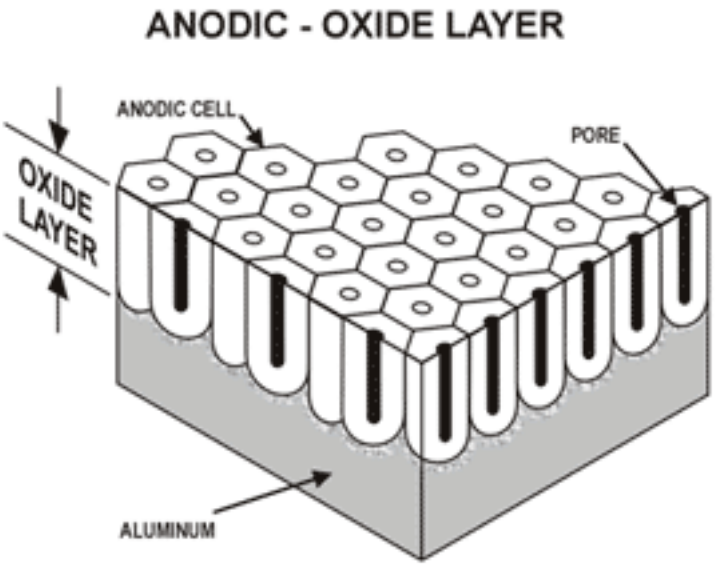
Anodizing Reference Guide



Type	Thickness
Type II	
Conventional coatings produced from sulfuric acid bath	1.8μ-25.4μ
Type I A Conventional coatings produced from chromic acid bath	0.5μ-7.6μ (microns)
Type I B	
Low voltage chromic acid anodizing (20 volts) Used for 7000 series alloys	0.5μ-7.6μ
Type III	
Hard coat (uniform anodic coatings)	12.7μ-115μ

- **Class 1**
  - Non dyed
- **Class 2**
  - Dyed

Information courtesy of Aluminum Anodizers Council

For more information, go to www.midstal.com or call 920.922.7207.

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Test Methods For Type II Anodized Aluminum

Oxide Coating Thickness

ASTM B 244-79 ASTM B 487-85	*Min Thickness*
Class I	18 Microns (μ)
Class II	10 Microns

Oxide Coating Weight and Apparent Density

ASTM B 137-89	*Min Weight*	*Min Density*
Class I	4.18 mg/cm^2	2.32 g/cm^3
Class II	2.40 mg/cm^2	2.32 g/cm^3

(Adopted from AMAA 611)

Corrosion Resistance

ASTM B 117-90	*Min Hours*	*Max Spots*
Class I	3000	15
Class II	1000	15

Seal Quality

ASTM B 136-77 ASTM B 680-80 ISO 3210	*Max Weight Loss*
Class I	40 mg/dm^2
Class II	40 mg/dm^2

Aluminum Alloy Reference for Anodizing

Series (AA)*	***Alloying Constituants***	***Metal Properties***	***Coating Properties***	***Uses***	***A.Q.*** Types***	***Non-A.Q.*** Types***
1000	None	soft, conductive	clear, bright	cans architectural	none	1100, 1175
Finishing advice: Care should be taken when racking this soft material; good for bright coatings; susceptible to etch staining						
2000	Copper	very strong, hard, low elongation	yellow, poor protection	aircraft mechanical	none	2011, 2017 2219, 2224
Finishing advice: Since copper content is > 2%, these produce yellow, poor weather-resistant coatings; don't mix with other alloys on load						
3000	Manganese	strong, small grains	grayish-brown	cans, architectural lighting	none	3003, 3004
Finishing advice: Difficult to match sheet-to-sheet (varying degrees of gray/brown); used extensively for lighting						
4000	Silicon	strong, fluid	dark gray	architectural, welding, wire	none	4043, 4343
Finishing advice: Produce heavy black smut which is hard to remove; 4043 & 4543 used for architectural dark gray finishes in past years						

