TECHNICAL DATA SHEET

EB 700-04 BRIGHT NICKEL PROCESS:

Bright Nickel Process (EB 700-04) is a high performance addition agent system for bright nickel plating. The process has been formulated to give superior leveling, brightness, coverage, better chrome receptivity and extremely good brightness at medium and low current density areas.
The process gives excellent performance over a wide range of operating bath concentrations, and current densities. EB 700-04 process can be used for either rack or barrel plating applications and bath with air or mechanical agitations.

FEATURES:

- EB 700-04 process produces the ultimate in leveling.
- EB 700-04 process built brightness faster.
- EB 700-04 process is very receptive to chrome over plate.

BENEFITS:

- Shorter plating time required.
- Less deposit thickness for the desired finish.
- Will deposit over a wide range of operating conditions.

SOLUTION COMPOSITION:

CHEMICALS	RANGES	OPTIMUM AIR AGITATION	OPTIMUM MECHMICAL AGITATION
Nickel sulfate	225-300 g/l	250 g/l	250 g/l
Nickel chloride	50-70 g/l	60 g/l	60 g/l
Boric acid	40-50 g/l	45 g/l	45 g/l
Bright Nickel Make-up EB-700	20-25ml/l	20 ml/l	20 ml/l
Bright Nickel Laveller EB-702	0.6-1ml/l	0.8ml/ltr	1 ml/l
Bright Nickel Brightener EB-701	0.6-1ml/l	0.8ml/ltr	1 ml/l
Bright Nickel Wetting Agent EB-703	2-4ml/l	2ml/ltr	2 ml/l

OPERATING CONDITIONS:

	RANGE	OPTIMUM
Cathode current density	2.0-4.0 A/dm^2	3.0 A/dm^2
Anode current density	1.0-3.0 A/dm^2	2.0 A/dm^2
Temperature	58-62°C	60^{o}C
pH	4.4-4.6	4.4
Density	20-24 B°	22^o Be.
Agitation	Air	Cathode Rod
Filtration	Continuous	Continuous

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Optimum bath composition depends upon the particular requirements unique to the processing equipment and the parts to be plated. This includes cathode current density type and finish of basis metal plated; deposit thickness; part geometry etc. Similarly addition agent's consumption also varies depending upon the above mentioned factors.

FUNCTIONS OF SOLUTION CONSTITUENTS:

NICKEL SULPHATE:

Nickel Sulfate is the main source of nickel ions to the operating solution. A low Nickel Sulfate yields low concentration of Nickel ion which reduces the overall cathode efficiency a high nickel sulfate level allows higher operating current densities.

NICKEL CHLORIDE:

Nickel chloride improves the bath conductivity and anode dissolution. Lower concentration can reduce the conductivity of the bath whereas higher concentration of nickel chloride can lead to increased attack on processing equipment and decrease deposit ductility.

BORIC ACID:

Boric acid acts as an overall pH buffer for the solution and prevents burning, pitting giving ductile deposits. However higher concentration can lead to shelf roughness, if it is present in a concentration above its solubility limit.

NICKELS MAKE UP EB-700:

This is a carrier brightener to provide the basis brightness and ductility to the deposits, and also acts synergistically with the main brightener EB-701&702 to maintain maximum brightness and leveling. It also ensures proper chrome receptivity.

A moderately low concentration has no appreciable effect on the performance. A concentration less than 10ml/l usually causes sluggish response to the additions of EB 701&702, and can cause less ductility and chrome coverage problems.

NICKEL BRIGHTNER EB-701:

This is the main brightening agent used to control the high rates of leveling and brightness as well as the low current density brightness and coverage.

A low concentration reduces overall performance, but slight to moderate excess has no harmful effect, other than it needs closer in plant control and increase in operating cost. Very high concentration can cause ductility and chrome coverage problems as well as low current density dullness but this normally can be brought under control by adding extra quantity of Nickel make up EB-700 to current bath. It is depleted primarily by electrolysis although minor losses can occur through carbon treatment, absorption in anodes bags, tank lining etc.

