EVECO CORPORATION
ISO 9001-2000

DATA SHEET

Dev-Zinc Ni-alloy

Dev-Zinc Ni-alloy is an acid chloride based zinc-nickel alloy plating system utilizing ammonium chloride, boric acid, zinc chloride and nickel chloride in the electrolyte. The alloy deposited is bright over the entire current density plating range of 1 to 100 ASF. Parts plating with the **Dev-Zinc Ni-alloy** process are leveled and ductile.

The nickel content of the alloy will vary between 10 – 15% by weight, where maximum corrosion resistance is achieved. Generally, the range of nickel deposited is varies 2 to 3% over the current density range plated. This allows for maximum performance of the specially designed chromate conversion coatings for this process.

Dev-Zinc Ni-alloy can be used in either rack or barrel plating operations with either air or mechanical agitation. Where barrel plating is used, barrel rotation is sufficient for solution movement.

Specially designed chromate conversion coatings allow the deposit to be chromated in blue-bright, yellow and black conversion coatings. Trivalent and non-chrome black conversion coatings are available.

Operating Parameters:

	Recommended	**Range**
Zinc Metal	2.0 oz/gal	1.7 – 2.2 oz/gal
Nickel Metal	3.5 oz/gal	3.2 – 3.8 oz/gal
Total Chloride	25 oz/gal	22 – 28 oz/gal
Boric Acid	3.0 oz/gal	2.7 – 3.3 oz/gal
Zinc to Nickel ratio	1:1.8	1:1.5 – 1:2.0
PH	6.2	6.0 – 6.5
Temperature	105 ^{o}F	100 – 110 ^{o}F
Dev-Zinc Ni-alloy Carrier	5%	4 – 6%
Dev-Zinc Ni-alloy Replenisher	0.30%	0.20 – 0.40%
Cathode Current Density ASF	5 – 25 ASF	
Anode Current Density ASF	15 – 35 ASF	

Make-up Procedure:

- Leach the tank with 1 to 2% Hydrochloric Acid if it's new or has been used in other applications.
- Add about 1/2 of the volume with cold water to the clean tank. Warm the water to 90 –100 ^{o}F to speed up the dissolution of the chloride salts.
- Add the Ammonium Chloride. The solution will cool. Allow it to return to room temperature before proceeding.
- Add the Zinc Chloride 50% solution, Nickel Chloride and Boric Acid.
- Adjust the pH with Ammonium Hydroxide to the pH range of 6.0 – 6.5.
- Add the appropriate amounts of Dev-Zinc Ni-alloy additives.

	100 Gallons	**100 Liters**
Ammonium Chloride	163 lbs	43 lbs
Zinc Chloride Solution 50%	5.7 gals	5.7 liters
Nickel Chloride salts ($NiCl_2 * 6H_2O$)	85 lbs	22 lbs
Boric Acid	19 lbs	5 lbs
Ammonium Hydroxide (as needed to adjust pH)	Approx. 8 gals	Approx. 8 liters
Dev-Zinc Ni-alloy Carrier	5 gals	5 liters
Dev-Zinc Ni-alloy Replenisher	1140 mls	300 mls

Control and Maintenance:

- Typical control of the additives is done by amp-hours. It may also be done by direct observation of the deposit, and use of a heated Hull Cell.
  - **Dev-Zinc Ni-alloy Carrier** is typically added at the rate of 1 gal (3.8 liters) per 7,500 A-Hrs. Alternative method - add at the rate of 1.5 gals (5.7 liters) per 100 lbs (45.5 Kg) Ammonium Chloride. It refines the grain and extends the bright current density plating range of the bath.
  - **Dev-Zinc Ni-alloy Replenisher** is typically added at the rate of 1 gal (3.8 liters) per 10,000 A-Hrs. It increases the brightness and leveling of the bath.
- It's highly advisable that before any adjustments are made in the organic additives, the temperature, pH, chloride, zinc and nickel be checked and adjusted within range.

