ROHM AND HAAS

ELECTRONIC MATERIALS
PACKAGING AND FINISHING TECHNOLOGIES

NICKEL GLEAM BR 220

BRIGHT NICKEL PROCESS

For Industrial Finishing Applications

Regional Product Availability

N. America	Japan/Korea	Asia	Europe
✓		✓	✓

DESCRIPTION

Nickel Gleam BR 220 is a bright nickel plating process. It was developed to meet the high performance requirements demanded by the bright nickel plater and may be used as the top layer of a duplex nickel system where maximum corrosion protection of the substrate is required.

ADVANTAGES

- Deposit has exceptional brightness and leveling over a wide current density range
- Deposit has excellent ductility and chromium acceptance
- Nickel Gleam BR 220 can be plated over many suitably prepared surfaces, but is not recommended for the plating of zinc die castings where the part fall or blind areas of the casting may contaminate the solution with zinc
- May be used with air agitation or mechanical agita tion when used with the appropriate anti-pitting agent
- The optional use of the Nickel Gleam BR 220 Replenisher greatly simplifies the operation of the process

MAKE-UP PROCEDURE

1. Add 400 ml/l (40% v/v) deionized water to a clean tank and heat to 50–60°C (120–140°F).
2. Add Nickel sulfate ($NiSO_4 \bullet 6H_2O$) to the tank. Mix well until completely dissolved.
3. Add Nickel chloride ($NiCl_2 \bullet 6H_2O$) and mix well until completely dissolved.
4. Add boric acid and mix well until completely dissolved.
5. Add Nickel Gleam BR 220 Make-up and mix well.
6. Add Nickel Gleam BR 220 Carrier and mix well.
7. Add Nickel Gleam BR 220 Additive **or** Nickel Gleam BR 220 Replenisher and mix well.
8. Add Nickel Gleam NAW-A (with air agitation) **or** Nickel Gleam NAW-M (with mechanical agitation) and mix well.
9. Adjust pH to 3.8–4.5 with either sulfuric acid to decrease the pH or nickel carbonate to increase the pH.
10. Dilute to final volume with deionized water.

Bath Make-up—Metric (U.S.)

Chemicals Required	Range	Recommended
Nickel sulfate ($NiSO_4•6H_2O$)	250–350 g/l (33–47 oz./gal.)	300 g/l (40 oz./gal.)
Nickel chloride ($NiCl_2•6H_2O$)	30–75 g/l (4–10 oz./gal.)	53 g/l (7 oz./gal.)
Boric Acid (H_3BO_3)	38–50 g/l (5.0–6.5 oz./gal.)	45 g/l (6.0 oz./gal.)
Nickel Gleam BR 220 Make-up	5–15 ml/l (0.5–1.5% v/v)	10 ml/l (1.0% v/v)
Nickel Gleam BR 220 Carrier	25–45 ml/l (2.5–4.5% v/v)	35 ml/l (3.5% v/v)
Nickel Gleam BR 220 Additive	0.75–1.25 ml/l (0.075–0.125% v/v)	1.0 ml/l (0.10% v/v)
Nickel Gleam BR 220 Replenisher (In place of BR 220 Additive for bath make-up)	1.5–2.5 ml/l (0.15–0.25% v/v)	2.0 ml/l (0.20% v/v)
Nickel Gleam NAW-A (Air Agitation) **or** Nickel Gleam NAW-M (Mechanical)	2.0–4.0 ml/l (0.20–0.40% v/v) 2.0–4.0 ml/l (0.20–0.40% v/v)	3.0 ml/l (0.30% v/v) 2.5 ml/l (0.25% v/v)

NICKEL GLEAM BR 220 BRIGHT NICKEL PROCESS

Bath Operation—Metric

Parameter	Range	Recommended
pH	3.5–4.5	4.0
Temperature	50–65°C	60°C
Cathode Current Density	2–8 ASD	4 ASD
Agitation	Air or mechanical agitation	

Bath Operation—U.S.