NICKEL LAVELLER EB-702:

Used as a top brightener and leveling agent, EB-702 can enhance the filled products polishing lines, mark and make the part mirror brighten quickly with pulp and smooth finish.

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WETTING AGENT EB-703:

Wetting Agent is an agent of a High foam/Low foam type suitable for mechanical agitated /air agitated nickel plating solution, it decrease surface tension of deposit, pitting, shelf roughness, hemp dots and increase ductility. Increase throwing power at low current density, Excessive usage cause of Overall less brightness of plated part.

REPLENISHMENT ADDITIONS:

Both the addition agents namely EB-700-03 is required to be added regularly to maintain the brightener components at the optimum concentration level.

Replenishment additions should be normally based on the ampere hours of plating done. The required amount of addition depends upon degree of leveling and brightness required drag out, base metal finish, and operating temperature etc.

Based on our experience, the replenishment additions are expected to be in the following range.

Bright Nickel Make up EB-700	2.5-3ltr/10,000 A.H
Bright Nickel Leveler EB-702	2.5-3ltr/10,000 A.H
Bright Nickel Brightener EB-701	1.5-2ltr/10,000 A.H

Brightener additions can be made manually but better control is achieved by using an ampere hour feeder pump since it reduces the brightener consumption and assures more uniform plating quality.

NOTES ON OPERATING CONDITIONS:

TEMPERATURE:

The optimum temperature to be maintained is in the range of 58 to 62°C. Too low an operating temperature can cause high current density burning at normal amperages. Higher values of temperature doesn't help base it gives rise to unnecessary energy loss.

PH CONTROL:

The recommended pH range for rack plating solutions is 4.4-4.6 and for barrel plating solution is 4.0-4.4.A lower pH is suggested for barrel plating to minimize laminated deposits, and to ensure maximum deposit ductility.

Due to difference in efficiencies of cathode and anode, it is generally tendency of the solution that pH is increased during regular operation. The necessary change in pH should be made, with technical grade sulfuric acid to reduce the pH and Nickel carbonate to increase the pH. Use of sodium hydroxide is not recommended.

CURRENT DENSITY:

The Anode current density is calculated by following equation.

Anode current density = total current /total anode surface area

Similarly,

Cathode current density=total current/ total cathode surface area

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Too high an operation cathode current density can produce burning while too low a cathode density results ion decreased plating speed. Similarly too high anode current density (i.e. too low anode area) can cause anode polarization and generation of chlorine gas at the anode. While too low and anode current density can lead to increase in Nickel content in the bath during bath operation.

AGITATION:

Low pressure Air agitation is more commonly used. Compressed air is not satisfactory due to likely hood of introducing oil to the nickel solution.

SOLUTION PREPARATION:

A fresh nickel plating bath is prepared as follows:

- Leach a rubber lined tank and filled with 5 % sulphuric acid (by volume) and 1 cc/lit wetting agent at 50-70° C and agitate the bath for some time. Leave it overnight and clean it with soft water next day.
- Fill the plating tank with 2/3rd of warm water and add required amount of Nickel Salt by stirring to dissolve completely.
- Make the level and adjust the pH to 2.5-3.5 with pure sulphuric acid (25% volume)
- Dummy the solution at 3 amps per sq.ft. For minimum of 12 hours. Remove the anodes and plate at low c.d.
- Pump the hot solution to the storage tank and add sufficient nickel carbonate and stir to raise the pH to 5.2-5.5.
  Add Hydrogen peroxide 1ml/litter and stir vigorously at 50-70^{0}C for 2 hours.
- Add 2-5 grams per liter activated carbon and air agitable for some time and leave it overnight.
- Filter the solution back into the clean plating tank without disturbing the layer of sludge on the bottom of the tank.
- After addition of Make-up EB-700 5ml/litter and pH adjustments the bath is ready for plating. (Brightener and leveler addition done throw analysis Hull Cull test)

NICKEL PLATING TANK:

The plating tank should be made of mild steel with rubber lining, PP/PVC.

