Anodizing (Guidelines for direct current method)

Mainly guideline values, list is only a recommendation, which is not binding. We also recommend preparing test samples before final application.

Processing steps	G.AL® C210R, G.AL® C210 DYNAMIC, G.AL® C250, G.AL® C250 ELOX^{PLUS}, G.AL® C330R, G.AL® C330, G.AL® C330 DYNAMIC		Rolled / Forged Plates
Degreasing	**Best in hot steam. Dip-degreasing in alkaline cleaner:Concentration max 6% Duration in degreasing bath:max. 5 minutes Temperature: 70 – 80°C**		Dip-degreasing in alkaline cleaner:Concentration approx. 40%, Duration in degreasing bath: 5 – 15 minutes Temperature: 70 – 90°C
Etching (alkaline Al-etchant)	**None only in exceptional cases: alkaline Al-etchant Duration max. 10 - 12 sec. Temperature: 60 – 70°C**		Always alkaline Al-etchant Duration: 30 – 120 sec.Temperature: 60 – 90°C
Rinsing	**two-stage rinsing**		two-stage rinsing
Pickling	**in a solution of:** **- 15% $NaHSO_4$** **- 12% H_2SO_4** **Duration: 20 – 30 secondsTemperature: 15 – 20°C**		AlCu - Alloys: 50% HNO_3 – solution, Duration 6 - 20 seconds Temperature 15 – 25°C AlSi - Alloys: 2,5% HF(hydrofluoric)–solution Duration 6 - 20 seconds Temperature 15 – 25°C AlCuSi - Alloys: 50% HNO_3–solution, + 2,5% HF Duration 6 - 20 seconds Temperature 15 – 25°C
Rinsing	**two-stage rinsing**		two-stage rinsing
Electrolytic Oxidation	**Acid Sulphur**	**200 – 220 g/l**	250 – 280 g/l
	Aluminium sulphate	**2 – 8 g/l**	10 – 25 g/l
	Temperature	**15 – 18 °C**	18 – 20 °C
	Voltage	**11 - 14 V**	14 - 20 V
	Current density	**1,5 A /dm²**	1,5 A/dm²
	Layer build-up	**~ 1 µm/min**	2 – 3 µm/min
	pH – value	**<1**	<1
	Electrolyte stirring	**oil-free compressed air**	oil-free compressed air
Rinsing	**two-stage rinsing**		two-stage rinsing

Processing steps	G.AL® C210R, G.AL® C210 DYNAMIC, G.AL® C250, G.AL® C250 ELOX^{PLUS}, G.AL® C330R, G.AL® C330, G.AL® C330 DYNAMIC		Rolled / Forged Plates
Dipping H_2SO_4 removed totallyout of the pores	**25% HNO_3 – solution, Duration: 6 – 20 secondsTemperature: 15 - 25°C**		25% HNO_3 – solution, Duration: 6 – 20 secondsTemperature: 15 – 25°C
Dip-Dying (coloring) (adsorptive dying)	**Temperature: 55 – 85 °C Duration: 20 – 25 minutes**		Temperature: 55 – 85 °C Duration: 15 – 30 minutes
Electrolytic Dying	**Voltage (alternating current)**	**14 V**	14 V
	Current density	**0,5 A/dm²**	0,5 A/dm²
	pH – value	**1,5**	1,5
	Temperature	**18 – 22° C**	18 – 22° C
	Duration	**6 – 15 minutes**	3 – 15 minutes
Rinsing	**two-stage rinsing**		two-stage rinsing
Repressing	**in repressing solution: Temp.: 90 – 100° C Timing: 3 minutes/1µm layer thickness in hot water: only with de-ionized waterTemp.: 90 – 100° C Timing: 3 minutes/1µm layer thickness**		in repressing solution:Temp.: 90 – 100° C Timing: 3 minutes/1µm layerthickness in hot water: preferable with de-ionized waterTemp.: 90 – 100° C Timing: 3 minutes/1µm layerthickness
Rinsing only when used repressing solution	**two-stage rinsing**		two-stage rinsing
Rinsing only when used repressing solution	**one-stage rinsing, only with de-ionized water**		one-stage rinsing, preferable with de-ionized water
Drying	**Stream of hot air**		Stream of hot air

Basic information

Materials of different alloys are not allowed to be used in the same bath.

Optical demands

Basically, the surface of the anodic oxide layer is closely related to the one of the material before anodizing, which means the roughness of the gained surface mainly depends on the roughness of the basic material.
High optical qualities can only be obtained with special rolled products, so called anodizing qualities [EQ]. Standard rolled qualities will show reasonable good results. Cast plates will show slightly worse results compared to rolled plates – as far as optical demands are focused. For both, rolled and cast products, good technical qualities can be obtained.

Good optical results are often required in applications with matt surfaces. These good results can be reached by applying the following processing steps.

The following list shows results in/for optical demands ranging from
(1) very good to (6) inapplicable

- Glass bead blasting, etching (rolled material), electric-chemical polishing, pre-anodizing, de- coating, anodizing **(1)**
- Glass bead blasting, etching (rolled material), pre-anodizing, de-coating, anodizing **(2)**
- Glass bead blasting, etching (rolled material), electric-chemical polishing, anodizing **(3)**
- Etching (rolled material), electric-chemical polishing, pre-anodizing, de-coating, anodizing **(4)**
- Glass bead blasting, etching (rolled material), anodizing **(5)**

Especially on surfaces, which had been tarnished by blasting previously, the pre-anodizing is important. During the blasting process, the surface will be "damaged" to a certain extent. The additional pre-anodizing and the following de-coating, "repairs" the surface and result in a smooth and even structure. The best surface quality is gained by applying the electric-chemical polishing process.

