NI-STAR HP

HIGH PHOSPHORUS ELECTROLESS NICKEL PLATING PROCESS

INTRODUCTION

Ni-Star HP is a state-of-the-art RoHS compliant electroless nickel plating process. Designed for high corrosion resistance with a uniform, high phosphorus deposit for ferrous and non-ferrous substrates. The deposit from Ni-Star HP is compressively stressed and will pass nitric acid fume porosity testing.

Ni-Star HP is supplied in 3-parts:

Ni-Star HP Part 1 Make Up and Replenishment Additive

Ni-Star HP Part 2 Make Up Additive (also see Notes)

Ni-Star HP Part 3 Replenishment Additive

BENEFITS

- Deposits ideal for marine environments
- Non-magnetic deposit
- Process capable of thicker plating deposits (>0.001 in.)
- Consistent performance throughout bath life
- Excellent ductility
- Deposits pass nitric acid fume porosity tests
- RoHS compliant
- Good solution stability
- Can be used for rack and barrel plating

DEPOSIT PROPERTIES

Phosphorus content	10 – 14%
Magnetic properties	Non-Magnetic
Hardness: As plated After heat treatment 400°C / 1 hour	 450 – 550 Vickers 900 – 1000 Vickers
Density	7.85 g/cc
Taber Wear Index (TWI): As plated After heat treatment @ 400°C Watts Nickel	 20 – 25 mg/1000 cycles 12 – 18 mg/1000 cycles 25 mg/1000 cycles
Corrosion resistance: Alkali salts Petroleum brine Acid Salts	 Fair Excellent Good
Porosity tests: Ferroxyl Salt Spray	 Excellent Excellent

SOLUTION MAKE-UP

Ni-Star HP Part 1	8% v/v
Ni Star HP Part 2	20% v/v

NOTE:

When making up working solutions of 250 gallons (1000 liters) or above it is recommended that you use Ni-Star HP Part 2 LS in place of Ni-Star HP Part 2.

OPERATING DATA

Nickel	5.0 – 6.0 g/L Optimum 5.6 g/L
Sodium Hypophosphite	27 – 33 g/L Optimum 30 g/L
Temperature	185 – 195°F
pH	4.6 – 4.9
Agitation	Air movement
Filtration	Continuous 5µm or less
Loading	0.2 – 0.7 sf / gal
Plating rate	0.3 – 0.6 mils/hr

Note: The plating rate is dependent on pH, temperature and bath age.

It is recommended not to leave the working bath idle at operating temperature for long periods of time. Stabilizers break down with heat and bath will be out-of-balance when re-started.

EQUIPMENT

Tanks	High density polypropylene is recommended or 316 Stainless Steel with anodic protection.
Heaters	PTFE or 316 Stainless Steel are recommended. Steam coils can be used, again made from PTFE or Stainless Steel.
Filtration	10 bath turnovers per hour through 5 micron or smaller filter bags or cartridges. All filter units must be of non-metallic parts. It is recommended that the solution tank and filter bodies are cleaned out at the end of every working day. If there is any sign of nickel metal the tank should be cleaned with 50% Nitric Acid.
Fume Exhaust	Essential

INSTALLATION

It is essential that the tanks to be used for Ni-Star HP are thoroughly cleaned and leached before any chemistry is introduced. See Equipment Maintenance for procedure.

1. Add DI water to one-half tank volume.
2. Add the required volume of Ni-Star HP Part 1 and mix well.
3. Add the required volume of Ni-Star HP Part 2 and mix well.
4. Add to level with DI water and mix well.
5. Analyze solution and adjust as necessary. (Adjust sodium hypophosphite with Ni-Star HP Part 2)
6. Heat solution to operating temperature.

PROCESS SEQUENCE

The general pretreatment sequences are as follows:

Steel:

1. Hot Soak Clean (Alkaline Clean 45)
2. Rinse
3. Periodic Reverse Clean (Alkaline Clean 45)
4. Rinse
5. Acid Activate (Econovate Dry Acid Salts) or Pickle
6. Rinse
7. Anodic Clean (Alkaline Clean 45)
8. Rinse
9. Wood's Nickel Strike (Optional – see Notes)
10. Ni-Star HP Electroless Nickel

Ferrous metals, including low carbon steel, high carbon low alloy steels, cast iron, cobalt and nickel together with precious metals will all plate spontaneously on immersion in the Ni-Star HP solution.

