Aluminum pretreatment

Cleaning and activation processes

General Metal Finishing

Cleaning Stripping Pretreatment

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Industry proven aluminum pretreatment

Aluminum alloys – composition and classification

Aluminum alloys can contain elements like zinc (7000), lithium (8000), magnesium (5000), manganese (3000), copper (2000), or silicon (4000) which may be present within the aluminum lattice, as microparticles, or as particles of intermetallic compounds generated when combined with aluminum. There are two main classifications of aluminum alloys; wrought and cast of which wrought is the most abundantly utilized.

Different metal properties require tailored pretreatment

Due to the wide variety of compositions and variations in metallurgy, microstructures, and surfaces, products formed from aluminum alloys can behave differently and do not respond uniformly to various chemical and electrochemical treatments thus constituting a challenge when preparing for subsequent plating or coating processes.

Preparing parts made from aluminum alloys requires several pretreatment steps to provide thorough cleaning to remove; oils, grease, smut, and oxides as well as to treat any surface modifications to create a uniform surface for the best quality of subsequent plating and coating layers.

Oxide formation and surface modification due to processing

Aluminum and aluminum alloys have one thing in common, they form an ever-present natural oxide film covering the surface, which can prevent proper adhesion of subsequent coatings. The oxide layer can vary in thickness and composition depending on the alloy type and processing conditions. Aluminum that has been through processes like rolling, grinding, and machining can have localized surface modifications that can affect the quality of subsequent coatings.



Typical contamination found on fabricated aluminum alloy parts

- Grinding/polishing compounds
- Metal fines
- Grease
- Machining fluids
- Lubricants
- Coolants
- Mold release agents
- Oxides
- Smut

Effects of poor pretreatment

The alloy type has a direct influence on the pretreatment sequence. The smut or residue formation caused by the alloying elements constitutes the main challenge occurring during pretreatment. When pretreatment is not performed correctly, the following issues can occur related to subsequent coating/plating layers:

- Poor bonding to base metal
- Peeling of deposit
- Poor corrosion resistance
- Contamination of coating or plating bath
- Roughness
- Blisters



Atotech pretreatment solutions for aluminum and its alloys

Atotech pretreatment technologies prepare a part for subsequent finishing operations like electroless and electrolytic plating and enhance the part's surface to ensure good adhesion and quality of the deposited metals.

There is always a demand for consistent, high deposit quality from the coating process at the lowest cost. Coating properties such as; excellent adhesion, corrosion resistance, and appearance are of critical importance. Our range of proven cleaners and pretreatment processes is designed to provide the best plating/coating quality for aluminum and aluminum alloys over a long operating time.

Soak cleaners

UniClean® 105

UniClean 105 is a highly concentrated liquid cleaner specially formulated to remove buffing compounds. Its unique blend of powerful surfactants and very mild builders allows it to be used on all conventional metal substrates, including aluminum, copper, copper alloys, steel, and zinc-based die cast. UniClean 105 exhibits excellent ultrasonic performance. Its non-phosphate, non-silicate, and non-boron formulation and the absence of harmful solvents make UniClean 105 a more sustainable product.

UniClean® 151

UniClean 151 is a mild alkaline hot soak cleaner for steel, non-ferrous metal, and aluminum, suitable for barrel and rack plating lines. The cleaner exhibits a high cleaning power and receptivity and can draw oil and pigmentation contaminations. UniClean 151 does not attack aluminum or aluminum alloys. The low-foaming cleaner is highly economical due to its recycling and oil decontamination capability and the ability to be operated at low temperatures.

UniClean® 154 (EU)

UniClean 154 (EU) is a medium alkaline soak cleaner applicable for heavy-duty cleaning of ferrous and non-ferrous metals, both in rack and barrel lines. The soak cleaner offers excellent cleaning capabilities for light milling oils, mineral oils, drawing compounds, and all soils, due to its oil penetrating and emulsifying properties. UniClean 154 (EU) requires low chemical concentrations in the cleaning bath providing economic advantages.

