

Ni-STAR HP (AF) ELECTROLESS NICKEL PLATING PROCESS

INTRODUCTION

Ni-Star HP (AF) is a state of the art electroless nickel-plating process, designed to deposit a uniform, nickel - phosphorus deposit, which has high corrosion resistance. Ni-Star HP (AF) has been designed to plate on ferrous and non-ferrous substrates. The deposit from Ni-Star HP (AF) exhibits low stress and will pass the Nitric Acid Test.

Ni-Star HP (AF) is supplied as a 3-part process:-

Ni-Star HP Part 1	Make up and Replenishment additive
Ni-Star HP Part 2	Make up additive
(Ni-Star HP Part 2 LS	Make up additive)
Ni-Star HP (AF) Part 3	Replenishment additive

BENEFITS

- Deposits suitable for marine environments
- Process suitable for plating high deposit thicknesses
- Consistent performance throughout bath life
- Excellent ductility and adhesion throughout bath life
- Deposits will pass Nitric Acid Test
- Good solution stability
- Can be used for rack and barrel plating

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DEPOSIT PROPERTIES

Phosphorus content	10-14%
Magnetic properties	Non Magnetic
Hardness:	
As plated	450-550VHN
After heat treatment 400°C / hour	900-1000VHN
Density (gm/cc)	7.85
Taber Abrader Index:	
As plated	20-25
After heat treatment @ 400°C	12-18
Corrosion resistance:	
Alkali salts	Fair
Petroleum brine	Excellent
Acid salts	Good
Porosity tests:	
Ferroxyl	Excellent
Salt Spray	Excellent

SOLUTION MAKE UP

Ni-Star HP Part 1	8% v/v
Ni-Star HP Part 2	20% v/v
(or Ni-Star HP Part 2 LS)	20% v/v (see NOTE)

Note

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

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OPERATING DATA

Nickel	5.0 - 6.0 g/L Optimum, 5.6 g/L
Sodium hypophosphite	30g/L
Temperature	85 - 90°C
pH	4.6 - 4.9
Agitation	Mild clean air agitation recommended
Loading	0.5 - 1.7 dm ² /L
Plating Rate	8 - 15 microns/hr

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

It is important not to leave the working bath idle at operating temperature for long periods of time. This activity will not only cause solution imbalance but also waste heat and expensive chemicals.

EQUIPMENT

- Tanks - High-density polypropylene or 316 Stainless Steel.
- Heating - PTFE or 316 Stainless Steel are recommended. Steam coils can be used, again made from PTFE or Stainless Steel.
- Filtration - 10 bath turnover per hour through 5 micron (or smaller) filter bags or cartridge. 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.

- Extraction - Essential.

INSTALLATION

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

1. Fill tank to half working volume with DI Water.
2. Add Ni-Star HP Part 1 (8% of final bath volume) mix well.
3. Add Ni-Star HP Part 2 or Ni-Star HP Part 2 LS (20% of final bath volume) mix well.
4. Add DI Water to final volume and mix well.

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5. Check solution pH (optimum 4.7 - 4.8). Adjust to within range if required. To increase pH use Ni-Star pH Adjuster and to lower pH use dilute sulphuric acid.

PROCESS SEQUENCE

See notes on pre-treatment.

MAINTENANCE AND CONTROL

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

Nickel analysis is used as a basis of maintaining the additions of Ni-Star HP Part 1 and Ni-Star HP (AF) Part 3.

Ni-Star HP Part 1 and Ni-Star HP (AF) Part 3 are added in 1:1.86 ratio.

