

AURUNA® 313

Strongly acidic gold-iron electrolyte for direct gold plating of stainless steel

- Good activating effect - without halogenides
- Low-pore coatings, providing corrosion protection
- For decorative and technical applications
- Suitable for rack and barrel plating

Electrolyte characteristics

The strongly acidic gold electrolyte AURUNA® 313 is used for the adhesive direct gold plating of stainless steels. It is particularly suitable for chromium-nickel steels, molybdenum-containing steels and nickel-based alloys that are difficult to activate. Due to its activating effect, it can also be used successfully in many cases for other passive materials that are difficult to plate. If necessary, activation must be supported by special pre-treatment steps. Base metal intermediate layers and a diminished corrosion resistance can be avoided by using AURUNA® 313. The electrolyte does not contain chloride or fluoride. AURUNA® 313 is suitable for decorative or technical applications, has a large operating range and is suitable for operation in racks and barrels.

Precautionary measures/safety instructions

Attention

No potassium gold(I) cyanide may be used for the make-up and replenishment of the electrolyte, only AURUNA® Gold Solution CAP 50 or CAP 100! If the usual potassium gold(I) cyanide is used, the development of highly toxic prussic acid fumes must be expected in addition to the destruction of the electrolyte!

AURUNA® 313 must not be mixed or brought into contact with other types of gold electrolyte based on $\text{KAu}(\text{CN})_2$ or with cyanide-containing substances or solutions, as the very toxic hydrocyanic acid (HCN) is also formed here!

Observe precautionary measures for handling cyanide electrolytes!

Observe precautionary measures for handling strong acids!

For further safety information, please refer to the relevant safety data sheets.

Operating conditions

Electrolyte type	Strongly acidic
Gold content	2 g/l (1 - 3 g/l)
Iron content	0.5 g/l (0.3 - 1 g/l)
pH value	0.9 (0.8 - 1)
Temperature	Room temperature up to max. 30 °C
Electrolyte density	1.04 g/cm ³ , increasing
Current density	4 A/dm ² (0.5 - 8 A/dm ²)
Deposition speed	Approx. 0.07 µm/min at 4 A/dm ²
Deposition rate	Approx. 3.4 mg/Amin at 4 Amin/dm ²
Electrolytic and product agitation	Movement of fabric and electrolytic material depends on the type of system. The recommended speed for racks is 2 - 8 cm/s. Continuous filtration of the electrolyte is recommended.

Coating characteristics

The coatings made from AURUNA® 313 are crack-free, ductile and low in pores. They can be brightly deposited up to a coating thickness of 0.5 µm. The deposition speed is sufficient to economically deposit the desired coating thickness directly from the electrolytic AURUNA® 313 in many cases. The coatings retain their gloss.

Coating	Gold-iron
Alloy	99.5 % Au; 0.5 % Fe
Hardness	Approx. 165 HV
Maximum coating thickness	0.5 µm
Coating density	Approx. 19 g/cm ²
Colour	Deep yellow

Form of supply

Electrolyte makeup

AURUNA® 313 Initial Concentrate	100 ml for 1 litre of electrolyte
AURUNA® Gold Solution CAP 50	Contains 50 g gold per litre 40 ml for 1 litre of electrolyte with 2 g/l Au
alternatively AURUNA® Gold Solution CAP 100	Contains 100 g gold per litre 20 ml for 1 litre of electrolyte with 2 g/l Au
AURUNA® Density Correction Salt 9	15 g for 1 litre of electrolyte

Electrolyte replenishment

AURUNA® 313 Replenishment Solutions	5 ml per 1 g gold, gold-free
AURUNA® Gold Solution CAP 50	Contains 50 g gold per litre 20 ml for 1 g Au
alternatively AURUNA® Gold Solution CAP 100	Contains 100 g gold per litre 10 ml for 1 g Au

Electrolyte corrections

AURUNA® 313 Acid Concentrate	To lower the pH value
AURUNA® 313 Iron Correction Solution	To increase the iron content
AURUNA® Wetting Agent 16	2 - 4 ml/l for wetting problems, e.g. pores
AURUNA® Density Correction Salt 9	20 g/l for a rise of the density of 0,01 g/cm ³

Electrolyte makeup

Makeup sequence

To prepare 1 litre of AURUNA® 313, first dissolve 15 g of AURUNA® Density Correction Salt 9 in approx. 800 ml of deionized water, then add 100 ml of AURUNA® 313 Initial Concentrate. Then add 40 ml AURUNA® Gold Solution CAP 50 or 20 ml AURUNA® Gold Solution CAP 100 (for 2 g/l gold) and fill up to 1000 ml.

Due to insufficient solubility of the gold complex, a gold-containing sediment is found in the AURUNA® Gold Solution CAP 100. This must first be shaken up and then brought into solution by heating the solution (preferably in a water electrolyte).

Calculation of coating thickness and plating time

Coating weight [mg] = $\frac{\text{Surface area [cm}^2\text{]} \times 1.9 \times \text{coating thickness [\mu m]}}{\text{Exposure time [min]}}$

Exposure time [min] = $\frac{\text{Required coating weight [mg]}}{3.4 \text{ [mg/Amin]} \times \text{current [A]}}$

Electrolyte replenishment, monitoring and correction

Electrolyte replenishment

Replenishment should take place after 10 - 20 % gold removal (200 - 400 mg/l), as otherwise the deposition rate will decrease.

For the replenishment of 1 g Au, add to the electrolyte

- 5 ml AURUNA® 313 Replenishment Solution, and
- 20 ml AURUNA® Gold Solution CAP 50, or
- 10 ml AURUNA® Gold Solution CAP 100.