UniClean® 158 (EU)

The silicate-free, weakly alkaline, hydrophobic cleaner is ideally suited to aluminum substrates. It is especially designed to remove polishing paste residues and can also be combined with ultrasonic or hydroson support for better contamination removal.

UniClean® Soak BCR

UniClean Soak BCR is a highly concentrated liquid cleaner specially formulated to remove water-based buffing compounds. UniClean Soak BCR's unique blend of powerful surfactants and very mild builders allow its usage on all conventional metal substrates, including aluminum, copper, copper alloys, steel, and zinc. The cleaner exhibits excellent ultrasonic performance. Its non-phosphate and non-silicate formulation and the absence of harmful solvents make UniClean Soak BCR a more sustainable product.

Alkaline and acid etches

UniClean® 1020

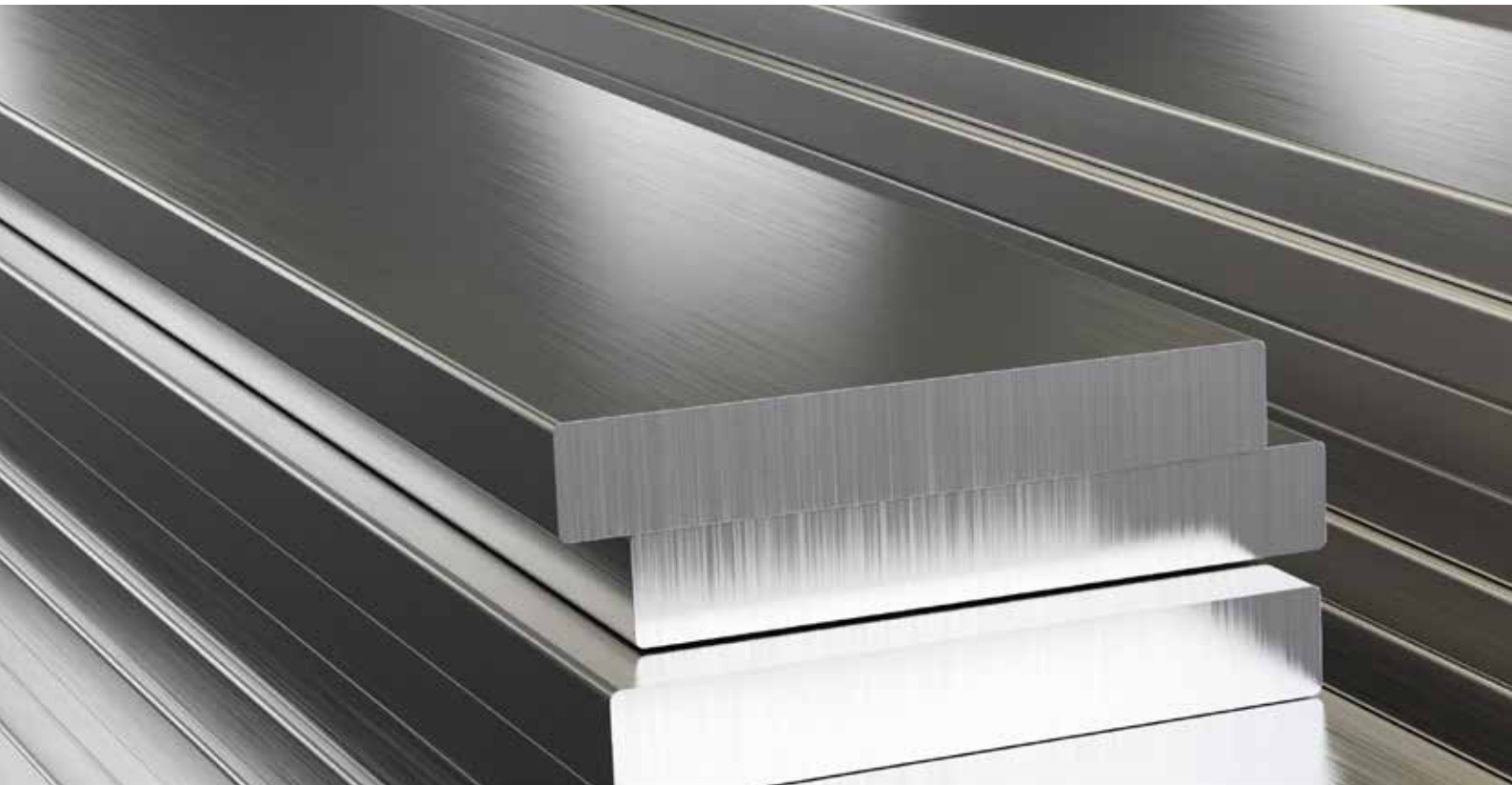
UniClean 1020 is a highly alkaline etchant for aluminum and its alloys. It contains a special sequestrant, which produces a highly specular etch giving a very decorative effect. It has an unusually high capacity for the prevention of oxide scale formation preserving equipment and reducing maintenance and costly cleanup of tanks or coils.