Aluminum (Option 1):

1. Soak Clean (Cleaner 505)
2. Rinse
3. Etch (EtchAL)
4. Rinse
5. 50% Nitric acid
6. Rinse
7. Rinse
8. Alzon CF, 30 sec
9. Rinse
10. Zincate strip (50% nitric acid)
11. Rinse
12. Rinse
13. Alzon CF, 20 sec
14. Rinse
15. Rinse
16. Ni-Star Strike (Optional) + Rinse
17. Ni-Star HP Electroless Nickel

Aluminum (Option 2):

18. Soak Clean (Cleaner 505)
19. Rinse
20. Etch (EtchAL) - Optional
21. Rinse
22. 50% Nitric acid + 50-100 g/L Econovate A
23. Rinse
24. Rinse
25. Alzon CF, 30 sec
26. Rinse
27. Zincate strip (50% nitric acid)
28. Rinse
29. Rinse
30. Alzon CF, 20 sec
31. Rinse
32. Rinse
33. Ni-Star Strike (Optional)
34. Rinse
35. Ni-Star HP Electroless Nickel

Notes about pretreatments:

- Correct cleaning is absolutely vital in electroless nickel plating. Good rinsing is also important in order not to drag into the solution ions which could cause contamination of the Ni-Star HP including zincate compounds.

- It is preferable that the articles enter the solution with an alkaline rather than acid film in order to give the best possible start to the process and increase adhesion.

- All materials must be free of oils, grease, organic contaminants, oxides and scales. It is very important that the base metal itself is carefully examined for physical damage such as scratches, pits, inclusions, cracks, roll or extrusion marks, all of which may adversely affect the appearance and performance of the electroless nickel deposit.

- Copper and its alloys, zinc, lead, tin, chromium and cadmium all need initiation before they will plate. This may be carried out using a separate electrolytic nickel strike or initiate the plating electrolytically in the EN tank using the stainless steel tank or a temporary anode. A steel brush will also initiate plating.

- Stainless steels should be treated in a Woods nickel strike solution before immersing in the Ni-Star HP. Nonmetals such as alumina, graphite, plastics and silicon can also be coated after using appropriate pre-treatment systems.

EQUIPMENT MAINTENANCE

Good housekeeping in electroless nickel plating is essential. All electroless nickel processes are sensitive to contamination such as metals, sulfur compounds and particulate matter such as dust. Great care should be taken to avoid contamination.

It is good practice to pump the solution out through the filter each day and wash the tank out. Once a week (or more often if required) carry out the full stripping procedure as described below.

When not in use the solution should be covered to reduce evaporation losses and contamination.

TANK STRIPPING PROCEDURE

When preparing brand new equipment fill the tank with fresh 50% v/v nitric acid and pump round the system for a minimum of 8 hours. This passivates stainless steel and leaches out soluble organics from plastic equipment. This should be followed by a thorough washing as indicated below.

Used tanks should be stripped regularly as follows:

1. Transfer the solution to spare tank.
2. Remove and clean filter bags.
3. Rinse and pump water round the equipment.
4. Fill the tank with 50% nitric acid.
5. Circulate the acid to ensure that all surfaces are contacted.
6. Leave overnight to strip nickel deposits which may have built up.
7. Pump acid to storage or effluent.
8. Wash out the tank and circulate water round system thoroughly.
9. Drain tank.
10. Fill tank with deionized water and circulate.
11. Drain tank.
12. Fit new filter.
13. Return nickel solution to tank, make up to volume with deionized water and analyses

MAINTENANCE AND CONTROL

The solution should be analyzed regularly and maintained at the optimum concentrations detailed under operating data.

Nickel analysis is used as a basis of maintaining the additions of Ni-Star HP Parts 1 and 3.

