HP RADIANCE AZ
ACID ZINC-CHLORIDE PROCESS

HP RADIANCE AZ produces a brilliant level and ductile deposit from Boric Acid or Potassium-Ammonium salt bath formulations.

HP RADIANCE AZ is tolerant to high temperature operation up to 120°F and works well in either rack or barrel operations.

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HP RADIANCE AZ contains a special compound that insures an extremely bright and ductile deposit at higher current densities.

HP RADIANCE AZ is simple two component system for easy bath control and maintenance.

HP RADIANCE AZ components are free of complexing agents and have excellent rinsing characteristics for reduced drag-out and improved chromate receptivity.

HP RADIANCE AZ very low foaming even with vigorous air agitation or evaporative recovery.

OPERATING PARAMETERS:

Boric Acid Bath:

	RACK	BARREL
Zinc Metal	3 – 4.5 oz/gal	2.5 – 4 oz/gal
Potassium Chloride	17 – 20 oz/gal	16 – 18 oz/gal
Boric Acid	3 – 4.5 oz/gal	2.5 – 4 oz/gal
HP RADIANCE AZ CARRIER	3 – 5% by vol	3 – 5% by vol
HP RADIANCE AZ BRIGHTNER	0.05 – 0.15% by vol	0.05 – 0.15% by vol
pH (Electrometric)	4.8 – 5.8	4.8 – 5.8
Temperature	75 – 120°F	70 – 120°F

Potassium-Ammonium Bath (Rack or Barrel):

Zinc Metal	2.0 - 5.0 oz/gal (15 - 37.5 g/l)
Chloride Ion*	16 - 20 oz/gal (120 - 150 g/l)
HP RADIANCE AZ CARRIER	3 - 5% by vol
HP RADIANCE AZ BRIGHTENER	0.05 – 0.15% by vol
pH (Electrometric)	5.0 - 5.9
Temperature	70 - 120ºF (22 - 48ºC)

*Bath requires a **MINIMUM** of 4 oz/gal (30 g/l) Ammonium Chloride and operates at an OPTIMUM of 6 oz/gal (45 g/l).

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SOLUTION MAKEUP:

Boric Acid bath:

	PER 100 GALLONS
Zinc Chloride	58 lbs
Potassium Chloride	200 lbs
Boric Acid	28 lbs
HP RADIANCE AZ CARRIER	4 gal
HP RADIANCE AZ BRIGHTENER	6 – 13 fl/oz (180 – 380 mls)

Potassium-Ammonium Bath:

Zinc Chloride	33 lbs
Potassium Chloride	171 lbs
Ammonium Chloride	30 lbs
HP RADIANCE AZ CARRIER	4 gal
HP RADIANCE AZ BRIGHTENER	6 – 13 fl/oz (180 – 380 mls)

Note: Prior to making up a **HP RADIANCE AZ chloride** zinc plating bath, the process tank should be thoroughly cleaned and leached for a period of 24 hour with a solution of 5% by volume Hydrochloric acid. The bath is then prepared by dissolving Zinc Chloride, Potassium Chloride and either Boric acid or Ammonium Chloride in approximately two-thirds of the bath volume in HOT water. After all the salts have been thoroughly dissolved, add the required amount of **HP RADIANCE AZ CARRIER** to the bath and mix until dispersed. Follow the same procedure with the **HP RADIANCE AZ BRIGHTENER**. Then add water to adjust to the operating volume and mix well.

Recommended total chloride range for potassium-ammonium salt bath should be as follows:

Zinc Metal (oz/gal)	Total Chloride (oz/gal)
1.0 – 3.0	16.0 – 18.0
3.0 – 5.0	18.0 – 21.0

The (total) chloride ion can be controlled by adding a mixture of 80% by weight potassium chloride and 20% by weight ammonium chloride. Two ounces per gallon of this mixture will yield one ounce per gallon of chloride ion.

Ammonium Chloride and Potassium Chloride or Boric acid are the only chemical additions required in the bath during normal operation. They should be added on a regular basis based on periodic analysis for chloride or boric acid.

The following equivalents should be noted when maintaining the chloride content of the bath:

Ammonium Chloride contains 66% chloride.
Potassium Chloride contains 48% chloride.
Zinc Chloride contains 52% chloride and 48% zinc metal.