UniClean® 152

UniClean 152 is a high-performance cleaner used for soaking and electro-cleaning multiple types of metals. UniClean 152 can also be used for etching aluminum substrates. The cleaner is resistant to water hardness. It activates metal surfaces and has a deoxidizing effect. The highly economical cleaner forms a thin foam cover over the bath surface.

Alklean® AC-2

Alklean AC-2 is a versatile acid etchant process suitable for aluminum metal alloys. It replaces alkaline etching in many applications and functions as an adhesion promoter before plating on aluminum. Its mild etching action provides a uniform etch that is readily modified by adjusting the operating temperature and bath concentration.



Desmutters and de-oxidizers

Alumetch® LF

Alumetch LF combined with nitric acid acts as a conditioner for aluminum. The acidic, highly concentrated aqueous solution is formulated to deoxidize, desmut, and condition the surface of any aluminum alloy for subsequent processing. It exhibits an aggressive etch rate and acts as an adhesion promoter for subsequent coatings. Alumetch LF is suitable for various aluminum pretreatment applications such as plating, painting, rubber bonding, anodizing, passivation, and other decorative and functional applications. The conditioner is highly recommended for high silicon-containing alloys like A356 and ADC 12. Alumetch LF is also designed to reduce the amount of hazardous NOx fumes.

Desmutter NF2

Desmutter NF2 is a nitric acid-free desmutting process for aluminum and its alloys. Desmutter NF2 combined with sulfuric acid quickly dissolves undesirable smut and is much less aggressive on aluminum substrates than nitric acid-based processes. Due to its mild action, Desmutter NF2 reduces the opening of pores and pitting compared to conventional technologies. Desmutter NF2 was specially designed to achieve the best possible surface conditioning when used with non-cyanide zincates.

There is a wide range of desmut/de-oxidizer processes available, including Alum-Etch® NN, Alum-Etch® S, Alum-Etch® G, Alum-Etch® A, tailored to different aluminum alloys and requirements.



Zincate processes

Alumseal® 650

Alumseal 650 is a cyanide-free zincate process for aluminum. The concentrated liquid single-additive process diluted in water forms a well-operating zincate solution used before the plating of aluminum. Alumseal 650 deposits a highly uniform, immersion zinc coating onto a wide variety of aluminum alloy surfaces preventing the formation of an oxide film and promoting an excellent adhesion of subsequent metal deposits. The Alumseal 650 immersion zinc deposit can also be plated with copper, nickel, or other metal deposits.

Alumseal® 611

The cyanide-free zincate process has the same characteristics as Alumseal 611 and has been designed to be thinner and less contaminating to electroless nickel plating baths.

Alumseal® NCY

Alumseal NCY is a cyanide-free, multi-metal, zincate process for use with a wide variety of aluminum alloys. Alumseal NCY deposits a highly uniform, immersion zinc coating onto the aluminum surface preventing the formation of an oxide film.