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(Aluminum Alloy Reference for Anodizing continued)

Series (AA)*	Alloying Constituants	Metal Properties	Coating Properties	Uses	A.Q.** Types	Non-A.Q.** Types
5000	Magnesium	strong, ductile, fluid	clear, good protection	architectural, welding, wire, lighting	5005, 5657	5052, 5252
Finishing advice: For 5005 – keep silicon < 0.1% and magnesium between 0.7% and 0.9%; watch for oxide streaks; 5005 used extensively for architectural						
6000	Magnesium & Silicon	strong, ductile	clear, good protection	architectural, structural	6063, 6463	6061, 6101
Finishing advice: Matte-iron > 0.2%; bright-iron < 0.1%; 6063 best match for 5005; 6463 best for chemical brightening						
7000	Zinc	very strong	clear, good protection	automotive	none	7029, 7046, 7075
Finishing advice: Zinc over 5% will produce brown tinted coating; watch zinc in effluent stream; good for bright coatings						

** AA - Aluminum Association*

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

TYPE I "Chromic Acid"

Color will vary from clear to dark gray depending on alloy. Copper bearing alloys only yield gray colors. Not as readily dyed as sulfuric anodize due to thinness of coating.

New salt spray requirement is 336 hours
(5% solution per method 811 or FED-STD-No. 151)

Type I Chromic acid anodized coating. This process is used principally for the treatment of aircraft parts. An example is the Bengough-Stewart process where a 30-50 g/l chromic acid bath is maintained at 100°F and the voltage is gradually raised to 50V. Adjustments are made for high copper, zinc, and silicon alloys. Coating weights must be greater than 200 mg/ft^2. Criteria for corrosion resistance, paint adhesion, and paint adhesion testing must be specified.

Type IB Low voltage (22)2V) chromic acid anodized coating. Typically associated with higher temperature, more concentrated chromic acid electrolytes. Coating weights must be greater than 200 mg/ft^2. Criteria for corrosion resistance, paint adhesion, and paint adhesion testing must be specified.

Type IC Anodized coating produced in a non-chromic acid electrolyte. As with other Type I coating processes, the treatment is designed to impart corrosion resistance, paint adhesion, and/or fatigue resistance to an aluminum part. Coating weights must fall between 200-700 mg/ft^2. Criteria for corrosion resistance, paint adhesion, and paint adhesion testing must be specified.

TYPE II “Sulfuric Acid”

MECHANICAL FINISHING	A.A.	COMMON	DESCRIPTION	EXAMPLES OF FINISHING METHODS
As fabricated	M-10		Unspecified	
	M-12		Nonspecular as fabricated	No particular reflectiveness
Buffed	M-21		Smooth specular	Polished first with coarser than 320 grit, followed by 320 grit, then buffed with Alum oxide
	M-22		Specular	Buffed with Alum oxide compound
Directional textured	M-31		Fine satin	Sanded with 320-400 grit Alum oxide
	M-32		Medium satin	Sanded with 180-220 grit Alum oxide
	M-33		Coarse satin	Sanded with 80-100 grit Alum oxide
	M-35		Brushed	Brushed with stainless steel wire brush
CHEMICAL FINISHING				
Nonetched Cleaning	C-11		Degreased	Organic solvent treated
	C-12		Inhibited chemical cleaned	Soap cleaner only
Etched	C-22	R-1	Medium matte	Sodium hydroxide (caustic soda) 30-45 gr/li @ 60-65˚C for 5 min
Brightened	C-31	R-5	Highly specular	Chemical bright dip solution of the proprietary phosphoric-nitric acid type, or electropolishing
	C-32		Diffuse bright	Etched finish C-22 followed by Brightened finish C-31
ANODIC COATING				
General	A-11		Prep for other applied coatings	15% Sulfuric acid @ 20˚C, 12 amps/sq ft. for 10 min. sometimes not sealed
Decorative	A-21		Clear coating 2.5μ-7.5μ	15% Sulfuric acid @ 20˚C, 12 amps/sq ft.
Less than 10μ	A-211	200	Clear coating min. 2.5μ	15% Sulfuric acid @ 20˚C, 12 amps/sq ft. for 10 min.
	A-212	201	Clear coating min. 5μ	15% Sulfuric acid @ 20˚C, 12 amps/sq ft. for 15 min.
	A-213	202	Clear coating min. 7.5μ mil	15% Sulfuric acid @ 20˚C, 12 amps/sq ft. for 20 min.
	A-23		Coating with impregnated color	15% Sulfuric acid @ 20˚C, 12 amps/sq ft., followed by dyeing with organic or inorganic colors
	A-24		Coating electrolytically	15% Sulfuric acid @ 20˚C, 12 amps/sq ft. , deposited color followed by deposition of inorganic metallic salts

