

# **NI-809 lead-free and cadmium-free bright medium phosphorous electroless nickel deposition process**

## **Technical Data Sheet**

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### **1、 Process description and advantages**

#### Overview

NI-809 is the latest generation of lead-free and cadmium-free electroless nickel deposition process. Because it is lead-free and cadmium-free, this system can meet the ELV regulations of the automotive industry. In addition, the use of this process can also meet the WEEE regulations of the electronics industry. This process is a unique electroless nickel precipitation system, which can produce an excellent coating and the bath is easy to operate and maintain. The coating contains 7.5-9% phosphorus, its hardness and wear resistance meet various requirements, and it exhibits good corrosion resistance in various environments.

#### Advantages:

Lead-free and cadmium-free bright plating

Similar to traditional chemical nickel, it consists of three components

Excellent plating rate suitable for high output

There is no EDTA in the process, which can be used as a completely ammonia-free operation

The bath is extremely stable and works well in stainless steel baths and equipment (without anode protection), without the need for expensive anode passivation systems

Meet or exceed the following performance specifications: GMW 3059, FORD WSS-M99P9999-A1 WSD-M1P65B1&B2, Chrysler PS5009, AMS-26074 (formerly MIL-C-26704), AMS 2404 and ISO4527 standards.

## 2、Coating characteristics

Characteristic	value
Density	8.1 g/cm <sup>3</sup>
Phosphorus content	7.5-9%mass ratio
Hardness	550-650 HK <sub>100</sub> (after plating) (47-53Rc)
	850-950 HK <sub>100</sub> (heat treatment, 400°C for one hour) (65-72Rc)
Wear resistance	16-20 TWI <sup>1</sup> (after plating)
	9-12 TWI (heat treatment, 400°C for one hour)
Magnetic	micro-magnetic
Resistivity	70-110 μ Ω cm
Salt spray test	for more than 96 hours (25.4μm per ASTM B117 deposition)
Nitric acid test	failed <sup>2</sup> (concentrated nitric acid, 30 seconds)

1. TWI—"Taber Wear Index" is the weight lost every 1000 cycles (mg) using one CS-10 round
2. If the coating is darkened after 30 seconds in concentrated nitric acid, it is considered a failure.

## 3、Process composition

### Make Up:

1) .NI-809A

Nickel component for make up, used at 6.0% by volume (60 mL/L)

2.) NI-809B

Reducer and complexor component for make up, used at 12% by volume (120 mL/L)

### 3.) NI-809H

Only as a supplementary component of reducing agent/stabilizer. No PH self-adjustment function, 6% (volume ratio), 60ml/L per cycle.

## 4、 Bath Make Up:

A new bath is made up as illustrated by the following table:

Tank volume	NI-809A	NI-809B
100 gallons	6 gallons	12 gallons
100 liters	6 liters	12 liters

●If the electroplating solution cannot be electroplated, use 30-50% nitric acid by volume to clean and passivate the electroplating tank for at least 4-8 hours. In some serious cases, it needs to be stripped in nitric acid for more than 24 hours. Once completed, transfer the nitric acid to the collection container and thoroughly clean the plating tank. The tank body must be free of any traces of nitric acid. It is recommended to use a nitrate test strip to ensure that there is no residual nitric acid in the plating tank.

- Put about 2/3 of pure water into the cleaned and passivated tank.
- Add the required amount of NI-809B (12% by volume) and mix well.
- Add the required amount of NI-809A (6% by volume) and mix well.
- Replenish the liquid level to the operating volume with pure water and mix thoroughly.
- Measure the pH value of the solution and adjust to 4.9 if necessary. The pH value of the solution can be increased by adding a small amount of diluted (diluted to 50% by volume) ammonia, and a small amount of diluted sulfuric acid (10% by volume) solution can be added to lower the pH value of the solution.
- Heating to operating temperature (88°C).

At this point, the NI-809 built-in bath can now be used for operation.

## 5. BATH OPERATION & CONTROL

The operating conditions of NI-809 process are as follows:

Parameter	range	best value
Nickel metal:	5.4-6.3 g/L	6.0 g/L
	90-105% activity	100% activity
Sodium hypophosphite:	27-33 g/L	30 g/L
	90-135% activity	100% activity
Temperature:	85-91 °C	88°C
	185-195°F	190°F
pH:	4.7-5.1	4.9
Electroplating rate:	14-22µm/hr	18 µm/hr
	0.55-0.9mils/hr	0.7 mils/hr
Tank liquid load:	0.25-2.5 dm <sup>2</sup> /L	1.2 dm <sup>2</sup> /L
	0.1-1.0 ft <sup>2</sup> /gal	0.5 ft <sup>2</sup> /gal
Supplement ratio:	The ratio of NI-809A to NI-809H is 1:1	
Electroplating tank:	high-density PP or stainless steel	
Heating:	Use steam or hot water with an external heating switch, or use an immersion stainless steel heating machine, or a heating machine with a Teflon coating.	
Stirring:	Use a circulating pump to circulate the solution, move the workpiece or stir with clean and gentle air. Compressed air cannot be used.	
Filtration:	Use a one-micron pore filter to continuously filter at a rate of 10-14 bath volumes per hour. It can be filtered with a filter element or a filter bag.	

