



BARRETT SN

Sulfamate Nickel Plating Process

Product Code: 113401

DESCRIPTION

The **Barrett SN** Sulfamate nickel plating process is a method of rapidly electrodepositing nickel having exceptionally low tensile stress without the use of addition agents. This naturally low tensile stress makes the Sulfamate nickel electrolyte ideal for electroforming and other engineering applications.

Barrett SN is supplied either as a highly purified, ready-to-operate solution requiring no additional purification such as carbon treatment or 'dummy' electrolysis before use, or as a purified make up and replenishment concentrate. The Sulfamate nickel concentrate is Barrett SNR-24. This can be used as the nickel source when baths are made up from basic components instead of using the ready to use mix, **Barrett SN**, or as a replenisher concentrate where excessive drag-out operations lowers the nickel concentration.

Quality specification sheets for the Barrett SNR-24 are available from your MacDermid representative. Obtain and use the Barrett Sulfamate Nickel Operations Guide for more detailed information concerning the properties and options of operation for Barrett Sulfamate Nickel.

READ ENTIRE TECHNICAL DATA SHEET BEFORE USING THIS PRODUCT





FEATURES & BENEFITS

Bath Advantages

- Exceptionally high solution purity
- High current density operation at all temperature ranges
- High tolerance for impurities
- Wide latitude of operating conditions
- Simplicity of bath composition makes control and maintenance easy
- Produces nickel deposits of high chemical purity
- Excellent covering power
- Supplied either as a purified, ready-to-operate solution or concentrate solution

Deposit Advantages

- Electroforming complex shapes with low deposit stress
- Exact reproduction of mandrel surface
- High dimensional accuracy
- Wide range of easily reproduced physical properties
- Thick deposits with a minimum of nodules or treeing
- Ductile deposits over a wide range of hardness
- Prevents galling and fretting
- High tensile strength with low weight factor
- High temperature resistance
- Excellent corrosion resistance
- Minimizes loss of fatigue strength of basis metal

Some of these advantages can be obtained with other nickel solutions, but normally, additions of specific additives are required. Consequently, the deposit suffers in one or more physical property variations. Thus, Barrett Sulfamate nickel plating solutions have become the standard of many industries for electroplating and electroforming applications requiring engineering physical properties.





PHYSICAL PROPERTIES

Applications

The Barrett SN process is most often used for functional or engineering purposes rather than for decorative purposes. The wide range of physical properties attainable, the ease of control and maintenance, and the speed of deposition make it ideal for many electroplating applications.

The Barrett SN process is currently being used for these, as well as many other applications.

I. Electroplating

- | | |
|-------------------------------------|---------------------------|
| Electronic components: | Office machine parts |
| Printed circuits | Wire & strip plating |
| Transistors & diodes | Cladding softer metals |
| Connectors & terminals | Magnetic memory drums |
| Aircraft parts | Spark plugs |
| Missile & rocket hardware | Misc. nickel applications |
| Salvage (worn & mis-machined parts) | Brake pistons |
| | Hydraulic cylinders |

II. Electroforming

- | | |
|----------------------------|----------------------------|
| Record stampers | Printing screens |
| Plastic molds: | Prosthetic devices |
| Slush | Surface standard gauges |
| Compression | Paint spray masks |
| Injection | Embossing rolls & dyes |
| Electrotypes | Fine mesh screens |
| Electronic components: | Foil & tubing |
| Wave guides | Jewelry |
| Complex Aircraft parts | Plaques |
| Missile & rocket hardware: | Nameplates |
| Motor bodies | Switchplates |
| Nose cones, nozzles | Reflectors |
| Coffee urns & cookware | Optical mirrors & gratings |
| Fuel cells | Various molds & dies |
| Copy machine parts | Video & compact discs |





The physical properties of nickel, including its good corrosion protection and resistance, make it the ideal metal for many engineering applications. Unfortunately, the typical high internal stress developed in nickel deposited from other electrolytes (non-Sulfamate) has precluded their use for many engineering applications. Excessively high stresses can cause peeling, cracking, crazing, warping, blistering, distortion, shrinkage, and even complete destruction and failure of plated metals either as structural units or as protective coatings. Not only do high tensile stresses in plated coatings cause coating failure; they also induce premature fatigue failure of the underlying basis metal. The utilization of the Barrett SN process overcomes these problems.