(TYPE II "Sulfuric Acid" continued)

Architectural Class 2	A-31	204	Clear coating	15% Sulfuric acid @ 20˚C, 12 amps/sq ft.
10μ-18μ	A-33		Coating with impregnated color	15% Sulfuric acid @ 20˚C, 12 amps/sq ft. for 30 min., followed by dyeing with organic or inorganic colors.
	A-34		Coating electrolytically	15% Sulfuric acid @ 20˚C, 12 amps/sq ft. deposited color for 30 min., followed by deposition of inorganic metallic salts.
Architectural Class 1	A-41	215	Clear coating	15% Sulfuric acid @ 20˚C, 12 amps/sq ft.
18μ and more	A-43		Coating with impregnated color	15% Sulfuric acid @ 20˚C, 12 amps/sq ft. for 60 min., followed by dyeing with organic or inorganic colors.
	A-44		Coating electrolytically	15% Sulfuric acid @ 20˚C, 12 amps/sq ft. deposited color for 60 min., followed by deposition of inorganic metallic salts.

Data derived from "Designation System for Aluminum Finishes" (DAF45), published by The Aluminum Association.

TYPE III "Hard Coating"

Color will vary from light tan to black depending on alloy and thickness. Color overtones listed below may vary with the use of additives and/or the process. Can be dyed in darker colors depending on thickness. Coating PENETRATES base metal as much as builds up on the surface. The term THICKNESS includes both the buildup and penetration. Provides very hard ceramic type coating. Abrasion resistance will vary with alloy and thickness of coating. Good dielectric properties. Corrosion resistance is good, but recommend sealing in 5% dichromate solution where increased corrosion resistance is required. Where extreme abrasion resistance is required do not seal as some softening is encountered.

Type III Anodize Thickness Guide

Alloy	***Major Constituent (in)***	***Maximum Thickness****	***Color Overtones*****
1100	99.5% pure Alum.	.003	Gray/Green**
2011	Copper	Not recommended	Not recommended
2014	Copper	.001	Bronze
2017	Copper	.001	Bronze
2024	Copper	.0015	Bronze
3003	Manganese	.002	Gray
4032	Silicon	.0012	Gray
5005	Magnesium	.0035	Gray/Brown
5052	Magnesium	.0035	Gray/Brown
5083	Magnesium	.0035	Gray/Brown
6061	Mag/Silicon	.003	Dark Gray
6063	Mag/Silicon	.004	Green
6105	Mag/Silicon	.0035	Gray/Green

(TYPE III “Hard Coating” continued)

Alloy	*Major Constituent (in)*	*Maximum Thickness**	*Color Overtones****
6262	Mag/Silicon	.0025	Gray
6463	Mag/Silicon	.003	Gray
7075	Zinc	.004	Bronze
355	Silicon	.0035	Gray
356	Silicon	.0035	Gray
357	Silicon	.0035	Gray
360	Silicon	.0005	Gray
380	Silicon	.0005	Gray
319	Silicon	.0025	Light Gray
MIC-6	Silicon	.0035	Dark Gray

50% penetration and 50% buildup per surface

** Generally Accepted*
*** Over .0025˝ Thick*
**** May vary*

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