E.g. To raise the total chloride content 1.0 oz/gal requires 0.34 oz/gal Ammonium Chloride (NH4CL) and 1.75 oz/gal Potassium Chloride (KCL).

Only Untreated Potassium Chloride must be used in making up and replenishing the **HP RADIANCE AZ** baths and must not contain any harmful or organic additives. Only high purity grade zinc chloride should be used. Low-grade chemicals will cause the bath to not perform properly.

MAINTENANCE ADDITIONS:

HP RADIANCE AZ BRIGHTENER is maintained in the bath at the rate of one gallon per 15,000 to 20,000 ampere-hours. Additions should be made every two to four hours of operation or continuously through the use of an addition agent pump.

HP RADIANCE AZ CARRIER is primarily lost through drag-out but may also be lost due through frequent treatment for iron. The most efficient and effective way to replace **HP RADIANCE AZ CARRIER** is to add it in conjunction with **HP RADIANCE AZ BRIGHTENER** as follows:

LOW DRAG-OUT/LOW IRON CONTAMINATION (Most Rack Baths)
Add 1/2 gallon **HP RADIANCE AZ CARRIER** with each 1 gallon **HP RADIANCE AZ BRIGHTENER**

MEDIUM DRAG-OUT (Most Barrel Baths, Some Rack Baths)
Add 1 gallon **HP RADIANCE AZ CARRIER** with each 1 gallon **HP RADIANCE AZ BRIGHTENER**

HIGH DRAG-OUT/HIGH IRON CONTAMINATION (Some Barrel Baths)
Add 2 gallons **HP RADIANCE AZ CARRIER** with each 1 gallon **HP RADIANCE AZ BRIGHTENER**

Note: Maintenance of **HP RADIANCE AZ** additives should be checked by the use of periodic Hull-cell evaluations.

PLATING CHEMICAL ADDITIONS, EQUIPMENT & PROCEDURES:

pH:
pH of the bath should be maintained within operating limits by the addition of dilute Hydrochloric Acid. Care should be taken during pH adjustment as the pH changes quite rapidly with small additions of acid. Hydrochloric acid should be diluted with equal parts water prior to adding to the bath to avoid localized precipitation of addition agents. The pH should be checked using a meter and not pH paper.

Too high of a pH (over 6.0) causes Low Current Density dullness. Low pH conditions are not normally encountered and occur only if excessive amounts of Hydrochloric Acid have been added during pH adjustment. If this occurs, dilute Ammonium Hydroxide or Potassium Hydroxide may be added to raise the pH to the proper operating level. Ammonium Hydroxide is preferred because it is instantly soluble in the bath.

Zn Metal:
Zinc Metal is normally maintained by anodic dissolution during electrolysis. High-grade zinc slab anodes of minimum 99.99% purity are recommended as an economical anode source.

Anodes may be drilled and tapped or used in titanium anode baskets. Little or no dissolution of anodes occurs during idle periods and anodes do not have to be removed from the bath during shutdowns. It is recommended to maintain as much anode area as possible to promote good current distribution. Anode baskets should be kept full. High drag-out barrel operations may require supplemental additions of zinc chloride. Acid resistant anode bags of cotton, Dynel, or polypropylene are optional but recommended for rack operation to reduce anode-caused roughness.

Operating Temperature:
HP RADIANCE AZ baths have a very wide range of bright operating temperatures, from approximately 70 - 120ºF. Although the bath has a very high cloud point and is stable at high temperatures, brightener consumption will increase. Therefore, the optimum temperature range for best brightness at minimum brightener consumption is 80 - 85ºF. Baths should be maintained at this temperature by cooling coils or refrigeration systems whenever economically feasible.

Filtration:
Continuous filtration at 15 microns is recommended for routine operation. When carbon treatment or other bath purification is necessary, 5 - 10 micron filtration should be substituted.

Equipment:
All plating tanks, racks and hardware etc., which come into direct contact with **HP RADIANCE AZ** solutions should be plastisol, polyethylene, hard rubber, or similarly coated to provide adequate protection from corrosion.

Agitation:
Unlike many competitive processes, **HP RADIANCE AZ** does not foam excessively so both mechanical and air agitation are acceptable as required by current density demand.