Parameter	Range	Recommended
pH	3.5–4.5	4.0
Temperature	120–150°F	140°F
Cathode Current Density	20–80 ASF	40 ASF
Agitation	Air or mechanical agitation	

BATH MAINTENANCE

NICKEL SULFATE

The nickel sulfate concentration contributes the nickel metal necessary to provide the latitude for the operating current density range. Complex shapes and/or the use of higher current densities should have the highest nickel sulfate concentration. Nickel sulfate should be maintained on the basis of regular analysis.

Analytical Procedure

The nickel metal is furnished by the nickel sulfate, as well as the nickel chloride.

I. Equipment

a) 1 ml class A volumetric pipette

b) 250 ml Erlenmeyer flask

c) 50 ml burette

d) 25 ml and 100 ml graduated cylinder

II. Reagents Required

a) Murexide indicator

b) Concentrated ammonium hydroxide

III. Titrant

Standardized EDTA solution

IV. Procedure

a) Pipette a 1 ml sample of nickel solution into a 250 Erlenmeyer flask.

b) Add 10 ml of deionized water.

c) Add 10 ml of concentrated ammonium hydroxide.

d) Titrate with a standardized EDTA solution until bluish-purple endpoint.

V. Calculation

Total nickel metal in g/l =ml of EDTA x M x 58.7

Total nickel metal in oz./gal. = ml of EDTA x M x 7.826

NICKEL CHLORIDE

The chloride ion is furnished by the nickel chloride. The chloride ion assists in anode corrosion, improves the conductivity of the bath and improves the limiting current density. Concentrations higher than those recommended may be used but may pose equipment corrosion problems and/or reduced ductility and increased internal stress. Nickel chloride should be maintained on the basis of regular analysis.

Analytical Procedure

The nickel metal is furnished by the nickel chloride, as well as the nickel sulfate. The total nickel metal should be maintained at 34–120.8 g/l (4.5–16.1 oz./gal.).

I. Equipment

a) 5 ml Class A volumetric pipette

b) 50 ml burette

c) 250 ml Erlenmeyer flask

II. Reagents Required

a) 2% potassium chromate (K_2CrO_4) indicator

III. Titrant

1.0N silver nitrate ($AgNO_3$)

IV. Procedure

a) Pipette a 5 ml sample of nickel solution into a 250 Erlenmeyer flask.

b) Add 50 ml of distilled water.

c) Add 2 ml of 2% potassium chromate (K_2CrO_4) Indicator; 2% solution of potassium chromate is made by adding 2g (K_2CrO_4) to 98 ml H_2O.

d) Titrate with 1.0N silver nitrate ($AgNO_3$) until the precipitate formed is tinged with a red color.

V. Calculation

g/l nickel chloride ($NiCl_2 \bullet 6H_2O$) =
ml silver nitrate x N x 23.78

oz./gal. nickel chloride ($NiCl_2 \bullet 6H_2O$) =
ml silver nitrate x N x 3.17

BORIC ACID

The boric acid concentration contributes the cathode film buffering necessary for the bath to produce deposits with good ductility, brightness, leveling and limiting current density. Concentrations greater than those recommended may produce clogged air pipes, deposit roughness, etc, due to the lower solubility of boric acid.

Analytical Procedure

I. Equipment

a) 10 ml graduated pipette

b) 125 Erlenmeyer flask

c) 50 ml burette

II. Reagents Required

a) Mixed bromothymol blue/bromocresol purple indicator (dissolve 2g bromothymol blue powder + 10g of bromocresol purple powder in 1 liter of isopropanol)

b) Mannitol powder

c) 3% v/v sulfuric acid

III. Titrant

1.0N sodium hydroxide (NaOH)

IV. Procedure

a) Pipette a 10 ml sample of nickel solution into a 125 ml Erlenmeyer flask.

b) Add 10 drops of mixed bromothymol blue/bromocresol purple indicator.

c) Add dropwise 1N NaOH until a deep blue-green color is obtained.

d) Add dropwise 3% sulfuric acid until the solution turn olive-green. These last two steps compensate for the pH of the working bath.

e) Add 2 spatulas of Mannitol powder. Mix thoroughly.

f) Titrate with 1.0N sodium hydroxide to a dark blue endpoint.