#### Bath control

During the operation, the nickel concentration should be analyzed frequently and its activity should be maintained between 90 and 100%. Analyze the concentration of sodium hypophosphite at least once per MTO (metal cycle) and maintain its concentration between 90 and 100%. In this way, the best deposition quality and plating rate can be obtained, the metal plating of the tank body and equipment can be reduced, and the service life of the tank liquid can be prolonged.

In order to achieve the best effect, keep away from the workpiece in the tank when making supplementary addition. Each addition increases the activity of nickel by 5-10%, and it is better to add a small amount and multiple times. Do not pre-mix the added ingredients.

Before sampling and analyzing nickel and sodium hypophosphite, ensure that the operating liquid level is correct.

Avoid replenishing the activity more than 20% at a time. If the activity of nickel in the plating solution is lower than 80% (4.8g/L) due to some reason, add a small amount of times when replenishing until the bath activity reaches 100%. A single large amount of addition will cause chemical imbalance, and will reduce the plating rate, which will affect the deposition quality.

After the replenishment is completely completed, mix the solution evenly and ensure its homogeneity, and then test its pH value. The pH value of the solution can be increased by adding a small amount of diluted (diluted to 50% by volume) ammonia water. If necessary, the pH value of the solution can be lowered by using a diluted sulfuric acid (10% by volume) solution. High-purity potassium carbonate solution can be used to increase the pH value of the solution. It must be added slowly and accompanied by good stirring to avoid splashing of the solution due to the release of carbon dioxide.

The nickel concentration is determined according to the EDTA titration method in Chapter 6 Solution Analysis Method. The supplement of NI-809 tank is shown in the following table:

mls 0.0575M EDTA (10ml sample)	Nickel metal percentage activity%	g/L Nickel metal	mL/L NI-809A	mL/L NI-809H
18.7	105	6.3	0	0
17.8	100	6.0	0	0
16.9	95	5.7	3.0	3.0
16.0	90	5.4	6.0	6.0
15.1	85	5.1	9.0	9.0
14.2	80	4.8	12.0	12.0

## 6. Bath analysis

Nickel content analysis

Reagent: concentrated ammonia

Ammonium violurate indicator (1g of ammonium uronate mixed with 100g of solid sodium chloride)

0.0575M EDTA (21.41 g/L ethylenediaminetetraacetic acid disodium salt solution)

step:

1. ) Draw 10mL of cooled tank liquid into a 250mL conical flask;
2. ) Add about 100mL pure water and 10mL concentrated ammonia water;
3. ) Add 1 pinch of urethane ammonium indicator to make the solution turn yellow-brown;
4. ) Titrate with 0.0575M EDTA to purple as the end point. If other concentrations of EDTA solution are used, use the first calculation formula below to determine the nickel concentration.

Calculation:

$\text{g/L nickel metal} = \text{consumed EDTA milliliters (mLs)} \times \text{EDTA molar concentration} \times 5.87$

$\text{g/L nickel metal} = \text{consumption of 0.0575 EDTA milliliters (mLs)} \times (0.3376)$

$\% \text{ Nickel activity} = \text{consumption of 0.0575M EDTA milliliters (mLs)} \times 5.626$

Analysis of sodium hypophosphite concentration

Reagent: 6N reagent grade hydrochloric acid

0.10N iodine solution

0.10N sodium thiosulfate solution

step:

1. ) Draw 5mL cooling tank liquid into a 250mL conical flask;
2. ) Add 25mL 6N hydrochloric acid;
3. ) Draw 50 mL of 0.10N iodine solution, and use a 50-ml pipette to measure out 0.1N iodine solution. Do not use a graduated cylinder because the results obtained by the graduated cylinder are not accurate.
4. ) Put the lid on and let stand in the dark for 45 minutes;
5. ) After 45 minutes, take out the bottle from the dark and immediately drip with 0.10N sodium thiosulfate solution until the solution is colorless.

Calculation:

$\text{g/L sodium hypophosphite} = (\text{0.10N iodine milliliters} - \text{0.10N sodium thiosulfate milliliters consumed}) \times 1.06$

$\% \text{ Sodium hypophosphite activity} = (\text{0.10N iodine milliliters} - \text{0.10N sodium thiosulfate milliliters consumed}) \times 3.53$

The bath concentration of sodium hypophosphite in the NI-809 bath is 30 g/L.

