

RIAG Ni 112

Brightness preserving nickel process

The nickel process **RIAG Ni 112** is mainly used in technical applications. It is well-proven that barrel plating of parts for the electronic industry is successful. **RIAG Ni 112** produces nickel deposits with the following advantages:

Properties

- Brightness preserving
- Light, white deposits
- Excellent metal deposit thickness distribution
- Good ductility
- Uniform brightness in all current densities
- Ideal for technical nickel plating

Make up

	Rack		Barrel	
	Range	Optimum	Range	Optimum
Nickel sulphate (NiSO ₄ x 6 H ₂ O)	220 – 290 g/L	240 g/L	180 – 250 g/L	200 g/L
Nickel chloride (NiCl ₂ x 6 H ₂ O)	50 – 70 g/L	60 g/L	50 – 70 g/L	60 g/L
Boric acid (H ₃ BO ₃)	40 – 45 g/L	42 g/L	40 – 45 g/L	42 g/L
RIAG Ni 112 Brightener	10 – 18 mL/L	15 mL/L	10 – 18 mL/L	15 mL/L
RIAG Ni 138 Tenside M* / or RIAG Ni 139 Tenside L*	* 1 – 3 mL/L	* 2 mL/L	2 – 4 mL/L	3 mL/L
pH-value	3.8 – 4.5	4.2	3.8 – 4.5	4.2

* depends on mechanical - (M) or air (L) agitated electrolyte

The process is usually operated with one additive only.

Operating values

	Rack		Barrel	
	Range	Optimum	Range	Optimum
Nickel (Ni ²⁺)	60 – 85 g/L	70 g/L	50 – 75 g/L	60 g/L
Chloride (Cl ⁻)	15 – 21 g/L	18 g/L	15 – 21 g/L	18 g/L
Boric acid (H ₃ BO ₃)	40 – 45 g/L	42 g/L	40 – 45 g/L	42 g/L

Make up

A separate tank is filled with deionised water to 2/3 of the final volume.

The water is then heated to at least 60 °C after which the chemicals are added and the tank is filled to the final volume with deionised water. To remove contaminants 0.5 mL/L Hydrogen peroxide is added and the solution is stirred for at least one hour. 3 – 5 g/L **RIAG Carb SF** activated carbon are added and the electrolyte is mixed for another 60 minutes. After settling, preferably overnight, the electrolyte needs to be transferred to the working tank by filtration. Finally, the correct undiluted amounts of **RIAG Ni 112 Brightener** and **RIAG Ni 138 Tenside M / RIAG Ni 139 Tenside L** are added while stirring.

Operating Parameters

Temperature	55 °C (50 – 65 °C)
pH-value	4.2 (3.8 – 4.5)
Cathodic current density	Barrel : 0.1 – 2.0 A/dm ² Rack: 2.0 – 8.0 A/dm ²
Anodic current density	< 3.0 A/dm ²
Current efficiency	< 100 %
Deposit rate	at 1 A/dm ² ca. 0.2 µm/min at 5 A/dm ² ca. 1.0 µm/min
Anodes	Minimum purity 99.7 % Ni. We recommend polypropylene anode bags
Agitation	Cathode movement 2 – 3 m/min, barrel rotation or air agitation (oil-free)
Tanks	Plastic or lined steel
Filtration	It is important to use continuous filtration and we recommend using activated carbon filtration as well. The filtration rate should be two to three times the electrolyte volume per hour.
Heating	Immersion heaters, but thermostatic control is essential
Cooling	not required
Fume extraction	Recommended

Maintenance	Nickel sulphate, nickel chloride and boric acid should be analysed and corrected regularly. Additions of RIAG Ni 112 Brightener and RIAG Ni 138 Tenside M or RIAG Ni 139 Tenside L are made via Ampere-hour consumption. Metallic contamination can be removed by frequent selective plating-out at 0.1 – 0.3 A/dm ² . The filter pump should be on with the filter outlet directed at the panels. This will ensure thorough electrolyte circulation and essential agitation at the same time.						
pH-value setup	To lower the pH chem. pure sulphuric acid (10 %) is added. To raise the pH only nickel carbonate must be used. Ammonia or ammonia compounds must <u>not</u> be added.						
Additive consumption	The additives are consumed during electrolytic reactions as well as drag-out losses and the use per 10 kWh can therefore vary. <table> <tr> <td>RIAG Ni 112 Brightener</td> <td>1.0 – 2.5 L/10 kWh</td> </tr> <tr> <td>RIAG Ni 138 Tenside M *</td> <td>0.2 – 0.5 L/10 kWh</td> </tr> <tr> <td>RIAG Ni 139 Tenside L *</td> <td>0.2 – 0.5 L/10 kWh</td> </tr> </table> (* depends on kind of agitation)	RIAG Ni 112 Brightener	1.0 – 2.5 L/10 kWh	RIAG Ni 138 Tenside M *	0.2 – 0.5 L/10 kWh	RIAG Ni 139 Tenside L *	0.2 – 0.5 L/10 kWh
RIAG Ni 112 Brightener	1.0 – 2.5 L/10 kWh						
RIAG Ni 138 Tenside M *	0.2 – 0.5 L/10 kWh						
RIAG Ni 139 Tenside L *	0.2 – 0.5 L/10 kWh						

Function of electrolyte components

RIAG Ni 112 Brightener

For uniform bright coatings it is essential to add the **RIAG Ni 112 Brightener** in small doses and according to the operating instructions.