Ni-Star HP Part 1 and Ni-Star HP Part 3 are added on an equal basis (1:1)

Analysis		Additions	
Nickel	**Activity**	**ml/L Ni-Star HP Part 1**	**ml/L Ni-Star HP Part 3**
5.6	100%	0	0
5.5	98%	1.4	1.4
5.4	96%	2.9	2.9
5.3	95%	4.3	4.3
5.2	93%	5.7	5.7
5.1	91%	7.2	7.2
5.0	89%	8.6	8.6
4.9	88%	10.0	10.0
4.8	86%	11.4	11.4
4.7	84%	12.9	12.9
4.6	82%	14.3	14.3
4.5	80%	15.7	15.7
4.4	79%	17.2	17.2
4.3	77%	18.6	18.6
4.2	75%	20.0	20.0

pH - The replenishment chemistry should maintain the pH within the specified range. If it is necessary to adjust use a 50% v/v solution of ammonia or a 10% v/v solution of sulfuric acid.

NOTES:

1. To provide optimum plating conditions, it is be recommended to make frequent additions.

2. A complete solution replenishment is achieved when 80 ml per liter additions of Ni-Star HP Part 1 and Part 3 have been made.

3. It is unwise to operate below 90% bath strength. Should this occur, then make several additions to restore optimum operating conditions. There are three stabilizers in the bath. Failure to keep the bath at optimum can lead to instability and shorten life of the bath. Large additions may lead to over stability of the bath.

4. Plate-out and poor performance can occur chemically or initiated by parts in the tank. Care should be taken to avoid parts to touch the bottom of the tank and removed quickly if fallen in. If the bath maintains performance, plate-out was from parts and bath is usable after adjustments. If bath rate slows down or parts come out dark, contamination has occurred and a re-make is recommended

ANALYSIS METHODS

1. Nickel Concentration

Reagents

1. 0.1M EDTA
2. 50% ammonia solution
3. Murexide indicator

Method

1. Pipette 5.0 ml of bath (previously cooled) into an Erlenmeyer flask.
2. Add 50 ml of DI water.
3. Add approximately 10 ml 50% ammonia solution.
4. Add a small spatula tip of murexide indicator.
5. Titrate against 0.1 M EDTA solution to a purple end point.
6. Record titrant = t ml.

Calculation

Nickel (g/L) = mls of 0.1 M EDTA X 1.174

Replenishment

Refer to table in Maintenance and Control for appropriate additions.

2. Sodium Hypophosphite

Reagents

1. 0.1N iodine (standard volumetric solution)
2. Concentrated hydrochloric acid
3. 0.1N sodium thiosulfate (standard volumetric solution)
4. Iodine indicator solution

Method

1. Pipette 5.0 ml of bath (previously cooled) into an iodine flask.
2. Add approximately 50 ml DI Water.
3. Add 50 ml concentrated hydrochloric acid.
4. Pipette 50.0 ml 0.1N iodine into flask. Stopper flask and shake.
5. Place the flask in the dark for 30 minutes.
6. Titrate with 0.1 N sodium thiosulfate to a pale straw color.
7. Add a few drops of iodine indicator and continue titration to a clear end point.

Calculation

Sodium hypophosphite (g/L) = (50 - mls of 0.1 N sodium thiosulfate X 1.06

Replenishment

For every 1 g/L required add 2.5 ml/L Ni-Star HP Part 3. Do not add more than 7.5 ml/L in a single addition.

STORAGE

Store in original containers above 40°F

SAFETY

CAUTION! Ni-Star Part 1 concentrates contain acidic components. Ni-Star Part 2 and 3 concentrates contain alkaline components. Avoid contact with eyes, skin and clothing. Wear chemical handler's gloves, goggles and protective clothing when handling. Read and understand Material Safety Data Sheet before using this product.

PRODUCT GROUPS

The following products are referred to in this data sheet.

PRODUCT NAME	PRODUCT NUMBER
Alkaline Clean 45	206040
Econovate Dry Acid Salts	223001
Cleaner 505	206001
EtchAL	206044
Econovate A	223004
Alzon CF Make Up / Replenisher	225003 / 225004
Ni-Star Strike (Part 1, 2, 3)	551003, 551004, 557019
Ni-Star HP Part 1	557016
Ni-Star HP Part 2	557017
Ni-Star HP Part 2 LS	557037
Ni-Star HP Part 3	555011

NOTICE

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