V. Calculation

g/l boric acid = ml titrant x N x 6.16

oz./gal. boric acid= ml titrant x N x 0.821

NICKEL GLEAM BR 220 BRIGHT NICKEL PROCESS

NICKEL GLEAM BR 220 MAKE-UP

Nickel Gleam BR 220 Make-up is used at the time of make-up of the solution and it should not be necessary to replenish this material except under unusual circumstances such as high drag-out and/or high current concentrations. Additions after make-up should be based on analysis.

Nickel Gleam BR 220 Make-up cooperates with the Nickel Gleam BR 220 Carrier and Nickel Gleam BR 220 Additive (or Replenisher) to produce the high leveling, bright throwing power and chromium acceptance of the deposit.

NICKEL GLEAM BR 220 CARRIER

Nickel Gleam BR 220 Carrier is the primary brightener or carrier and cooperates with the Nickel Gleam BR 220 Additive to produce maximum leveling and brightness while maintaining good ductility and should be maintained within the limits indicated for best results and economy. Regular additions are desirable. Consumption should be based on ampere-hours and an occasional analysis. Typical replenishment rate is 0.2 ml/Amp-hour.

Low concentrations of Nickel Gleam BR 220 Carrier will result in lowered ductility, reduced bright throwing power (low CD darkening), decreased tolerance to many organic and inorganic contaminants, reduced chromium acceptance and reduced leveling. High Nickel Gleam BR 220 Carrier is not especially harmful but will increase operating cost due to higher drag-out. Some crystallization, especially at lower temperatures, may occur if Nickel Gleam BR 220 Carrier is maintained at values greater than 6 % v/v.

NICKEL GLEAM BR 220 ADDITIVE

If used in place of Nickel Gleam BR 220 Replenisher, Nickel Gleam BR 220 Additive is the brightener and cooperates with the Nickel Gleam BR 220 Carrier to produce the desired deposit properties. The concentration should be maintained within the limits specified for best results. High concentrations of Nickel Gleam BR 220 Additive will produce brighter deposits, but at the expense of reduced ductility and chromium acceptance.

The concentration of Nickel Gleam BR 220 Additive can best be controlled by observation based on experience and/or plating tests such as the Hull Cell. Typical replenishment rate is 0.25 ml/Amp-hour.

NICKEL GLEAM BR 220 REPLENISHER

As a convenience, Nickel Gleam BR 220 Replenisher can be used in place of maintenance additions of both Nickel Gleam BR 220 Make-up and in place of maintenance and make-up additions of Nickel Gleam BR 220 Additive. Nickel Gleam BR 220 Replenisher contains both of these additives in the consumptive proportions most frequently encountered and should maintain both materials near optimum when added on a regular basis. An occasional analysis can determine the need for any adjustment of additives. Nickel Gleam BR 220 Replenisher should be added as required for brightness and leveling in a fashion similar to Nickel Gleam BR 220 Additive. Typical replenishment rate is 0.50 ml/Amp-hour.

NICKEL GLEAM NAW-A

Use of a small amount of anti-pitter in the solution will aid in preventing gas pitting of the deposit under most conditions. Nickel Gleam NAW-A should be used with air-agitation solutions and Nickel Gleam NAW-M with mechanically-agitated solutions.

CAUTION! Nickel Gleam NAW-M should not be added to air-agitated solutions or serious foaming will result. Concentrations of about 1.5 ml/l (0.15% v/v) will be satisfactory in most circumstances. Typical replenishment rate is 0.05 ml/Amp-hour.

pH

The Nickel Gleam BR 220 Additive process will function over a wide pH range, but best results will be obtained within the range 4.0–4.5. Many metallic impurities will precipitate within this range and will be removed by the filter on a continuous basis (e.g. Fe^{+3},Al,Si, Cr^{+3}).

The pH will rise during normal operation of the bath. Dilute sulfuric acid (at least 1 part H_2SO_4 to 2 parts water) of an acceptable grade should be used to adjust pH.

