

# DATA SHEET

## Empire Zinc Chloride Process (FOR POTASSIUM, AMMONIUM AND MIXED CHLORIDE SALTS BATHS)

**Deveco Empire** is an economical high temperature zinc chloride plating process that can be used with or without ammonia. It produces a superior bright, level finish on barrel or rack plated parts. It will easily plate carbonitrided steel, cast iron, and case hardened steel.

With the addition of Cobalt Chloride, the mixed potassium-ammonium bath can be easily converted to a Zinc-Cobalt alloy bath, plating an alloy containing 0.3–0.9% (by weight) Cobalt.

### BENEFITS:

**1. High operating temperature range:**

The plating bath can be operated as high as 120 degrees F. and not oil out. Cooling requirements are greatly reduced or eliminated.

**2. Wide plating current density range:**

This product operates at higher current densities to produce bright deposits with excellent ductility, productivity, and faster plating over a wider variety of parts without burning. The tendency for flaking or blistering is reduced or eliminated when plating thicker deposits.

**3. Low foam operations:**

This product permits increased use of air agitation to improve plating brightness and oxidize iron. It reduces or eliminates the need for hydrogen peroxide treatment of iron.

**4. Simplified control:**

The two-component system is stable over a wide temperature range. The uncomplicated operating and replenishment procedures reduce the chance of brightener imbalance.

**5. In-house wetter test:**

This system has an easy to run wetter concentration test with no boiling down of the solution.

### HOW TO USE:

Before making up the **Deveco Empire** Zinc solution, the tank must be cleaned and rinsed thoroughly. In addition, the tank should be leached for 24 hours minimum with 3% by volume Hydrochloric Acid to which has been added 0.1% by volume of **Empire Zinc Wetter** or **Wetter AC**. At the end of the leaching period, the tank should be drained and rinsed thoroughly with water.

### MAKE UP:

**100 GALLONS**

**\* Preferred Zn-Co \***

	Non-Ammonium	Mixed Bath with Boric	* Mixed Bath without Boric *	All Ammonium
Zinc Chloride	6 gallons	6 gallons	7.5 gallons	6 gallons
Potassium Chloride*	200 lbs.	170 lbs.	144 lbs.	---
Ammonium Chloride*	---	20 lbs.	48 lbs.	140 lbs.
Boric Acid*	20 lbs.	10 lbs.	---	---
Empire Zinc Wetter	3.5 gallons			
Empire Zinc Wetter AC		3.5 gallons	3.5 gallons	3.5 gallons
Empire Zinc Brightener	1 pint	1 pint	1 pint	1 pint
CoCl <sub>2</sub> (14% Co)			1.85 gallons	
Water to make	100 gallons	100 gallons	100 gallons	100 gallons

\*Pre-mixed salts are available.

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### SOLUTION COMPOSITION:

Zinc Metal	3.0 oz/gal	3.0 oz/gal	3.8 oz/gal	3.0 oz/gallon
Chloride	18 oz/gal	18 oz/gal	20 oz/gal	18 oz/gallon
Boric Acid	3.0 oz/gal	1.5 oz/gal	---	---
Cobalt Metal			3.5 gr/liter	

### OPERATING RANGE:

PH	5.0 to 5.8	5.0 to 5.8	5.0 to 5.8	5.0 to 5.8
Zinc	2.5 to 3.5 oz/gal	2.5 to 3.5 oz/gal	3.0 to 4.0 oz/gal	2.5 to 3.5 oz/gal
Chloride	16 to 20 oz/gal	16 to 20 oz/gal	18 to 22 oz/gal	16 to 20 oz/gal
Cobalt			3.0 to 3.6 gr/liter	
Boric Acid	2 to 3 oz/gal	1 to 1.5 oz/gal	---	---
Empire Zinc Wetter	3 to 4%			
Empire Zinc Wetter AC		3 to 4%	3 to 4 %	3 to 4%
Empire Brightener	Based on amperage and drag-out. Avg. 25,000 to 40,000 amp hrs/gal	Based on amperage and drag-out. Avg. 25,000 to 40,000 amp hrs/gal	Based on amperage and drag-out. Avg. 25,000 to 40,000 amp hrs/gal	Based on amperage and drag-out. Avg. 25,000 to 40,000 amp hrs/gal

### MAKE- UP PROCEDURE:

1. Add water to one-half of tank volume. Use warm water 140 degrees F if available.
2. Add the Potassium Chloride and/or Ammonium Chloride and dissolve.
3. Add the Boric Acid (if required) and dissolve.
4. Add the Zinc Chloride concentrate.
5. Check the pH with a meter (do not use paper). Adjust the pH to 5.0 to 5.8 with Potassium Hydroxide (caustic potash) or 50% Hydrochloric Acid
6. Bring solution near operating level and recheck pH.
7. Add the Cobalt Chloride (if required).
8. Add **Empire Wetter** or **Wetter AC**, then **Empire Brightener** to tank.
9. Bring solution to operating volume and stir to achieve uniform composition.

