopic pores of anodic oxide coating are sealed off, while the coating becomes chemically inactivated. The sealing treatment improves corrosion resistance and stain resistance of coating, which is also applied to dye fixing for dyed products. In nickel acetate sealing, orifices of microscopic pores are filled with deposits, thus preventing dye bleeding and providing excellent corrosion resistance and surface smoothness. The MIL-A-8625 specifies that pores of non-dyed coating should be completely sealed off in 5% sodium dichromate,

potassium dichromate, acetate, or other suitable solutions. The high-pressure steam sealing developed by the Institute of Physical and Chemical Research (RIKEN) allows the maximum-level hydration sealing treatment and provides outstanding corrosion resistance. At the Riken Alumite Industry, we offer nickel acetate sealing treatment, dichromate sealing treatment, deionized water (hot water) sealing treatment, and high-pressure steam sealing treatment.

In cold sealing treatment also called pseudo-sealing treatment, chemical reactions at around ambient temperature between nickel fluoride or other chemicals and the inner surface of pores chemically inactivate anodic oxide coatings leading to improvement of corrosion resistance.

#### Design Information -----

◎Size change: Depending on the material of products and the coating thickness, after coating, the surface of a product generally increases in thickness by approximately one third the coating layer thickness, leading to an increase in product size. Meanwhile, reduction in size during pretreatment must also be considered. Products with strict requirements for their finished size therefore need adjustment before coating.

◎Products with complex shapes and assembled products: Sulfuric acid alumite is produced by using sulfuric acid which is a strong acid as the electrolytic solution. Concerning the objects where electrolytic solution is highly likely to remain such as products with complex shapes, components with deep blind holes, and products assembled by using welding, riveting and other methods, the residual electrolytic solution may cause problems including corrosion and discoloration. When sulfuric acid anodization is applied to those types of object, the problems mentioned above may be prevented from occurring with post-processing, coating applied separately for individual components, and masking of any gaps.

◎Electrical insulation: The anodic oxide coating has electrical insulation properties.

For the sites requiring electrical contacts, electrical contacts can be secured by removing the coating through post-processing or leaving the conductive substrate uncoated with prior masking. Note that the insulation resistance may vary depending on use environment. Please be careful when using an anodic oxide coated-product as an insulator.

◎Precautions pertaining to chemical substances: Since containing sulfate, the coating elutes sulfate ions in water and releases SO<sub>x</sub> and water vapor in a low-pressure or high-temperature environment. Sulfuric acid alumite sealed by nickel acetate may elute very small quantity of nickel.

Table 4: Coating thickness grade and major applications (JIS H8601:1999)

Coating Thickness Grade	Major Application
AA3	Reflectors, electrical parts (internal parts), etc.
AA5 AA6	Kitchen utensils, household products, home appliance parts, decorative products, furniture components, vehicle interiors,

AA10	building components (indoors)
AA15 AA20 AA25	Kitchen utensils, vehicle exteriors, civil engineering and architectural materials, ship parts