TEMPERATURE

The Nickel Gleam BR 220 Additive process can be operated over a wide temperature range, however, it is recommended that a relatively narrow range be selected and adhered to. Wide fluctuations in temperature will affect the current being drawn at a given voltage setting and can result in either poor performance or uneconomical operation.

EQUIPMENT

Tanks: PVC or Polypropylene

Anodes

Use electrolytic grade nickel anodes in titanium baskets with anode bags to prevent roughness.

Anode area should be adjusted to yield a maximum anode current density of about 30 ASF (3 ASD) for air-agitated solutions and 18 ASF (1.8 ASD) for mechanically agitated solutions. Insufficient anode area may lead to anode polarization, which, in turn, will produce poor deposits due to low thickness, high addition agent consumption, etc. Baskets should be filled on a regular basis to assure maximum anode area.

Anode Bags

Double cotton, cotton flannel or napped polypropylene anode bags are preferred. Cotton bags should be leached, before use, in 5% sulfuric acid solution containing 0.1% of either the Nickel Gleam NAW-A or NAW-M used. Polypropylene bags should be laundered and rinsed thoroughly using conventional laundry procedures and detergent.

Filtration

Filtration is strongly recommended. The filter should have at least 0.0245 m^2 of surface area for each 100 ml (one square foot of surface area for each 100 gallons) of solution. The pump should be capable of turning the solution over at least every hour for air agitated solutions.

Agitation

Air agitation from a low pressure blower is preferred. Parameters for construction of a suitable air agitation supply system are available.

Mechanical agitation of the oscillatory type, at a rate of 0.91–2.44 meters/minute (3–8 feet/minute), should also prove satisfactory.

NICKEL GLEAM BR 220 BRIGHT NICKEL PROCESS

EQUIPMENT PREPARATION

Prior to make-up, the process tank and ancillary equipment should be thoroughly cleaned as outlined below.

This procedure is particularly important for new equipment or equipment previously used for other processes.

Cleaning Solution

Trisodium Phosphate	15 g/l	2 oz./gal.
Sodium Hydroxide	15 g/l	2 oz./gal.

Leaching Solution

Sulfuric Acid	50 ml/l	5% v/v

PROCEDURE

1. Thoroughly wash down tank and ancillary equipment with clean water.
2. Recirculate water through the complete system to remove water-soluble materials.
3. Discard water.
4. Add cleaning solution to the tank, heat to 55–60°C (130–140°F) and recirculate through the complete system for a minimum of 8 hours.
5. Discard cleaning solution.
6. Recirculate water through the complete system.
7. Discard rinse water.
8. Add leaching solution and recirculate the complete system.
9. Leave leaching solution in tank for a minimum of 8 hours.
10. Discard leaching solution.
11. Recirculate water through the complete system.
12. Discard rinse water.

PRODUCT DATA

For the specific Product Data values, please refer to the Certificate of Analysis provided with the shipment of the product(s).

ASSOCIATED PRODUCTS

Nickel Gleam BR 220 Make-up

Nickel Gleam BR 220 Carrier

Nickel Gleam BR 220 Additive

Nickel Gleam BR 220 Replenisher

Nickel Gleam NAW-A

Nickel Gleam NAW-M

NICKEL GLEAM BR 220 BRIGHT NICKEL PROCESS

HANDLING PRECAUTIONS

Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

CAUTION! Keep combustible and/or flammable products and their vapors away from heat, sparks, flames and other sources of ignition including static discharge. Processing or operating at temperatures near or above product flashpoint may pose a fire hazard. Use appropriate grounding and bonding techniques to manage static discharge hazards.

CAUTION! Failure to maintain proper volume level when using immersion heaters can expose tank and solution to excessive heat resulting in a possible combustion hazard, particularly when plastic tanks are used.

STORAGE

Store products in tightly closed original containers at temperatures recommended on the product label.

DISPOSAL CONSIDERATIONS

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Rohm and Haas Electronic Materials Technical Representative for more information.

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