MIXING AND PURIFICATION:

This tank is meant for the preparation and purification of solution. This tank is suitably lined with good quality rubber PP, PVC and should have a capacity sufficient to accommodate the plating solution of the plating tank. This should also have heating and agitation accessories.

HEATING:

The plating tank should be equipped with a suitable heating device thermostatically controlled to heat the solution. The following heating equipment is recommended:

a) Titanium heating coil.
   This can be used where steam or thermic fluid is used for heating purpose.

FILTER UNITS:

It is essential to use continuous filtration during the process. The capacity of the filter unit should be turn over 2-3 times of tank volume per hour. All the parts of the filter unit coming into contact with the solution should be made of PP/PVC.

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ANODES:

Cast or roll depolarized Nickel anodes are recommended. The anodes are should be as high as possible. Titanium anodes baskets are strongly recommended as these give minimum wastage resulting in high economy due to less rejection as well as a less material consumption. Anodes should be essentially covered with anode bags made of cotton, spun woven Ethylene or polypropylene to prevent the anode sludge creeping into the tank and causing roughness to the deposit.

WATER:

Hard water should not be used for the preparation of the solution and for making up of working level of the solution as the calcium salts present get crystallized and give roughness and overall dullness to plating deposit

MAINTNANCE:

Nickel salt:

Where the anode dissolution is proper the nickel salt is generally lost only by drag out and by general wastage. It is strongly recommended that small daily addition of Nickel Salt is made and analytical control used to adjust the amounts of the daily addition; adjust the bath contents as given below:

Nickel metal	60-70 g/l
Nickel sulfate	225-300 g/l
Chloride as nickel chloride	50-70 g/l
Boric acid	40-50 g/l

When it is required to make large addition of nickel salt, these additions should be followed by low current density electrolysis to remove metallic impurities.

PURIFICATION:

METALLIC IMPURITIES:

Most common metallic impurities found in Nickel solution are copper, zinc, chromium, lead and iron. Zinc, copper and lead can be effectively removed by electrolytic purification accomplished by using corrugated dummy cathode at current density 3 Amp/sq. High agitation low pH and high temperature will help to eliminate quickly these impurities. Chromium contamination of hexavalent chrome can be eliminated by adding exact equivalent quantity of lead carbonate so that lead chromate precipitates and this removed by filtration. Care should be taken to avoid excess dilution of lead carbonate as otherwise this will give dark deposits at low current density region.

Iron can be removed by oxidation carbon treatment as enumerated in the following paragraphs.：

ORGANIC IMPURITIES:

During plating, organic impurities enter in the solution by drag in or from pre-treatment solutions. These can be removed by oxidation carbon treatment.

OXIDATION CARBON TREATMENT:

When the contamination is not severe, the solution can be continuously filtered through a small amount of carbon packed with the filter. Should the solution become seriously contaminated, with organic impurities oxidation, carbon treatment is required to remove the same and should be carried out as follows:

- Heat the solution to 70°C and pump it into a storage tank.
- Add sufficient Nickel carbonate slurry and stir well to raise the pH value more than 5.2.
- Add 1-2 grams per liter of potassium permanganate dissolved in water or 2-3 ml of hydrogen peroxide.
- Stir well for 30 min.
- Add 3-5 gm/lit Activated carbon and equal quantity of filter aid.
- Air agitates vigorously for at least 2 hours.
- Allow the solution to stand out without stirring overnight so as to allow the carbon and the other impurities to settle.
- Filter the solution back into the plating tank, taking care not to disturb the layer of the sludge at the bottom of the tank.

This treatment will remove the Nickel Additive EB-700-04 and it is therefore recommended to add the rate of 5 ml /l of Nickel Make-up EB-700 and 0.1-0.2 ml. Nickel Brightener EB-701. Exact addition of EB-700 and EB-701 should be decided by Hull Cull test.

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