Durability

Anodized aluminium is resistant to neutral chemical substances (pH 5-8).
The anodic generated layer is very resistant and stays stable even in an acid or light alkaline environment on short-term use in case that the layer thickness is sufficient and the process has been well performed.
In outdoor weather, anodized aluminium shows good wear resistance if the cleaning process had been properly performed. (Alkaline cleaner will destroy the oxide layer in a long time run).

Coating thickness

The required thickness in anodized parts depends on its application and the chemical and mechanical strains of the application. The coating layer builds up 2/3 into the material and 1/3 on top of the material.

Suggested coating thickness according to application (empirical formula):

Indoor & dry	approx. 10 µm
Wet areas	approx. 20 µm
Mechanical stressed components	approx. 20 µm
Aggressive environment	approx. 25 µm

Note:
The inside of slots and drilling holes might show a thinner coating thickness than the surface of the plate.

Minimum instruction/information for the galvanization

Material	Alloy (e.g. AW 5754 or AlMg3)	
Degreasing	only in cast plates: "degreasing with superheated steam" or dip bath concentration max. 6%	
Contact points	e.g. in threats or clamps	
Pre-treatment	e.g. E0 = non etching	E6 = etching
Color	e.g. EV1 = natural	EV6 = black
Coating thickness	e.g. 15 µm	

Possible Pre-Treatments for Anodic Oxidation according to EURAS

(European Anodizing Association)

Code	Pre-treatment	Result
E 0	Anodizing withoutpre-treatment	Only degreasing and a very lightly etched. Any kind of surface irregularities will remain.
E 1	grinded and anodized	By grinding, the surface gets a smooth and directional structure. The rougher the abrasive grain, the more stump the appearance. Any irregularities at the surface will usually be removed. No surface polish ispossible.
E 2	brushed and anodized	By brushing, the surface gets an even and light structure. Scratches andstripes will be party removed.
E 3	polished and anodized	By polishing, the surface gets a smooth and almost shining surface. Scratches and stripes will hardly be removed but only smoothened.
E 4	grinded, brushed andanodized	By grinding and brushing, the surface gets a clean and evenly light structure. Average scratches and stripes will be totally removed (No surface grinding).
E 5	grinded, polished andanodized	The surface has a smooth, shining and almost stainless appearance. Anykind of surface irregularities will normally be removed.
E 6	chemical pre-treatment (coating) and anodized	Through the chemical pre-treatment in intensively etching baths, the surface gains a matt silvery and very even surface. Any kind of surfacedamages will show less intensive.

Color according to EURAS – standard colors			
	Dip-Dying		Electrolytic Coloring
Code	Color Shade	Code	Color Shade
EV1	natural	C0	colorless
EV2	new silver (light)	C31	light bronze
EV3	gold	C32	bright bronze
EV4	bronze middle	C33	middle bronze
EV5	bronze dark	C34	dark bronze
EV6	black	C35	black
		C36	light gray
		C37	medium gray
		C38	dark gray

Important for a good result:

Contacting:

During the anodizing process, a big attention has to be paid on solid contacts. Not sufficiently solid contact always leads to erroneous surfaces (blotchiness, fluctuating layer thickness, partial melting of the base material).

Different alloys:

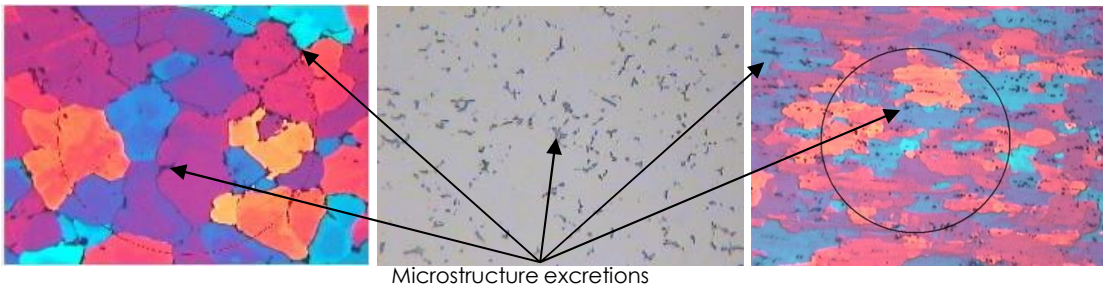
In principle, only components with the same / similar electrical conductivity can be anodized in one bath. Deviates the electrical conductivity between two components from each other about 15-20%, it may cause electrical discharges in the bath. Is a component hit from such a discharge; at this point, no anodic layer structure is possible. Especially after black anodizing, the material will show white dots.

Why should G.AL® - (cast) aluminum plates not be etched?

The raw material for aluminum rolling and casting plates are ingots of Al-alloys (e.g. EN AW 5083). Special features of each aluminum wrought alloy are chemical depositions at the grain boundaries of the structure, which are considerably less noble than the rest of the structure. A rolling ingot is reshaped (rolled), and these chemical depositions are comminuted and laminated into the structure.
With cast plates, these excretions are "free" to the grain structure. During the etching, these base components are strongly affected and removed. This creates a rough, unsightly and stained surface. It is often misunderstood but not true that etching of cast plates uncovers or opens pores.

Microstructure of Al-cast plates

Microstructure of Al-rolled plates



Microstructure excretions