

## riag Ni 141

### Bright nickel process for ductile, bright deposits, particularly for technical applications

**riag Ni 141 Additive** is an additive to reduce internal stress in “Watts”- or sulfamate-nickel electrolytes and therefore is particularly used when plating electronic components, including printed circuits and electroforming. Pitting can be monitored by adding wetting agent. The electrolyte can be used in both rack and barrel applications.

### Properties

- Ductile and bright deposits with slight tendency to levelling
- Uniform brightness in nearly all current densities
- Hardness of deposit: ca. 400 HV, lower temperatures and lower pH-values increase the hardness
- Internal stress of nickel deposit: 0 – 35 kg/cm<sup>2</sup> tensile stress  
Comparison with regular „Watts“-nickel electrolyte: ca. 1,000 kg/cm<sup>2</sup> tensile stress

**riag Ni 141** deposits produce an excellent prelayer when coating precious metals, mainly because a hard but ductile and corrosion-resistant primary layer is created and it also substantially improves the abrasion resistance.

### Make up

Nickel sulfamate concentrate (185 g/L Ni)	400 mL/L
Nickel chloride (NiCl <sub>2</sub> x 6 H <sub>2</sub> O)	10 g/L
Boric acid (H <sub>3</sub> BO <sub>3</sub> )	40 g/L
<b>riag Ni 141 Additive</b>	10 mL/L
<b>riag Ni 138 Tenside M* / riag Ni 139 Tenside L*</b>	2 mL/L

\* depending on customer-specific process requirements

## Operating parameters

	Range	Optimum
Nickel (Ni <sup>2+</sup> )	60 – 90 g/L	75 g/L
Chloride (Cl <sup>-</sup> )	2 – 5 g/L	3.5 g/L
Boric acid (H <sub>3</sub> BO <sub>3</sub> )	30 – 50 g/L	40 g/L
pH-value	3.8 – 4.5	4.2

## Make up

The tank is filled with deionised water to 1/3 of the final volume, the nickel chloride is added and solved in water. Afterwards the nickel sulfamate solution and the boric acid are added. The tank is filled with deionised water up to 95 % of its final volume. To completely solve the boric acid the electrolyte has to be heated-up and stirred. After adding **riag Ni 141 Additive** and **riag Ni 138 Tenside M / riag Ni 139 Tenside L** we recommend a filtration of the electrolyte during 2 – 4 hours.

## Operating parameters

Temperature:	55 °C (50 – 65 °C)
pH-value:	4.2 (3.8 – 4.5)
Cathodic current density:	Rack : 3 A/dm <sup>2</sup> (1 – 4 A/dm <sup>2</sup> ) Barrel: 0,75 A/dm <sup>2</sup> (0.5 – 1.0 A/dm <sup>2</sup> )
Current efficiency:	100 %
Deposition rate:	Rack: at 3 A/dm <sup>2</sup> ca. 0.6 µm/min. Barrel: at 0.75 A/dm <sup>2</sup> ca. 0.15 µm/min.
Agitation:	Electrolyte agitation 2 – 3 m/min. or air agitation with oil-free compressed air
Anodes:	„S“ Nickel with polypropylene bags. Titanium baskets may be used.
Tanks:	Semi hard PVC or polypropylene
Filtration:	Continuous filtration is essential using 3 – 5 µm polypropylene filter cartridges
Heating:	Porcelain immersion heaters or titanium heating coils with thermostatic control
pH-value adjustment:	To lower the pH use sulphamic acid. To increase the pH only use nickel carbonate, never apply ammonia or ammonium compounds
Rectifier	Barrel up to approx. 8 volt, rack up to ca. 4 volt An ampere-hour meter simplifies the support
Metallic contamination	Metallic contamination can be removed by frequent selective plating-out at 0.1 – 0.3 A/dm <sup>2</sup> . 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.

#### Additive consumption

The additives are consumed during electrolytic reactions as well as drag-out losses. The use is therefore process-related.

**riag Ni 141 Additive** 1.0 – 1.5 L per 10 kWh

**riag Ni Tenside M / L** 0.1 – 0.3 L per 10 kWh

### Function of electrolyte components

#### riag Ni 141 Additive

We recommend frequent additions of **riag Ni 141 Additive** to produce uniform, bright coatings.

#### riag Ni 138 Tenside M / L

**riag Ni 138 Tenside M** reduce the surface tension of the electrolyte. This lowers the adsorption of hydrogen molecules and dirt particles on the cathode surface, thus pitting in the nickel coating is prevented.

#### 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.

We recommend our **riag Carb SF** dust-free product which has an active surface area of 1500 m<sup>2</sup>/g. A significant contamination of the electrolyte can be removed by filtration in the bypass (filter pump with a filled sack of **riag Carb GR**). **riag Carb GR** is ideally suited for this purpose, as such treatment may be performed during the plating process. **riag** can provide such filter system.

#### 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.

### General information

1. If required the internal stress of the deposit may be checked periodically with a spiral contractometer (Brenner) or a similar instrument.
2. We recommend frequent treatment with activated carbon. Use 3 – 5 g/L **riag Carb SF** and leave the electrolyte at 60° C for an hour. After each treatment you have to add approx. 35 % **riag Ni 141 Additive** of the original make-up, ca. 3 mL/L. Of course the total amount of wetting agent must be added.
3. Deposits with compressed stress are particularly well suited for the finishing of high-tensile steel and its components.

## 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.  
Titration with  
0.1 mol/L Sodium hydroxide from yellow to green, to dark green and finally to blue-violet.

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

### Nickel chloride hexahydrate

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: Consumption of mL AgNO<sub>3</sub> x 2.380 = Nickel chloride hexahydrate (g/L) = **B**

Consumption of mL AgNO<sub>3</sub> x 0.709 = Chloride (g/L)

**Nickel sulfamate  $\text{Ni}(\text{NH}_2\text{SO}_3)_2 \times 4 \text{H}_2\text{O}$** 

Reagents:	Buffer solution pH 10 Na <sub>2</sub> EDTA 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 the Na <sub>2</sub> EDTA 0.1 mol/L to a blue- end- point
Calculation:	Consumption of mL Na <sub>2</sub> EDTA 0.1 mol/L x 5.869 = Nickel (g/L) = <b>A</b>  [A – (B x 0.247)] x 5.41 = mL/L Nickel sulfamate solution  A = Nickel concentration in g/L  B = Nickel chloride conc. in g/L

**riag Ni 138 Tenside M**

Reagents:	Glycerine Butyl phosphate solution: Mix 5 mL Tri-n-Butyl phosphate 500 mL Methanol 500 mL water DI
Procedure:	25 mL electrolyte are transferred via pipette into a 300 mL Erlenmeyer flask, add 3 drops glycerine, shake well, to form a foam cover. Add in steps of 0.5 mL butyl phosphate solution, shake well after each addition, until the foam cover disappears within 10 seconds
Calculation:	consumption in mL = mL/L <b>riag Ni 138 Tenside M</b>