Temperature

- Below the recommended range will cause the bath constituents to precipitate.
- Above the recommended range will cause excessive nickel to be deposited, particularly in the low current density areas.

pH

- Below the recommended range will induce brittleness in the high current density areas.
- Above the recommended range will cause graininess in the deposit and may cause some of the bath constituents to precipitate.
- Monitor with a pH meter regularly; raise the pH with Ammonium Hydroxide and lower it with Hydrochloric Acid.

Ammonium Chloride

- It's essential to the operation of the bath. The ammonium ion acts as an additive, resulting in brighter deposits as well as controlling the amount of nickel available for deposition.

Anode baskets

- Anode baskets for both the zinc and nickel should be constructed of Titanium. In rack installations, Dynel or polypropylene bags should be used.

Zinc to Nickel ratio

- This number is very important since it affects the quality and appearance of the plate. The best ratio yields a deposit with 10 – 15% nickel in it.
- High nickel levels induce brittleness and the deposit becomes difficult to chromate.
- Low nickel levels result in a cloudy deposit and adversely affect corrosion resistance.

Anodes

- The most economical operation uses both Nickel and Zinc anodes in the bath. The ratio of nickel to zinc must be determined empirically after operating the bath, but is generally in a ratio of 1 anode nickel for each 2 to 3 anodes zinc.
- An easier to control operation uses Nickel anodes in the bath, and additions of liquid zinc chloride 50% - to control the Zinc concentration in solution.
- Inert anodes – Iridium Oxide coated Titanium – may also be used.

Agitation

- Agitation is extremely important in the alloy plating process. Air or cathode rod agitation are acceptable methods. The speed of the cathode rod will influence the alloy deposition and must be determined to insure the proper alloy is deposited.

Filtration

- Filtration is essential for plating quality. Suspended solids from anode sludge, iron salts, organic iron salts, etc. will cause roughness if not filtered. Filter media of 20 to 50 microns works well. The use of diatomaceous earth is highly recommended to facilitate the filtering process.

Zinc Analysis:

- Pipette a 1 ml sample of the bath into a 250 ml Erlenmeyer flask.
- Add 100 mls DI water .
- Add 20 mls pH 10 Buffer solution (70 g Ammonium Chloride, 570 mls conc. Ammonium Hydroxide, and DI water to dilute to 1000 mls) Mix well.
- Add 0.5 – 1.0 gr Sodium Cyanide and mix until the Sodium Cyanide is dissolved
- Add 0.1 gr EBT indicator. Color of the solution should be blue/green to violet.
- Add 15 mls 10% Formaldehyde or until the color changes to violet.
- Titrate with 0.0575 M EDTA a permanent blue color persists for at least 15 seconds.

Mls 0.0575 M EDTA x 3.75 = g/l Zinc
Mls 0.0575 M EDTA x 0.5 = oz/gal Zinc

Nickel Analysis:

- Determine by Atomic Absorption methods

Chloride Analysis

- Pipette a 1 ml sample of the bath into a 250 ml flask
- Add 50 to 100 mls DI water
- Add 5 mls 10% Sodium Chromate solution
- Titrate with 0.1 N Silver Nitrate to a reddish-brown end-point.

Mls 0.1 N $AgNO_3$ x 3.55 = g/l Chloride
Mls 0.1 N $AgNO_3$ x 0.473 = oz/gal Chloride

Boric Acid Analysis

- Pipette 2 mls of sample into a 250 ml flask
- Add about 50 mls DI water
- Add 10 drops Bromocresol Purple indicator
    - If the solution color is yellow-orange, add 0.1 N NaOH dropwise to a slight purple color
    - If the solution color is purple, add 0.1 N HCl dropwise to a definite yellow-orange, then add 0.1 N NaOH to a slight purple
- Add 5 grams Mannitol powder and mix. Approx one heaping tablespoon
- Add one dropper of Phenolphthalein indicator.
- Titrate with 0.1 N Sodium Hydroxide to a slight purple end-point

Mls 0.1 N NaOH x 0.412 = oz/gal Boric Acid