RIAG Ni 146 Support

The additive **RIAG Ni 146 Support** is used to remove dark plating in low current density areas that cannot be removed by selective plating-out. However, the maximum **RIAG Ni 146 Support** addition must be limited to 1 mL/L. Higher dosing reduces levelling and deposit brightness. **RIAG Ni 146 Support** can also be used to compensate for brightener overdosing (0.2 – 0.5 mL/L). To avoid overdosing of **RIAG Ni 146 Support** additions should be made in small volumes.

RIAG Ni 143 Purifier

Zinc-die casting processing in rack or barrel mode often leads to zinc and copper electrolyte contamination. This can be treated by additions of 0.1 – 0.5 mL/L **RIAG Ni 143 Purifier**. The volume **RIAG Ni 143 Purifier** to be added depends on contamination levels but overdosing results in loss of deposit brightness as well as levelling and must be avoided.

RIAG Ni 138 Tenside M (for mechanically agitated solutions)
RIAG Ni 139 Tenside L (for air agitated electrolytes)

Reduces the surface tension and prevents pitting.

Activated Carbon

Continuous filtration over activated carbon is recommended. This can be done via a by-pass whereby the carbon will remove organic contaminants such as oils and breakdown products.

For this we recommend our **RIAG Carb SF** dust-free product which has an active surface area of 1500 m² /g. The additional brightener consumption should not exceed 5 %.

RIAG Ni 147 Oxidant

Iron contamination (pitting) can be removed effectively by additions of **RIAG Ni 147 Oxidant**. The maximum concentration of 0.5 g/L should not be exceeded. The salt is first dissolved in hot water and the iron is removed via the filter.

Environmental considerations and product safety

All concentrates, rinse waters and waste solution must be treated and discharged in accordance with local effluent control regulations. Information can be gleaned from the material safety data sheets. Chemicals shall not be stored below 10 °C.

Liability

This instruction manual was compiled with reference to the state of the art and all current standards, and is based on the long-term knowledge and experience of RIAG. However, RIAG cannot monitor compliance with this instruction manual and the methods described herein at the customer/end-user's premises. Work carried out with RIAG products must be adapted accordingly to meet local conditions. In particular, RIAG cannot accept liability for damage, loss or cost incurred due to a failure to adhere to this instruction manual, improper application of the methods, unauthorised technical modifications, insufficient maintenance or the absence of maintenance in respect of the requisite technical hardware or equipment, or in the event of use by unqualified personnel. RIAG is not liable for damage or loss caused by RIAG or its employees except where intention or gross negligence can be proved. RIAG furthermore reserves the right to make changes in relation to products, methods and the instruction manual without prior notice.

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Analysis (Analytical Methods)

Sample preparation:

The sample must be taken from a well-mixed point and allowed to cool down to 25 °C.

Boric acid

Reagents: Sodium hydroxide solution 0.1 mol/L
Bromcresol purple (1 % in Ethanol)
Mannitol

Procedure: 10 mL electrolyte are transferred via pipette into a 100 mL measuring flask and filled up to the mark with deionised water followed by mixing well.
10 mL of this mixture is given into a
250 mL beaker via pipette followed by
100 mL deionised water addition.
2 – 3 g Mannitol is added followed by addition of 10 drops Bromcresol purple.
0.1 mol/L Titration with Sodium hydroxide from yellow to green, to dark green and finally to blue-violet.

Calculation: Boric acid (g/L) = consumption of mL NaOH x 6.18

Nickel chloride

Reagents: Silver nitrate solution 0.1 mol/L
Potassium dichromate solution 5 %

Procedure: 5 mL electrolyte are transferred into a
250 mL glass beaker and diluted with
50 mL deionised water.
10 drops of Potassium dichromate solution are added.
Titration with 0.1 mol/L Silver nitrate solution from white yellow to a light brown end point.

Calculation: Nickel chloride (g/L) = consumption of mL AgNO₃ x 2.380

Chloride (g/L) = consumption of mL AgNO₃ x 0.709

Nickel

Reagents: Buffer solution pH 10
 Na₂EDTA 0.1 mol/L
 Murexide (Sodium chloride 1: 100)

Procedure: 10 mL electrolyte are transferred via pipette into a
 100 mL measuring flask and filled- up to the mark with deionised
 water and mixed well
 10 mL of this mixture is given into a 250 mL glass beaker by
 pipette followed by
 15 mL Buffer solution addition
 100 mL deionised water and
 1 spatula tip of Murexide are added The sample colour should then be
 deep yellow
 Titrate immediately with Na₂EDTA 0.1 mol/L to a blue-
 end- point

Calculation: Nickel (g/L) = consumption of mL Na₂EDTA 0.1 mol/L x 5.869

Nickel sulphate (g/L) = [A – (B x 0.247)] x 4.48

A = Nickel concentration in g/L

B = Nickel chloride conc. in g/L