

THE SHAPE **MAKERS**[®]

A Publication of the Aluminum Extruders Council



EXTRUSION SPANODIZING TIGHT



Anodizing Aluminum Extrusions

What is Anodizing

Anodizing is an electro-chemical process. Extruded aluminum shapes (profiles) are immersed in an acid solution under controlled conditions. An electrical current passes through the solution to produce an aluminum oxide film on the profiles being anodized.

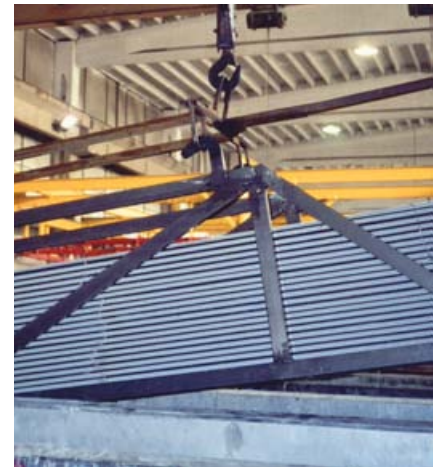
This oxide film is extremely hard, durable and resistant to corrosion. It serves as a color anchor in the anodizing process.

Anodizing is one of the most environmentally friendly metal finishing processes. It is commonly called the “Green” finish for aluminum.

The Process

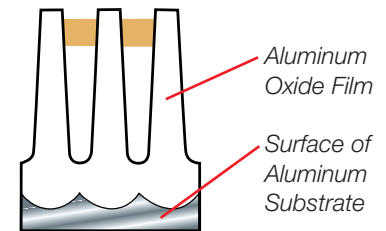
Typically, the anodizing process is carried out in a series of tanks, as depicted in the accompanying diagram.

Extruded aluminum profiles are cleaned, etched to a desired finish, and deoxidized prior to anodizing. In the anodizing step the thickness of the aluminum oxide is closely controlled to comply with the AAMA 611-98 specification. After anodizing, many colors can be obtained. Sealing completes the process of developing this true metallic finish. Coloring methods fall into four categories.



Four Types of Color Anodizing

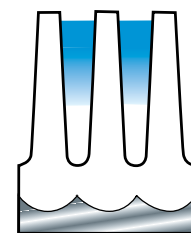
1. Inorganic Dyeing



ANODIZING → INORGANIC DYE

Inorganic dye is absorbed at the surface of the anodic pores. Typical colors include pale to dark bronze and muted gold tones.

2. Organic Dyeing



ANODIZING → ORGANIC DYE

Organic dye is distributed throughout the coating, but is principally concentrated near the surface and the middle area of the anodic pores. Typical colors include deep yellow, red, blue, green, turquoise, and black.





Benefits of Anodizing

The unique anodized finish satisfies each of the factors that must be considered when selecting a high-performance aluminum finish.



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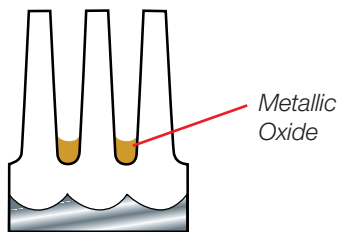
EASE OF MAINTENANCE:

Scars and wear from fabrication, handling, installation, frequent surface dirt cleaning and usage are virtually nonexistent. Rinsing or mild soap-and-water cleaning usually will restore an anodized



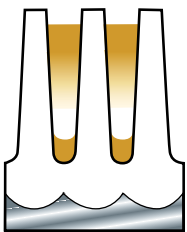
profile to its original appearance. Mild abrasive cleaners can be used for more difficult deposits.

3. Electrolytic Coloring



ANODIZING → ELECTROCOLORING
Metal is deposited deep into the anodic pores.
Typical colors include brown, bronze, gray, slate, black, pink, and burgundy.

4. Electrolytic Coloring in Combination with Organic Dyeing



ANODIZING → ELECTROCOLORING
→ ORGANIC DYEING
Metal is deposited deep into the pores electrolytically, followed by a dye which is distributed throughout the coating nearer the surface. Many muted colors are attainable.

DURABILITY: Most anodized profiles have an extremely long life span and offer significant economic advantages through maintenance and operating savings. Anodizing is a reacted finish that is integrated with the underlying aluminum for total bonding and unmatched adhesion.

COLOR STABILITY: Exterior anodic coatings provide good stability to ultraviolet rays, do not chip or peel, and are easily repeatable.

AESTHETICS: Anodizing offers a large (and increasing) number of gloss and color alternatives and minimizes color variations. Unlike other finishes, anodizing allows the extruded aluminum to maintain its metallic appearance.

Sealing

The anodic pore must be sealed to prevent corrosion and enhance the durability of the finish. This can be done with chemical seals, hot water, steam or hot water with additives, plus other specialized seals.



COST: Anodizing is a very cost-effective value compared to other finishing methods.