Titre	Analysis		Additions	
	Nickel	Activity	Mls / litre Ni-Star HP Part 1	Mls / litre Ni-Star HP (AF) Part 3
4.8	5.6	100%	0	0
4.7	5.5	99%	1.2	2.2
4.6	5.4	96%	2.9	5.3
4.5	5.3	94%	4.5	8.4
4.4	5.2	92%	6.2	11.6
4.3	5.0	90%	7.9	14.7
4.2	4.9	88%	9.6	17.8
4.1	4.8	86%	11.2	20.9
4.0	4.7	84%	12.9	24.0
3.9	4.6	82%	14.6	27.2
3.8	4.5	80%	16.3	30.3
3.7	4.3	78%	18.0	33.4
3.6	4.2	75%	19.6	36.5
3.5	4.1	73%	21.3	39.7

Notes

1. To provide optimum plating conditions it would be preferable to make frequent additions.
2. A complete solution replenishment is achieved when 80ml/s per litre additions of Ni-Star HP Part 1 has been made.
3. It is unwise to operate solution below 90% strength. Should this occur then make several small additions to restore optimum operating conditions. 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.

ANALYSIS METHODS

Nickel Concentration

Reagents

0.1 M EDTA (standard volumetric solution)
50% Ammonia solution
Murexide indicator

Method

1. Pipette 5.0mls of bath (previously cooled) into a conical flask.
2. Add 50mls of DI Water.
3. Add 10mls 50% Ammonia solution.
4. Add a small spatula tip of Murexide.
5. Titrate against 0.1 M EDTA solution to a purple end point.
6. Record titre = t mls.

Calculation

$t \times 1.174 = \text{g/L Nickel}$

Replenishment

Refer to table in Maintenance and Control for appropriate additions.

Sodium Hypophosphite Concentration

Reagents

0.1 N Iodine (standard volumetric solution)
Concentrated hydrochloric acid
0.1 N sodium thiosulphate solution (standard volumetric solution)
Iodine indicator solution

Method

1. Pipette 5.0mls of bath (previously cooled) into an iodine flask.
2. Add 50mls concentrated hydrochloric acid.
3. Pipette 50.0mls 0.1 N iodine into flask. Stopper flask and shake.
4. Leave in a dark cupboard for 30 minutes.
5. Titrate with 0.1 N sodium thiosulphate to a pale straw colour.
6. Add a few drops of iodine indicator and continue titration to a clear end point.
7. Record titre = t mls.

Calculation

$(50-t) \times 1.08 = \text{g/L sodium hypophosphite.}$

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Replenishment

For every 1g/L required add 4.7ml/L Ni-Star HP (AF) Part 3. Do not add more than 14ml/L in a single addition.

EQUIPMENT MAINTENANCE

Good housekeeping in electroless nickel plating is essential. All electroless nickel processes are sensitive to contamination such as metals, sulphur 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.

STRIPPING PROCEDURE

When preparing brand new equipment fill the tank with fresh 50% v/v nitric acid (SG 1.37) 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 deionised water and circulate.
11. Drain tank.
12. Fit new filter.
13. Return nickel solution to tank, make up to volume with deionised water and analyse.

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NOTES

Pre-Treatments

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 (AF).

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.

The general pre-treatment sequence for steel is as follows.

1. Econoclense S, hot soak clean.
2. Rinse.
3. Econoclense D, periodic reverse clean.
4. Rinse.
5. Econovate acid activate or pickle (vary concentration and temperature depending on requirement).
6. Rinse.
7. Econoclense D, anodic clean.
8. Rinse.
9. Ni-Star HP (AF) 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 (AF) solution.

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.

Stainless steels should be treated in a Woods nickel strike solution before immersing in the Ni-Star HP (AF).

Non metals such as alumina, graphite, plastics and silicon can also be coated after using appropriate pre-treatment systems.

DISPOSAL

Dispose of in accordance with local authority requirements.

PRODUCT FAMILIES

The following product or product families are referred to in this data sheet.

<u>Product Name</u>	<u>Product Number</u>
Econoclense D	206004
Econoclense S	206005
Econovate Dry Acid Salt	223001
Ni-Star HP Part 1 (25L)	557016
(200L)	557021
(1000L)	557035
Ni-Star HP Part 2 (25L)	557017
(200L)	557022
(1000L)	557036
Ni-Star HP Part 2 LS	557037
Ni-Star HP (AF) Part 3(25L)	555027
(200L)	555028
(1000L)	555029

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