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riag Ni 151

Electrolyte to achieve uniform and non reflective Nickel deposits

In contrast to bright nickel, the **riag Ni 151** electroplating process produces non-reflective, satin, fine crystalline nickel deposits.

Even on polished surfaces are these deposits non-reflective.

Properties

- Uniform mat deposits across the whole current density range
- Very active surface condition for subsequent coatings
- Excellent metal deposit thickness distribution

Make up

	Range	Optimum
Nickel sulphate ($\text{NiSO}_4 \times 6 \text{ H}_2\text{O}$)	410 – 460 g/L	435 g/L
Nickel chloride ($\text{NiCl}_2 \times 6 \text{ H}_2\text{O}$)	20 – 40 g/L	30 g/L
Boric acid (H_3BO_3)	40 – 45 g/L	42 g/L
riag Ni 162 Carrier W	15 – 22 mL/L	20 mL/L
riag Ni 161 Carrier S	3 – 10 mL/L	6 mL/L
riag Ni 151 Satin Additive 1	0.3 – 0.8 mL/L	dep. on Finish
pH-value	4.1 – 4.5	4.2

Important

The satin nickel effect is dependent on daily additions of **riag Ni 151 Satin Additive 1**.
Any other additions are not recommended.

Operating values

Nickel (Ni^{2+})	100 – 110 g/L	105 g/L
Chloride (Cl^-)	7 – 13 g/L	10 g/L
Boric acid (H_3BO_3)	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 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. This is followed by addition of 3 – 5 g/L **riag Carb SF** activated carbon and mixing for another 30 minutes. After settling, preferably overnight, the electrolyte needs to be transferred to the working tank by filtration. Finally, the correct undiluted volumes of **riag Ni 162 Carrier W** and **riag Ni 161 Carrier S** are added. The **riag Ni 151 Satin Additive 1** must be diluted 1: 20 with deionised water and mixed well prior to tank addition whilst stirring.

All additions should be made ½ – 1 hour before starting the electroplating.

Important Notice

No other organic chemicals (wetting agents etc.) must be added to the electrolyte. The drag-in of other electrolytes could result in bright plating and an increased requirement for **riag Ni 151 Satin Additive 1**. The pre-plating water rinse should also be deionised water. The pH is corrected by additions of 10 % Sulphuric acid or Nickel carbonate.

Operating Parameters

Temperature:	52 °C (50 – 55 °C) The temperature should be maintained above 35 °C during idle times
pH-value:	4.2 (4.1 – 4.5)
Cathodic current density:	1.5 – 5.0 A/dm ²
Anodic current density:	1 – 3 A/dm ²
Tank voltage:	4 – 10 Volt
Rectifier:	< 5 % Ripple
Current efficiency:	< 100 %
Deposition rate:	at 5 A/dm ² ca. 1 µm/min
Anodes :	Minimum purity 99.7 % Ni. We recommend polypropylene anode bags
Agitation:	Cathode Movement 2 – 3 m/min
Tanks:	Plastic or lined steel
Agitation:	Cathode movement (3 dimensional) 2 - 3 m/min with shaking action

Filtration:	It is important not to use filtration during plating! Filtration can be carried out through 5 µm plate or cartridge filters at 4 times electrolyte volume per hour for ca. 8 hours after production.				
Heating:	Immersion heaters but thermostatic control is essential				
Cooling:	not required				
Fume extraction:	Recommended				
Contacting:	Maximal 10 seconds after immersion. Uniform mat coatings are achieved by connecting the work as soon as possible after immersion.				
pH-value adjustment:	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. The brightener consumption will increase if the pH is above 4.5 while reduced levelling is noticed at a pH lower than 4.0.				
Maintenance:	Nickel sulphate, nickel chloride and boric acid should be analysed and corrected regularly. Additions of riag Ni 162 Carrier W and riag Ni 161 Carrier S 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.				
Minimal thickness:	The mat effect requires a minimum layer thickness of 3 – 5 µm.				
Additive consumption:	The additives are consumed during electrolytic reactions as well a drag-out losses and the use per 10 kAh can therefore vary. <table> <tr> <td>riag Ni 162 Carrier W</td><td>0.5 – 1.5 L/10 kAh</td></tr> <tr> <td>riag Ni 161 Carrier S</td><td>0.8 – 1.7 L/10 kAh</td></tr> </table> <p>Too low concentrations of the riag Ni 162 Carrier W and riag Ni 161 Carrier S reduce the crystal mat effect. The nickel concentration should be maintained within close operating parameters to achieve optimum crystal mat deposits. The riag Ni 151 Satin Additive 1 can also be replenished during plating. This will ensure uniform quality deposits and 1: 20 diluted additions of up to 50 % of the original concentration can be made at 4 hours interval. The mentioned values are guidelines and may vary slightly in praxis.</p>	riag Ni 162 Carrier W	0.5 – 1.5 L/10 kAh	riag Ni 161 Carrier S	0.8 – 1.7 L/10 kAh
riag Ni 162 Carrier W	0.5 – 1.5 L/10 kAh				
riag Ni 161 Carrier S	0.8 – 1.7 L/10 kAh				