## 7. General control matters

For every 1mil-ft<sup>2</sup> of coating deposited, 180ml of NI-809A and 180ml of NI-809H need to be added.

The electroless nickel equipment must be resistant to nitric acid corrosion and be able to operate continuously at a high temperature of 94°C. It must be inactive in the plating solution to avoid deposition on parts of the equipment in contact with the solution. It is recommended to use natural high-density polypropylene or 316 stainless steel for the tank body. Anode protection is a method to protect its natural passivation layer to avoid nickel plating out of the stainless steel plating tank, but this method is not recommended for NI-809.

Adequate filtration can ensure the best deposition quality. Use a one-micron filter to continuously filter at a rate of 10-14 bath volumes per hour, especially for coatings of 12 microns or thicker. Poor filtration may result in rough electroless nickel plating, and may also result in the provision of a carrier in the bath, which may cause adsorption of stabilizers and other specific things.

In the successful application of electroless nickel, proper pretreatment is necessary. The electroplated surface must be thoroughly clean and free of oxide film. For special advice on the pretreatment cycle of special alloys, please contact your Bigley supplier.

Once the plated parts are placed in the plating tank, a uniform nickel-phosphorus alloy plating layer will be deposited on the cleaned and activated surface. The workpiece must be kept in the solution for the required time to obtain the required thickness of the deposited layer, and the workpiece cannot be removed from the bath before the workpiece has reached the required thickness.

The electroless nickel solution is very sensitive to pollutants. In order to avoid bath contamination, electroplating equipment and/or pretreatment solutions cannot be shared between electroless nickel and other electroplating solutions. Use deionized water when building the bath and adjusting the volume. After each passivation treatment, thoroughly clean the tank and related equipment to ensure that there is no residue of nitrate.

Plating rate is a main bath operating condition. Strictly maintain the chemical composition, pH, temperature, stirring, load and other factors that affect the plating rate.

The following are general guidelines for the phosphorus content of the coating. The pH value is high, the phosphorus content in the product is low; the low load (less than 0.25dm<sup>2</sup>/L) product has a high phosphorus content.

When there is serious solution loss or carry-out, adding NI-809B will compensate for the loss of the mixture. The volume of NI-809B higher than 3% will increase the concentration of the working solution.

## 8. WASTE MANAGEMENT

NI-809 waste liquid is acidic and contains nickel salts. It cannot be directly drained into the sewer without proper treatment in accordance with local/state/government regulations. In addition, if it is mixed with wastewater from other processes, the conventional treatment of complex reagents in the electroless nickel solution will be more difficult.

Special wastewater treatment methods can be obtained from your supplier. Of course, users must understand the local/state/government wastewater discharge standards before adopting wastewater treatment recommendations. If the recommendations conflict with local/state/government regulations, Subject to local government regulations.

However, if the concentration of sodium hypophosphite is very low due to long-term shutdown, when the solution is hot, it can be added in the following ways:

The addition ratio of NI-809H can be increased slightly until the sodium hypophosphite reaches the appropriate concentration range. Preferably, the volume ratio of 809A to 809H is 1:1.1.

Add up to 3% of the volume of NI-809B. Each increase of 1% of the volume of NI-809B can increase the concentration of sodium hypophosphite by about 2.5g/L.

## 9. safety warning

caveat

Storage NI-809 A, NI-809 B, NI-809 H should be sealed and stored, the container must be tightly closed, the temperature is 10-38 °C, NI-809 H is easier to decompose, avoid direct exposure to sunlight, avoid Contact with eyes, skin and clothing.

Safeguard

When handling concentrates and solutions, wear rubber gloves, goggles and corrosion-resistant aprons. After use, thoroughly clean them. The area around the plating tank must be ventilated.

Emergency assistance

If contact with eyes or skin, rinse immediately with plenty of clean water for at least 15 minutes. In case of eye





contact, see a doctor immediately. If swallowed, see a doctor immediately.

#### Splashing or leaking

Wear protective gear before cleaning up splash potions or leaks. Use inert materials such as sand, soil or vermiculite to absorb splashes or leaks. Dispose of absorbed material in accordance with local/state/federal regulations.

#### Safety and warning

NI-809 A, NI-809 B, and NI-809 H are only used in industry. Please read the material safety information and product label carefully before use.

### 10. Ordering Information

Product name/function	package
NI-809A (Nickel composition/build bath)	30kg/桶
NI-809B (Chelating agent and reducing agent/build bath)	30kg/桶
NI-809H (Reducing agent ingredients/no pH self-regulation/supplement)	30kg/桶