### OPERATING CONDITIONS:

#### pH

Check pH of bath daily. Standardize meter daily.

#### TEMPERATURE:

Optimum for best operation and low brightener consumption is 85-95 °F. If the **Empire** Zinc bath becomes chilled, crystallization of the salts may occur. These will redissolve on heating the bath to 70 °F. and agitating.

**WARNING: Do not allow bath to chill for long periods below 70 °F. Organic additives may also salt out.**

#### VOLTAGE:

Rack Plating: 1 to 4 volts

Barrel Plating: 4 to 9 volts

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#### CATHODE CURRENT DENSITY:

0.1 to 5A/dm sq. (1 to 50 A/ft sq.)

#### FILTRATION:

Filtration is recommended to remove iron sludge contamination. A filter rate sufficient to process the solution once or twice per hour is recommended for optimum performance.

#### AGITATION:

Air agitation is recommended. Either air or mechanical agitation is mandatory for rack operations.

#### RECOMMENDED PROCESS CYCLE:

- 1) Soak Clean
- 2) Rinse
- 3) Anodic Clean (12 volt rectifier)
- 4) Rinse
- 5) Hydrochloric Acid (15 to 50 % Inhibited)
- 6) Rinse
- 7) Deveco Empire Zinc Plate**
- 8) Rinse
- 9) Sour Rinse-Nitric Acid- 1/2 oz/gal
- 10) Chromate Dip
- 11) Rinse
- 12) Rinse
- 13) Dry

Rack Plating: 6-volt rectifier

Barrel Plating: 6 to 9 volt rectifier

Rinsing after **Empire Zinc** plating must be thorough, and the last rinse tank should be clear at all times (agitate rinse tanks and hold water in final rinse tank long enough for water to clear). In a barrel plating installation, it is sound practice to allow the barrels to drain before they enter the **Empire Zinc** bath, and also allow them to drain the zinc solution back into the plating tank or a drop out tank. This practice minimizes flooding of the plating tank as well as excessive drag-out of plating solution resulting in high cost operation.

#### MAINTENANCE:

Analyze for zinc and chloride and make required additions using Potassium Chloride, Ammonium Chloride or Zinc Chloride concentrate. Check pH electrometrically and adjust with 50% Hydrochloric Acid or Potassium Hydroxide (caustic potash).

Potassium Chloride used in making up and replenishing Empire Zinc baths must not contain humectants such as Tri-Calcium Phosphate or any organic additives. Use only chemical grade Potassium Chloride, or Deveco mixed salts are available.

Add 1 ½ to 2 gallons **Empire Wetter** or **Wetter AC** for every 100 lbs. of Ammonium or Potassium Chloride salts added to bath.

As brightener consumption and bath composition are affected by drag-out, drag-in and temperature, it is recommended that routine analysis and Hull Cell tests be made to better determine the need for additions of **Empire Brightener**, **Empire Wetter** and **Wetter AC**. Always perform a Hull Cell test before making large additions to the bath. Excessive additions of **Empire Brightener** may cause a brittle deposit.

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### TREATMENT OF IRON CONTAMINATION:

Care should be taken to avoid iron contamination. Fallen parts should be removed from the tank immediately. If the plating solution turns a brown, murky color, it is an indication that the bath is contaminated with iron.

To precipitate and remove the iron by filtration, add hydrogen peroxide (35%) at the rate of 10 ml. per 100 liters (1.2 fl. oz. per 100 gallons) of plating solution. Dilute the hydrogen peroxide with 4 parts water and spread as evenly as possible over the surface of the solution to achieve the maximum effect. Always add the hydrogen peroxide at the end of the working day. Daily additions may be necessary where the plating solution is continually contaminated with iron. Use of heavy agitation at a pH of 5.5 to 5.8 will reduce or eliminate the need for peroxide treatments.

### PRECAUTIONS:

**Empire Zinc** solution ingredients can be quite irritating to sensitive skin. If the materials are spilled or splashed on the skin, remove by washing the area with soap and water immediately.

### EQUIPMENT REQUIRED:

**Tank**--Steel, lined with PVC, rubber, or polyethylene. (If fiberglass is used, leaching must be most thorough.) Furthermore, the tank or lining manufacturer should warrant that no mold release was used in tank construction, or specify the mold release and means of removal of impregnation from the fiberglass.

**Anodes**--Anodes should be warranted as to analysis of the anode (not the zinc pig from which the anode was cast). Anodes should be pure zinc special high grade A.S.T.M. Specification (99.99% zinc), drilled and tapped for the anode hooks (titanium hooks preferred). No inert or bipolar anodes can be used. Baskets made of commercially pure titanium may be used with appropriate pure zinc anode metal if the applied voltage does not exceed 8 volts. Baskets must be kept full, with all the zinc below the level of solution. Baskets and anodes should be kept clean to maintain good contact between the basket and the zinc anode metal. Stray currents, current interruptions, excessive ripple in the power source must be avoided. Baskets may also be constructed of expanded metal and coated with Plastisol, using a titanium or zinc strip as a lead-in conductor to the anode metal. Anode area must be sufficient to keep anode current density below 25 ASF.