The physical properties of nickel deposited from the Barrett SN electrolyte may be varied over a wide range. Desired values can be consistently reproduced by controlling operating conditions such as pH, operating temperature, and current density. Average deposit properties are as follows:

Hardness	175 to 230 HV ₂₀₀
Elongation in 2"	15 to 25%
Tensile strength	90,000 psi max. (620 MPa)
Internal stress	500 to 4000 psi tensile* (3.4-28 MPa)
Deposit appearance	Semi-matte

*Determined using Spiral Contractometer under specific conditions per ASTM B-636.

NOTE: psi x 10³ x 6.89 = MPa





OPERATING CONDITIONS

Bath Composition Barrett SN Ready Mix* Option 1

	100 Gallon Bath	100 Liter Bath
Barrett SN*	100 gallons	100 liters

*The Barrett SN bath is supplied as a purified, ready-to-use solution that requires no dilutions, additions other than boric acid, or treatments prior to use. The composition of the Barrett SN solution is:

Nickel Sulfamate* (anhydrous)	327 g/L (43.6 oz/gal)
**Equivalent nickel metal concentration	76.5 g/L (10.2 oz/gal)
Boric acid	30 g/L (4.0 oz/gal)
Barrett Additive 'A' *	3 g/L (0.4 oz/gal)
Barrett SNAP® A/M (anti-pit agent)	0.3% by volume
Water	Balance

***Additive A is a chloride-bearing corrosion aid. If a bromide-bearing aid is preferred, Additive B can be used instead at a concentration of 1-3% by volume (2% typical).**

Boric Acid

The boric acid concentration should be increased at operating temperatures above 32°C (90°F) as shown in the following chart:

Temperature	Boric Acid Conc.
32°C (90°F)	31.9 g/L (4.25 oz/gal)
43°C (100°F)	37.5 g/L (5 oz/gal)
49°C (120°F)	45 g/L (6 oz/gal)
54°C (130°F)	47 g/L (6.25 oz/gal)
60°C (140°F)	49 g/L (6.5 oz/gal)

NOTE: If operating temperatures are lower or allowed to vary after initial additions, the excess boric acid will precipitate out and must be filtered from the solution to prevent deposit roughness.





Bath Composition: Barrett SNR-24 Mix Option 2

	100 Gallon Bath	100 Liter Bath
Barrett SNR-24	42 gallons	42 liters

Composition (using Barrett SNR[®]-24):

Barrett SNR-24	42% by vol
Barrett Additive A	3 g/L (0.4 oz/gal)
Barrett SNAP A/M	0.3% by vol
Boric Acid	Refer to Boric Acid Chart
Water	Balance

The following are the typical operating conditions using either Barrett SN ready mix or Barrett SNR-24 concentrate. Chemistries can vary so review table 1 in this document.

Nickel metal content	76.5 g/L (10.2 oz/gal)
Boric acid	30 g/L (4.0 oz/gal)
Temperature	32 to 60°C
Operating pH	3.6 to 4.4
Cathode Current density	5 – 200 ASF (0.5 – 21.6 A/dm ²)

NOTES: Rack, barrel, and high-speed operations require modifications to the chemistry. Adjusting one variable may affect another (for example, if the temperature is change, the pH may have to be adjusted to 4.0 at the new temperature).





Sulfamate operating conditions may vary greatly depending on the application of the system. The more common applications generally use the following guidelines.

Constituent	Rack Operation	Barrel Operation	High Speed Operation	Strike
Nickel Metal	70 to 90 g/L	70 to 90 g/L	90 to 135 g/L	40 to 75 g/L
Anode Corrosion aid Barrett Additive "A"*	3 to 9 g/L	18 to 26 g/L	7.5 to 45 g/L	1.2 %v/v HCL (12 mL/L)
Boric Acid	Saturation based upon temperature	Saturation based upon temperature	20 to 30 g/L	30 g/L
Operating pH	3.8 to 4.2	2.8 to 3.3	3.2 to 3.8	1.0 to 1.5
Wetting agent Barrett SNAP A/M	0.1 to 0.4% v/v	No Wetter Desired	0.05 to 0.25% v/v	No Wetter Desired
Operating Temperature	32 to 60°C	60 to 66°C	60 to 66°C	27 to 38°C
Ammonium Ion	< 2000 mg/L	< 2000 mg/L	< 1000 mg/L	< 3000 mg/L
Internal Stress PSI	5000 Compressive to 10,000 Tensile	5000 Compressive to 10,000 Tensile	5000 Compressive to 10,000 Tensile	Not Applicable
Other				20 to 25 g/L Barrett SNAC
Cathode Current Density	0.5 to 20 A/dm ²	0.5 to 10 A/dm ²	15 to 50 A/dm ²	0.5 to 20 A/dm ²





NOTES: * Barrett Additive B can be used in place of Additive A if desired. The concentration range for Additive B would be 1.5% to 4.0% v/v.