HEALTH AND SAFETY:

Anodizing is a safe process that is not harmful to human health. An anodized finish is chemically stable, will not decompose, is nontoxic, and is heat-resistant to the melting point of aluminum (1,221 degrees Fahrenheit).

Since the anodizing process is a reinforcement of a naturally occurring oxide process, it is nonhazardous and produces no harmful or dangerous by-products. Chemical baths used in the anodizing process often are reclaimed, recycled, and reused.



The industry is making a conscious effort to pursue source reduction, in addition to wastewater treatment, so as to maintain its "Green" reputation. It is a good idea to contact your extruder to discuss the best solution for your specific application.



Anodized Aluminum Applications

Anodized profiles and other products are used in thousands of commercial, industrial and consumer applications, including:

- Structures
- Architectural components
- Appliances
- Commercial and residential building products
- Food preparation equipment
- Furniture
- Sporting goods and boats
- Motor vehicle components

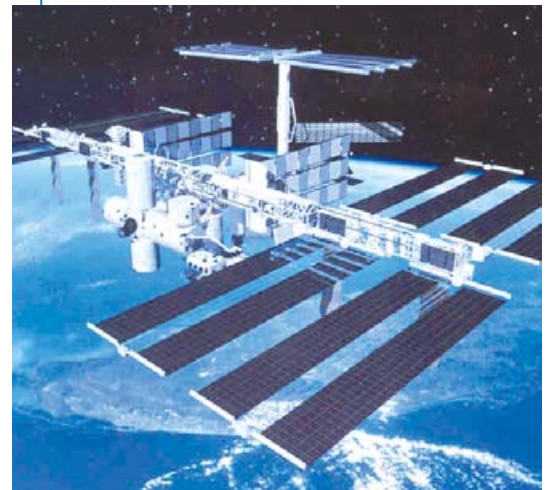
Here are a few examples of products that may utilize anodized aluminum profiles:

- Building exteriors, such as storefronts, curtain walls, and roofing systems
- Appliances, such as refrigerators, dryers, coffee brewers,



ranges, televisions, microwave equipment

- Vents, awnings, duct covers, light fixtures, storm doors, window frames, mailboxes, bathroom accessories, patio covers, and electronic equipment
- Display cases, pans, coolers, and grills for the food industry
- Tables, beds, files, and storage chests for homes and offices
- Golf carts, boats, and camping/fishing equipment for the leisure industry
- Hundreds of components for motor vehicles of all kinds, such as trim parts, control panels, seat rails, brackets, and structural components



- Exterior panels for aerospace vehicles, clocks and electronic products, fire extinguishers, photo equipment (tripods, lens housings), solar panels, telephones, picture frames, and bathroom accessories
 - Interior decoration and trim
- This is just a small sample list of products made up of anodized aluminum. Designers are constantly finding new ways to incorporate the advantages of anodized aluminum profiles into their new products.

Anodic Coatings

Type of Finish	Designation ¹	Description	Examples of Methods of Finishing ²
General	A10	Unspecified	
	A11	Preparation for other applied coatings	3 μ (0.1 mil) anodic coating produced in 15% H ₂ SO ₄ at 21°C \pm 1°C (70°F \pm 2°F) at 129 A/m ² (12 A/ft ²) for 7 min. or equivalent
	A12	Chromic acid anodic coatings	To be specified
	A13	Hard, wear and abrasion resistant coatings	To be specified
	A1X	Other	To be specified
Protective & Decorative Coatings less than 10 μ (0.4 mil) thick	A21	Clear coating	Coating thickness to be specified. 15% H ₂ SO ₄ used at 21°C \pm 1°C (70°F \pm 2°F) at 129 A/m ² (12 A/ft ²)
	A211	Clear coating	Coating thickness – 3 μ (0.1 mil) minimum. Coating weight – 6.2 g/m ² (4 mg/in ²) minimum.
	A212	Clear coating	Coating thickness – 5 μ (0.2 mil) minimum. Coating weight – 12.4 g/m ² (8 mg/in ²) minimum.
	A213	Clear coating	Coating thickness – 8 μ (0.3 mil) minimum. Coating weight – 18.6 g/m ² (12 mg/in ²) min.
	A22	Coating with integral color	Coating thickness to be specified. Color dependent on alloy and process methods.
	A221	Coating with integral color	Coating thickness – 3 μ (0.1 mil) minimum. Coating weight – 6.2 g/m ² (4 mg/in ²) minimum.
	A222	Coating with integral color	Coating thickness – 5 μ (0.2 mil) minimum. Coating weight – 12.4 g/m ² (8 mg/in ²) minimum.
	A223	Coating with integral color	Coating thickness – 8 μ (0.3 mil) minimum. Coating weight – 18.6 g/m ² (12 mg/in ²) min.
	A23	Coating with impregnated color	Coating thickness to be specified. 15% H ₂ SO ₄ used at 27°C \pm 1°C (80°F \pm 2°F) at 129 A/m ² (12 A/ft ²) followed by dyeing with organic or inorganic colors.
	A231	Coating with impregnated color	Coating thickness – 3 μ (0.1 mil) minimum. Coating weight – 6.2 g/m ² (4 mg/in ²) minimum.
	A232	Coating with impregnated color	Coating thickness – 5 μ (0.2 mil) minimum. Coating weight – 12.4 g/m ² (8 mg/in ²) minimum.
	A233	Coating with impregnated color	Coating thickness – 8 μ (0.3 mil) minimum. Coating weight – 18.6 g/m ² (12 mg/in ²) min.
	A24	Coating with electrolytically deposited colors	Coating thickness to be specified. Application of the anodic coating, followed by electrolytic deposition of inorganic pigment in the coating.
	A2X	Other	To be specified.
	Architectural Class II ³ 10 to 18 μ (0.4 to 0.7 mil) coating	A31	Clear coating
A32		Coating with integral color	Color dependent on alloy and anodic process.
A33		Coating with impregnated color	15% H ₂ SO ₄ used at 21°C \pm 1°C (70°F \pm 2°F) at 129 A/m ² (12 A/ft ²) for 30 min. followed by dyeing with organic or inorganic colors.
A34		Coating with electrolytically deposited color	Application of the anodic coating followed by electrolytic deposition of inorganic pigment in the coating.
A3X		Other	To be specified.
Architectural Class I ³ 18 μ (0.7 mil) and thicker coatings	A41	Clear coating	15% H ₂ SO ₄ used at 21°C \pm 1°C (70°F \pm 2°F) at 129 A/m ² (12 A/ft ²) for 60 min. or equivalent.
	A42	Coating with integral color	Color dependent on alloy and anodic process.
	A43	Coating with impregnated color	15% H ₂ SO ₄ used at 21°C \pm 1°C (70°F \pm 2°F) at 129 A/m ² (12 A/ft ²) for 60 min. followed by dyeing with organic or inorganic colors or equivalent.
	A44	Coating with electrolytically deposited color	Application of the anodic coating followed by electrolytic deposition of inorganic pigment in the coating.
	A4X	Other	To be specified.