**Filter**--Filter capacity sufficient to filter solution once or twice per hour recommended. All filter parts in contact with solution must be non-metallic. Stainless steel or iron is not acceptable. Do not use paper or cellulose in any form as a filtering media. Dynel or diatomaceous earth is suggested. (For filter recommendation, ask your Devco Representative)

**Agitation** - Air agitation using a low pressure air blower is recommended. Cathode rod agitators can also be used, with a movement rate of 1 to 2 meters (3 to 6 feet) per minute. Solution pump circulation is acceptable if it is vigorous. In a large tank in an automatic plating machine, intake and discharge if the filter or circulating system should be at opposite ends of the tank countercurrent to work flow. It is helpful to introduce a stirring mixture with the blade set at an angle so that the solution is made to roll and move in the tank.

**Power**--Rack plating: 6 volt power source; Barrel plating: 9 volt power source. Rectifier must have low ripple (5% maximum). Be sure that current for the plating tank is being measured with a reliable meter.

**Bus Bar Protection**--Cover bus bars with tape, clear vinyl or Plastisol except at points of anode hook contact, to minimize corrosion and possible Copper contamination of solution.

**Heating & Cooling**--To obtain maximum performance, heating is required. Heaters or heating coils must be titanium, Teflon or quartz. Cooling may be required in barrel or rack operation in extreme ambient temperature. Cooling coils: Teflon, Teflon-coated copper, circuit; graphite or quartz heat exchanger, tap water or refrigeration unit as required.

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#### ANALYSIS AND CONTROL:

##### Zinc Metal:

1. Pipette 5 ml. of plating solution into a 250 ml. Erlenmeyer flask.
2. Add 100 ml. of distilled water.
3. Add concentrated ammonium hydroxide until the solution turns from cloudy to clear.
4. Add a small amount of Eriochrome Black T indicator until a deep violet-red color develops.
5. Titrate with 0.0575 M EDTA solution to a blue endpoint (disappearance of any red color).

**Calculation:**  $\text{Oz/gal Zinc} = \text{ml. } 0.0575 \text{ M EDTA} \times 0.1$

To increase Zinc content  $\frac{1}{2}$  oz/gal add 1 gallon Zinc Chloride concentrate per 100 gallons of plating solution.

##### Boric Acid:

1. Pipette 10 ml. of plating solution into Erlenmeyer flask.
2. Add 100 ml. of 10% Mannitol.
3. Add 1 ml. Bromocresol Purple.
4. Titrate with 1.0 N NaOH solution until a bluish purple end point.

**Calculation:**  $\text{Oz/gal Boric Acid} = \text{ml. of } 1.0 \text{ N NaOH} \times .82$

To raise Boric Acid 1.0 oz/gal. add 6.25 lbs. of Boric Acid per 100 gallons of plating solution.

##### Chloride:

1. Pipette a 1 ml. sample of the plating bath into an Erlenmeyer flask.
2. Add 75-100 ml. of distilled water.
3. Add about 5 ml. of 10% Sodium Chromate.
4. Titrate with 0.1N silver nitrate until a permanent reddish brown color forms on a white chloride precipitate.

**Calculation:**  $\text{Oz/gal of Cl} = 0.473 \times \text{mls of Silver Nitrate}$

#### Empire Wetter Concentration:

##### Reagents and equipment needed:

1. 150 mls glass beaker
2. Thermometer (range to 200 degrees F.)
3. Heating magnetic stirrer with stir bar

##### Procedure:

1. Place 75 – 100 mls of the sample in the beaker.
2. Heat, while stirring, until the sample becomes cloudy.
3. Add about 10 mls of 50% HCl.
4. Place about 10mLs of acidified sample in a centrifuge tube.
5. Making sure the load is balanced, then centrifuge for 10 minutes.
6. Remove and compare the separation with the standards. Note estimated wetter concentration in %.

For standards, make up solutions of 2,3,4, and 5 % (by volume) of wetter product and treat as above.

#### MEASUREMENT OF pH:

Measure pH with pH meter. Adjust with 50% Hydrochloric Acid or Potassium Hydroxide (Caustic Potash).

#### RECOMMENDED CHROMATING SYSTEM

All Deveco chromates are compatible with the **Empire** brightener system, but check with a Deveco salesperson for the best chromate for a particular application.

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### PACKAGING:

**Empire Zinc Brightener** and **Empire Zinc Wetter and Wetter AC** are packaged in 55-gallon non-returnable polyethylene containers and totes.

### SHIPPING DATA:

Classifications:

<b>Empire Zinc Wetter</b>	Soap NOI, liquid
<b>Empire Zinc Wetter AC</b>	Soap NOI, liquid
<b>Empire Zinc Brightener</b>	Compounds or agents, proprietary electroplating additive; chemicals NOI, liquid

**Read Material Safety Data Sheet before using this product.**

### DISCLAIMER:

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Product Data Sheet/PZ037, PZ038, PZ075

Effective Date: 3-9-04

Supersedes: 7-27-02