More detailed operation data is found in the Barrett Sulfamate Nickel Operating Guide. Contact your Technical Advisor for this document.

BARRETT ADDITIVES

Barrett SNR-24 nickel Sulfamate concentrate contains a minimum of 180 g/l (24 oz/gal) of nickel metal, and is used to provide or maintain the metal concentration.

Barrett SNAC is a low ammonia, purified additive used to adjust the operating pH. In normal operation, using an active anode material, the pH will increase slowly. Reduction of pH is an indication of poor anode corrosion and should be corrected.

Barrett SNAP A/M is a wetting agent suitable for high agitation systems. Its function is to help prevent pitting caused by gassing or organic contamination.

Barrett SNAP L is a liquid wetting agent for the mechanically agitated Barrett sulfamate nickel plating solutions. Its function is to help prevent pitting caused by gassing or organic contamination.

Barrett SNHA is added to the electrolyte for applications requiring a hard more lustrous deposit or for compressive stress deposits. Electronic components and connector plating are typical applications. A concentration of 7.8 mL/L is typical for most applications.

Barrett Additive 'A' and 'B' are anode corrosion aids. Additive 'A' is a chloride bearing salt, highly purified and free of metallic contaminants. Additive 'B', a liquid has a similar function to the Additive A and is a bromide bearing salt.

More specific operational information is available in the Barrett Sulfamate Nickel Operating Guide.

Analytical procedures can also be obtained from MacDermid Inc. or your MacDermid Representative.

MAKE UP PROCEDURE

CAUTION: Read the Safety and Handling section before using or handling these products or their solutions.

1. Option A: Fill tank to proper operating level with Barrett SN solution. Add the additional required amount of boric acid based upon desired operating temperature.
1. Option B: If making the bath up using Barrett SNR-24 instead, add one half the required volume of water to the plating tank. Mix all components in the order listed.
2. Heat to the operating temperature.





3. Add the required amount of boric acid and mix thoroughly until dissolved.
4. Add the Barrett Additive 'A' (or 'B') and Barrett Snap A/M.
5. Adjust to final volume with water and mix until uniform.
6. Check the boric acid concentration and pH adjust if necessary.
7. The Solution is ready to use.

EQUIPMENT

Tanks:

Sulfur free rubber, plastisol or polypropylene tanks are recommended. Prior to use, tank should be leached for 12 hours with a solution of 25 g/l SNAC and 0.1% SNAP A/M.

Heating:

Karbate or PTFE steam coils, quartz immersion heaters or nickel, karbate, Pyrex or Duriron heat exchangers may be employed.

Filtration:

Continuous filtration is recommended with at least one solution turnover per hour. Polypropylene cartridges (5-10 micron) are recommended.

Anodes:

Sulfur depolarized nickel anodes are most suitable for Barrett Sulfamate processes, allowing higher current density operation. Insoluble anodes, when used, will produce oxidized forms of sulfur compounds that increase brightness and yield a harder, less ductile, more compressively stressed deposit. Polypropylene or ploynap anode bags are recommended to prevent rough deposits.

SOLUTION MAINTENANCE

Check the nickel metal content, boric acid concentration, pH, and SNAP A/M and Additive 'A' concentrations. Use Barrett SNR[®]-24 to maintain the nickel metal content at optimum concentrations. Maintain the pH with additions of Barrett SNAC[®]. Maintain the boric acid, SNAP A/M, and Additive 'A' concentrations with additions of each material as





SAFETY & WARNING

MacDermid Enthone recommends that the company/operator read and review the Safety Data Sheets for the appropriate health and safety warnings before use.

Safety Data Sheets are available from MacDermid Enthone.

WASTE TREATMENT

Prior to using any recommendations or suggestions by MacDermid Enthone for waste treatment, the user is required to know the appropriate local/state/federal regulations for on-site or off-site treatment which may require permits. If there is any conflict regarding our recommendations, local/state/federal regulations take precedent.

ORDER INFORMATION

Product	Code
Barrett SN	113401
Barrett SNR-24	113403
Barrett SNAC	113409
Barrett SNAP AM	113412
Barrett SNAP L	113410
Barrett SNHA	113414
Barrett Additive A	113415
Barrett Additive B	113416

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Also read carefully warning and safety information on the Safety Data Sheet. This data sheet contains technical information required for safe and economical operation of this product. READ IT THOROUGHLY PRIOR TO PRODUCT USE. Emergency directory assistance Chemtrec 1 - 800 - 424 - 9300.

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