1. The complete designation must be preceded by AA – signifying Aluminum Association.
2. Examples of methods of finishing are intended for illustrative purposes only.
3. Aluminum Association Standards for Anodized Architectural Aluminum.
4. One mil equals one one-thousandth of one inch.

Alcoa Designations*	
ALCOA DESIGNATION	FILM THICKNESS ⁴
Alumilite 200	minimum .15 mils
Alumilite 201	minimum .2 mils
Alumilite 202	minimum .3 mils
Alumilite 203	minimum .36 mils
Alumilite 204	minimum .4 mils
Alumilite 214	minimum .6 mils

*Originated by Aluminum Company of America

Aluminum Alloy Reference For Anodizing

Series (AA)*	Alloying Constituent	Metal Properties	Coating Properties	Uses	A.Q.** Types	Non-A.Q.** Types	Finishing Advice
1XXX	None	soft conductive	clear bright	cans architectural	none	1100 1175	Care should be taken when racking this soft material. Good for bright coatings. Susceptible to etch staining.
2XXX	Copper	very strong hard low elongation	yellow poor protection	aircraft mechanical	none	2011 2017 2219 2224	Since copper content is >2%, these produce yellow, poor weather-resistant coatings. Don't mix with other alloys on load.
3XXX	Manganese	strong small grain	grayish-brown	cans architectural lighting	none	3003 3004	Difficult to match sheet-to-sheet (varying degrees of gray/brown). Used extensively for architectural painted products.
4XXX	Silicon	strong fluid	dark gray	architectural lighting	none	4043 4343	Produces heavy black smut which is hard to remove. 4043 & 4343 used for architectural dark gray finishes in past years.
5XXX	Magnesium	strong ductile fluid	clear good protection	architectural welding wire lighting	5005 5657	5052 5252	For 5005 - keep silicon <0.1% and magnesium between 0.7% and 0.9%, maximum of ±20% for job. Watch for oxide streaks.
6XXX	Magnesium and Silicon	strong ductile	clear good protection	architectural structural	6063 6463	6061 6161	Matte - iron > 0.2% Bright - iron < 0.1% 6063 best match for 5005. 6463 best for chemical brightening.
7XXX	Zinc	very strong	clear good protection	automotive	none	7029 7046 7075	Zinc over 5% will produce brown-tinted coatings. Watch zinc in effluent stream. Good for bright coatings.

*AA - Aluminum Association

**A.Q. - Anodizing Quality - material suitable for architectural anodizing applications

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For More Information

The Aluminum Extruders Council is the association of the world's leading manufacturers of aluminum shapes - THE SHAPEMAKERS, including virtually all North American Aluminum Extruders and many other members worldwide, representing nearly 200 extrusion plants and more than 500 extrusion presses.

THE SHAPEMAKERS are dedicated to manufacturing and supplying only the highest quality products. They work closely with their customers to help reduce overall costs through engineering

assistance, design recommendations and, in most cases, fabricating, finishing or other value-added services.

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