

## NI-STAR MP (CAF)

MID-PHOS ELECTROLESS NICKEL PLATING PROCESS

## INTRODUCTION

Ni-Star MP (CAF) is a state-of-the-art RoHS compliant cadmium- and ammonia-free electroless nickel-plating process, designed to deposit a uniform, bright nickel – mid phosphorus (5-8%) deposit. Ni-Star MP (CAF) has been designed to plate on ferrous and non-ferrous substrates. Ni-Star MP (CAF) is particularly suitable for plating on aluminium alloys.

### Ni-Star MP (CAF) is supplied as a 4-part process:

Ni-Star MP (CAF) Part 1 Make-Up and Replenishment Additive

Ni-Star MP (CAF) Part 2 Make-Up Additive

Ni-Star MP (CAF) Part 3 Replenishment Additive

Ni-Star MP (CAF) Part 4 pH Adjust (+)

## BENEFITS

- Bright deposits throughout solution life
- Consistent performance throughout bath life
- Excellent ductility and adhesion throughout bath life
- Good solution stability
- pH self-regulating
- High deposition rates throughout bath life, 0.7 – 1.0 mils per hour
- Can be used for rack and barrel plating

## SOLUTION MAKE-UP

Ni-Star MP (CAF) Part 1	8% v/v
Ni Star MP (CAF) Part 2	15% v/v

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# OPERATING DATA

Nickel	5.5 – 6.5 g/L Optimum 6.0 g/L
Sodium Hypophosphite	27 – 33 g/L Optimum 30 g/L
Temperature	185 - 194°F
pH	4.6 – 4.9
Agitation	Air or solution movement
Filtration	Continuous 5µm or less
Loading	0.2 – 0.7 sq. ft. / gal.
Plating rate	0.7 to 1.0 mils/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 is recommended or 316 Stainless Steel.
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.
Ventilation	Required

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# INSTALLATION

It is essential that the tanks to be used for Ni-Star MP (CAF) 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 MP (CAF) Part 1 and mix well.
3. Add the required volume of Ni-Star MP (CAF) Part 2 and mix well.
4. Add DI Water to full volume and mix well.
5. Analyze solution and adjust as necessary.  
(Adjust sodium hypophosphite with Ni-Star MP (CAF) Part 2 and pH+ with Ni-Star MP (CAF) pH Adjust)
6. Heat solution to operating temperature.

# PROCESS SEQUENCE

The general pretreatment sequences are as follows:

## Steel:

1. Hot Soak Clean (Cleaner SOP)
2. Rinse
3. Periodic Reverse Clean (Cleaner SOP)
4. Rinse
5. Acid Activate (Econovate Dry Acid Salts) or Pickle
6. Rinse
7. Anodic Clean (Cleaner SOP)
8. Rinse
9. Wood's Nickel Strike (for stainless steel – optional for steel)
10. Ni-Star MP (CAF) 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 MP (CAF) solution.

## Aluminum:

1. Soak Clean (Cleaner 505)
2. Rinse
3. Etch (Acid: 50% nitric acid + 50 g/L Econovate A) or (Caustic: EtchAL + Rinse + 50% nitric acid desmut)
4. Rinse
5. Rinse
6. Alzon CF, 30 sec
7. Rinse
8. Zincate strip with 50% v/v nitric acid
9. Rinse
10. Rinse
11. Alzon CF, 20 sec
12. Rinse
13. Rinse
14. Ni-Star Strike or (AF) (optional)
15. Rinse
16. Ni-Star MP (CAF) Electroless Nickel

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

# MAINTENANCE AND CONTROL

The solution should be analysed 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 MP (CAF) Part 1 and Ni-Star MP (CAF) Part 3.

Ni-Star MP (CAF) Part 1 and Ni-Star MP (CAF) Part 3 are added in a 1:1.5 ratio.