Dissolve the precipitate in AURUNA® Gold Solution CAP 100 beforehand by heating! (See "Electrolyte makeup".)

This replenishment applies to both gold deposition as well as drag-out losses.

The amount of gold deposited can be determined by weighing or by measuring the amount of current (Amin). As the deposition rate (mg/Amin) depends on the nature of the articles and the coating thickness, only approximate values can be obtained:

- approx. 3.4 mg/Amin at 2 g/l Au, room temperature and 4 A/dm²,

In the case of thin layers and highly profiled parts, a considerable amount of drag-out must be expected. This must be estimated or determined by occasional gold analysis of the electrolyte.

Rough estimate for drag-out:

- 50 - 150 ml/100 dm² part surface.

It is strongly recommended to monitor gold consumption by regular analyses of the gold content.

Monitoring and correction

The maximum working temperature of 30 °C must not be exceeded for a longer period of time, as the electrolyte is irreversibly damaged at higher temperatures. To achieve perfect adhesion, the pH value should be 0.9 (maximum 1). If possible, the measurement should be carried out electrometrically using a glass electrode. The pH value is lowered with AURUNA® 313 acid concentrate. If the pH value needs to be raised, this is done with KOH. The electrolyte density does not need to be monitored. It is within the prescribed range if the acid content is sufficient, i.e. if the pH value is correct.

Special process hints

Pretreatment for alloys that are difficult to activate

Pretreatment is particularly important for the adhesive gold plating of stainless steel. In addition to rinsing processes, pretreatment consists of degreasing and acidic dipping.

Degreasing

In many simple cases (low passivated steel), the usual **cathodic degreasing** is sufficient after pre-cleaning. Their effect can be considerably improved by adding 10 g/l KCN to the degreasing electrolyte and analytical control of the cyanide content, which should not fall below 8 g/l.

Recommended working values

- Electrolyte voltage: 4 - 7 volts
- Current density: 10 A/dm² (5 - 20)
- Degreasing time: 1 minute (0.5 - 2)
- Movement: advantageous
- Anodes: Pure nickel or stainless steel
- Temperature: Room temperature up to 40 °C

For materials that are particularly difficult to activate, a **short anodic degreasing** in the same electrolyte, but at **room temperature and only for approx. 20 seconds**, is highly recommended after the cathodic degreasing.

For particularly difficult cases, we are available with our technical application advice.

Acid dip

After cathodic and anodic degreasing, careful, preferably multi-stage rinsing and subsequent immersion of the goods in 5 - 10 % sulphuric acid by volume is required.

Recommended working values

- Concentration: 5 - 10 vol.-% H₂ SO₄
Control of drag-out losses analytically or via electrolyte density.
- Temperature: room temperature
- Duration: approx. 1 minute
- Movement: advantageous, especially for highly structured parts (e.g. bracelets)

After acid dip, rinse briefly in deionized water and then gold-plate in AURUNA® 313.

Posttreatment

- Recovery rinse
- Intensive rinse
- Further processing in any gold electrolyte.

Careful intermediate rinsing must be carried out to ensure that no free acid is carried over from the strongly acidic adhesive gold electrolyte AURUNA® 313 into a cyanide-containing electrolyte!

Wetting agent

If there are wetting problems, 2-4 ml/l AURUNA® Wetting Agent 16 can be added to the electrolyte. Caution: The wetting agent produce foam.

Equipment

Coating tank

Plastic tank made of acid-resistant and temperature-resistant (70°C) material. We recommend PP, PE or PTFE. PVC must not be used as a tank material, as the plasticizers contained in PVC are released over time and destroy the electrolyte.

For rack and barrel applications, we recommend tanks with overflow to remove any foam blanket.

Pumps

Magnetically coupled centrifugal pump made of acidic and temperature-resistant (70°C) plastic. PP, PE or PTFE is the recommended material. PVC must not be used.

Hoses, pipes

PP, PE or PTFE is recommended as the material for hoses and pipes. PVC must not be used.

Barrels

PP, PE or PTFE, no PVC.

Heating device

Immersion heaters with porcelain, quartz or Teflon coating. Equipment for temperature control.

Product agitation

Required. 2 - 8 cm/s recommended.

Anodes

Platinum or platinized titanium, platinized niobium and iridium mixed metal oxide (MMO) are permitted. We recommend PLATINODE® with a 2.5 µm Pt coating or PLATINODE® 177 (Ir-MMO). Ratio of anode area : product approx. 2 : 1.

Rectifier

Sufficiently resilient, with current display

Exhaust system

Absolutely necessary!

(Strongly acidic electrolyte mist entrained by hydrogen development. Allergenic effect possible!)

Filtration

Required. The electrolyte can be continuously filtered via activated carbon filter cartridges to remove organic contaminants without adsorbing essential electrolyte components.

Notes

Precautionary measures/safety instructions

For safety instructions, please refer to the relevant safety data sheets. The applicable accident prevention regulations and safety instructions must be observed.

Storage stability

Our information on storage stability refers to storage in sealed original containers under the conditions stated on the label.

Further documents

Replenishment documents and information on this product are available on request.

Other

All information about our products, systems and processes is based on extensive research work and experience in application technology. We provide this information verbally and in writing to the best of our knowledge; we do not assume any liability beyond the individual contract. We expressly reserve the right to make technical changes in the course of product development. In addition, our application engineering service is available on request for further advice and to assist in solving production and application engineering problems.

The purchaser or user of our products is obliged to check our specifications and recommendations as well as the suitability for a specific purpose on his own responsibility before using them. This also applies to the protection of third-party property rights and to applications and procedures not expressly specified by us in writing. In the event of damage, our liability shall be limited to compensation of the same scope. Our General Terms and Conditions of Sale and Delivery shall apply.

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