Hard-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 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 seconds** **Temperature: 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**	**10 – 15 %**	10 – 20 %
	Aluminium sulphate	**2 – 8 g/l**	10 – 25 g/l
	Temperature	**-5 to +2° C**	-5 to +5° C
	Voltage	**60 – 65 V**	60 – 80 V
	Current density	**3 A /dm²**	2 – 6 A/dm²
	Layer build-up	**aprox. 1 µm/min**	aprox.. 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
Repressing	**in repressing solution:** **Temp.: 90 – 100° C** **Timing: 3 minutes/1µm layer thickness** **in hot water:** **only with de-ionized water Temp.: 90 – 100° C** **Timing: 3 minutes/1µm layer thickness**	in repressing solution: Temp.: 90 – 100° C Timing: 3 minutes/1µm layer thickness in hot water: preferable with de-ionized water Temp.: 90 – 100° C Timing: 3 minutes/1µm layer thickness
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.

Durability
Hard-anodized aluminium is resistant to neutral chemical substances (pH 5-8).
The hard-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 in case provided that 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 hard-anodized parts depends on its application and the chemical and mechanical strains of the application. The coating layer builds up 1/2 into the material and 1/2 on top of the material.
Recommended coating thickness according to application (empirical formula):

Indoor & dry	approx. 40 – 50 µm
Wet areas	approx. 50 – 60 µm
Mechanical stressed components	approx. 50 – 70 µm
Aggressive environment	approx. 60 – 100 µm

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

surfaceof the plate.

Roughness of the hard-anodized oxide layer

The roughness increases dramatically with Al alloys with a Cu content >2%.

Gliding abilities of the hard anodized layer

For improving the sliding property and corrosion resistance, the hard-anodized layer can be impregnated in a PTFE - bath. This operation takes place after dipping the components.

Construction feature

The columnar form of the hard-anodized layer can be the reason for chipped of parts on sharp edges of the component. Edges always have to be rounded otherwise parts will chip off and the correct function of the device cannot be guaranteed.
Rule of thumb:

Layer thickness	Radius
25 µm=	R 1.6 mm
50 µm=	R 2.4 mm
75 µm=	R 3.2 mm

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. etching
Colour	e.g. natural or black
Coating thickness	e.g. 50 µm

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.