Analysis			Additions	
Titre	Nickel g/L	Activity	ml/L Ni-Star MP (CAF) Part 1	ml/L Ni-Star MP (CAF) Part 3
10.2	6.0	100%	0	0
10.0	5.9	98%	1.7	2.6
9.8	5.8	96%	3.3	5.0
9.6	5.6	94%	4.9	7.2
9.4	5.5	92%	6.4	9.6
9.2	5.4	90%	8.0	12.0
9.0	5.3	88%	9.5	14.4
8.8	5.2	86%	11.1	16.6
8.6	5.0	84%	12.7	19.0
8.4	4.9	82%	14.2	21.4
8.2	4.8	80%	15.8	23.6
8.0	4.7	78%	17.3	26.0
7.8	4.6	76%	18.9	28.4

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pH - *The replenishment chemistry should maintain the pH within the specified range (self-regulating). If it is necessary to adjust use Ni-Star pH Adjuster to increase the pH or a 10% v/v solution of sulfuric acid to reduce it.*

## NOTES

1. To provide optimum plating conditions it is be preferable to make frequent additions.
2. A complete solution replenishment (1 MTO) is achieved when 80 ml/L additions of Ni-Star MP (CAF) Part 1 and 120 ml/L Part 3 have been made.
1. 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.

## TROUBLESHOOTING NOTES

1. Care should be taken to operate the process properly to prevent tank plate-out which can occur from the following:
  - a. Overactive due to high temperature or high pH.
  - b. Overactive due to out-of-balance solution.
  - c. Debris in the solution.
  - d. Poor filtration.
  - e. Poor solution agitation.
  - f. Too high bath loading.
  - g. Poor cleaning of tank leaving nickel residues.
2. 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.

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# ANALYSIS METHODS

## 1. Nickel Concentration

### Reagents

1. 0.05M EDTA (standard volumetric solution)
2. Ammonium hydroxide
3. Murexide indicator

### Method

1. Pipette 5.0 ml of bath (previously cooled) into a 250 ml Erlenmeyer flask.
2. Add 100 ml of DI water.
3. Add approximately 5 ml ammonium hydroxide.
4. Add a 2 small spatula tips of murexide.
5. Titrate against 0.05 M EDTA solution from yellow gold to deep violet.

### Calculation

Nickel (g/L) = mls of 0.05 M EDTA X 0.587

### Replenishment

Refer to table in Maintenance and Control for appropriate additions.

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# ANALYSIS METHODS (cont.)

## 2. Sodium Hypophosphite

### Reagents

1. 0.1N iodine
2. Concentrated hydrochloric acid
3. 0.1 N sodium thiosulfate
4. Starch indicator solution

### Method

1. Pipette 5.0 mls of bath (previously cooled) into an iodine flask.
2. Add approximately 50 ml DI Water.
3. Add 50 mls concentrated hydrochloric acid.
4. Pipette 50.0 ml 0.1N iodine into flask. Stopper flask and shake.
5. Leave in a dark cupboard for 30 minutes.
6. Titrate with 0.1 N sodium thiosulfate to a pale straw color.
7. Add a few drops of starch 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 4.65 ml/L Ni-Star MP Part 3. Do not add more than 7 ml/L in a single addition. If >7 ml/L adds are required, make adds in 10 minute or more intervals.

# 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.

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# 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 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.

## STORAGE

Store in original containers above 40°F

## SAFETY

CAUTION! Ni-STAR MP (CAF) Part 1 & 2 concentrates and working solutions containing acidic components. Ni-STAR MP (CAF) Part 3 concentrate contains 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.

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# PRODUCT GROUPS

The following products are referred to in this data sheet.

PRODUCT NAME	PRODUCT NUMBER
Cleaner SOP	000000
Econovate Dry Acid Salt	223001
Cleaner 505	206001
EtchAL	206044
Ni-Star MP (CAF) Part 1	557018
Ni-Star MP (CAF) Part 2	551002
Ni-Star MP (CAF) Part 3	555013
Ni-Star MP (CAF) pH Adjust	555012

## NOTICE

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