Alumseal® W2000

Alumseal W2000 is a cyanide-containing, alkaline zincate etch for aluminum and its alloys. It is used before electrolytic or electroless plating. The highly stable immersion process produces adhesive deposits even on challenging aluminum that can be directly plated with copper, nickel, tin, or other deposits.

Zincate stripping process

Alumseal® Activator BD

Alumseal Activator BD is a highly stable solution for stripping zincate from aluminum. It is used to strip the initial zincate layer in pretreatment sequences where double zincating is applied. It has a long life activity and is ammonia, chloride, fluoride, and nitrate-free for better sustainability. Alumseal Activator BD is used as an alternative to nitric acid.

Pretreatment sequences

Wrought aluminum – 2024, 5000, 6061

Category no.	Major alloyed metal	Properties
2000	Copper	Strength, machinability
5000	Magnesium	Hardness, corrosion resistance
6000	Magnesium, silicon	Extrudable, post finishing

Sequence	Products	Time	Temperature
1. Soak clean	UniClean® 151	1 – 5 min	70 °C
2. Rinse			
3. Etch (alkaline) or etch (acid)	UniClean® 1020, UniClean® 152, Alklean® AC-2	0.5 min	40 – 45 °C ambient
4. Rinse 5. Rinse			
6. Desmut	Alumetch® LF, Desmutter NF2	1 min	ambient
7. Rinse 8. Rinse			
9. Zincate I	Alumseal® 650 / 611 / NCY, Alumseal® W2000	1 min 1 – 2 min	ambient
10. Rinse			
11. Zincate strip	Alumseal® Activator BD	1 – 2 min	ambient
12. Rinse			
13. Zincate 2	Alumseal® 650 / 611 / NCY, Alumseal® W2000	15 – 30 sec	ambient
14. Rinse			
15. Strike	e.g., Watts Nickel	2 – 3 min	per TDS
16. Rinse			

Sand and die cast – Si containing, not polished

Sequence	Products	Time	Temperature
1. Soak clean	UniClean® 151, UniClean® 154 (EU)	5 min	50 °C
2. Rinse			ambient
3. Etch (alkaline) or etch (acid)	UniClean® 1020, UniClean® 152, Alklean® AC-2	0.5 – 1 min	40 – 45 °C ambient
4. Rinse			
5. Desmut	Alumetch® LF	1 – 2 min	ambient
6. Rinse			
7. Zincate I	Alumseal® 650 / 611 / NCY, Alumseal® W2000	1 min	ambient
8. Rinse			
9. Zincate strip	Alumseal® Activator BD	1 – 2 min	ambient
10. Rinse			
11. Zincate II	Alumseal® 650 / 611 / NCY, Alumseal® W2000	30 sec	ambient
12. Rinse			
13. Strike	e.g., Watts Nickel / electroless nickel	2 – 3 min	per TDS
14. Rinse			

Sand and die cast – Si containing, polished

Sequence	Products	Time	Temperature
1. Soak clean (Polishing compound remover)	UniClean® 105, UniClean® Soak BCR, UniClean® 158 (EU)	5 – 10 min	80 – 95 °C
2. Rinse			
3. Secondary soak clean	UniClean® 105, UniClean® 151, UniClean® 154 (EU)		50 – 60 °C
4. Rinse			
5. Etch (alkaline) or etch (acid)	UniClean® 1020, UniClean® 152, Alklean® AC-2	1 – 2 min	40 – 45 °C, ambient
6. Rinse			
7. Desmut	Alumetch® LF	1 – 2 min	ambient
8. Rinse			
9. Zincate I	AlumSeal® 650 / 611 / NCY, AlumSeal® W2000	1.5 – 2 min	ambient
10. Rinse			
11. Zincate strip	AlumSeal® Activator BD	1 min	ambient
12. Rinse			
13. Zincate II	AlumSeal® 650 / 611 / NCY, AlumSeal® W2000	1 min	ambient
14. Rinse			
15. Strike	e.g., Watts Nickel / electroless nickel	2 – 3 min	per TDS

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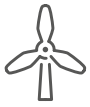

Energy

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