Equipment

The **riag Ni 151** process can be operated on a production basis without problems but relevant plant changes must first be considered. Our technical team is ready to advise you accordingly.

A trouble-shooting guide is available on request.

Function of the electrolyte components

riag Ni 151 Satin Additive 1

The function of this additive is to ensure non-reflective deposits. Increasing the concentration will intensify this mat effect. Overdosing ($> 1 \text{ mL/L}$) results in porosity at high current densities. Prior to adding the **riag Ni 151 Satin Additive 1** has to be diluted 1: 20 with deionised water. The mixture is then added carefully whilst stirring. The operational window lies between 8 – 14 hours depending on plant technology. Thereafter the electrolyte must be filtered to remove the **riag Ni 151 Satin Additive 1** residue and we recommend activated carbon filtration for duration of approximately 6 – 8 hours.

riag Ni 161 Carrier S

The **riag Ni 161 Carrier S** concentration can be determined by analysis and we recommend maintaining operational limits at all times. A too low concentration causes “porosity” during plating while overdosing results in poor “crystal mat” formation. Regular additions according to the data sheet must be made.

riag Ni 162 Carrier W

The **riag Ni 162 Carrier W** concentration can also be determined analytically and we recommend maintaining the minimum level at all times. While too low concentrations cause bright plating, slight overdosing is not detrimental. Regular additions must be made according to the data sheet.

The **riag Ni 162 Carrier W** and **riag Ni 161 Carrier S** can be mixed for use in automatic dosing systems.

Important

The filter pump must be switched off prior to **riag Ni 151 Satin Additive 1** additions and during plating otherwise **riag Ni 151 Satin Additive 1** is removed from the electrolyte.

Nickel additive riag Ni 143 Purifier

Zinc-die casting processing in rack mode often leads to zinc and copper electrolyte contamination. This can be treated by additions of $0.03 - 0.1 \text{ mL/L}$ **riag Ni 143 Purifier**. The volume **riag Ni 143 Purifier** to be added depends on contamination levels.

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.

Activated Carbon

The **riag Ni 151 Satin Additive 1** is removed by filtration and activated carbon treatment is beneficial during this stage for the removal of organic breakdown products as well. For this we recommend our dust-free product **riag Carb SF** that has an active surface area of 1500 m² /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.

Nickel Concentration

The nickel concentration has only a limited effect on deposit appearance as long as the operational concentration is maintained above 100 g/L nickel. Lower values tend to reduce the “mat-effect” and must be adjusted by nickel sulphate additions accordingly.

Chloride Concentration

Too high concentration results in a slight brightening effect while lower values do not affect deposit quality.

Boric acid

The Boric acid concentration has, within operational limits, little influence on deposit quality. However, too low values tend to cause deposit “burning” or pitting.

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

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:	Nickel chloride hexahydrate (g/L) = consumption of mL AgNO ₃ x 2.380	
	Chloride (g/L) = consumption of mL AgNO ₃ 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 hehahydrate (g/L) = [A – (B x 0.247)] x 4.48

A = Nickel concentration in g/L

B = Nickel chloride conc. in g/L