Ventilation:
Although any gas/fuming from **HP RADIANCE AZ** solutions is negligible and therefore not of concern, spray is inherently corrosive due to pH. Subsequently, the use of fiberglass, PVC, or polyethylene ventilation equipment and exhaust fans is recommended to pro-long equipment life.

Heating/Cooling:
Coils made from Teflon are optimum, but titanium coils may be used, taking care to ensure insulation from the electrical circuit. Lead or steel coils are not suitable.

Pre-Plate Treatment:
A standard cleaning and pickling cycle is recommended, as follows:

1. Hot alkaline soak clean
2. Hot alkaline electro-clean (anodic or periodic reverse)
3. Rinses
4. 30% to 50% muriatic acid pickle with 1% to 2% **HP DESCALER FEX**
5. Rinses
6. Acid Zinc Plate

Post-Plate Treatment:
HP RADIANCE AZ deposits are whiter and brighter than many competitive systems and provide surfaces that are highly receptive to most chromate dips as well as all hex-free passivation systems.

ANALYSIS OF RADIANCE AZ BATHS

Zinc Metal:

1. Pipette 5 ml bath sample into a beaker or flask and add 100 ml DI Water.
2. Add 10 ml conc. Ammonium Hydroxide.
3. Add approximately 0.2 grams Erichrome Black-T Indicator (solution will turn purple).
4. Add 10 ml 8% Formaldehyde solution.
5. Titrate immediately with 0.1M EDTA solution to a blue endpoint

Calculation: (ml 0.1M EDTA Titrated) x 0.174 = oz/gal **Zinc** M**etal**

Total Chloride:

1. Pipette 1 ml bath sample into a beaker and dilute to 50 ml with DI Water and mix well.
2. Add 2-5 ml of 2% Sodium Dichromate.
3. Titrate with 0.1N Silver Nitrate solution ($AgNO_3$) to the first orange/red endpoint

Calculation: (ml 0.1N $AgNO_3$ Titrated) x 0.473 = oz/gal **Total Chloride**

Boric Acid:

1. Pipette 2 ml bath sample into a 250 ml Erlenmeyer flask.
2. Add 100 ml of DI Water.
3. Add 15 ml saturated Potassium Ferrocyanide.
4. Add 5 grams Mannitol.
5. Add 8 - 10 drops Phenolphthalein indicator.
6. Titrate with 0.1N Sodium Hydroxide solution to a pink endpoint.

Calculation: (ml of 0.1N NaOH) x 0.479 = oz/gal **Boric Acid**

Ammonium Chloride:

1. Pipette 25 ml of 1.0N HCl into a 400 ml beaker and add 100 ml DI Water; set aside.
2. Add 25 ml 50% NaOH to a 250 ml distilling flask along with 100 ml DI Water.
3. Pipette 10 ml plating bath into the distilling flask and seal instantly so that no ammonia escapes.
4. Distill approximately 75 ml into the standard HCl, making sure that the tube from the condenser remains under the level of the standard HCl solution (see fig 1.)
   Note: Do not allow the distillation flask to cool while the tube from the condenser is still in the solution.
5. Titrate the standard HCl solution with 1.0N NaOH to a pH of 7.0.

Calculation: oz/gal NH_4Cl = $\frac{(25 - \text{ml 1.0N NaOH Titrated})}{1.4}$

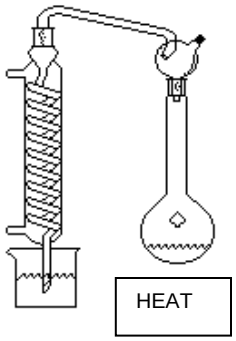

Fig. 1 (Set-up of Testing Apparatus)

CAUTION:

HP RADIANCE AZ SOLUTIONS ARE ACIDIC. CARE SHOULD BE TAKEN WHEN HANDLING BOTH CONCENTRATED MATERIALS AND THEIR SOLUTIONS. WEAR EYE PROTECTION AND RUBBER OR NEOPRENE GLOVES WHEN HANDLING. CONSULT THE MATERIAL SAFETY DATA SHEET FOR FURTHER DETAILS AND PRECAUTIONS.

STORAGE:

HP RADIANCE AZ components may freeze if exposed to below freezing temperatures for prolonged periods of time. Store above freezing. If freezing should occur, the container should be warmed and mixed thoroughly before using. Samples should be sent to **HAVILAND PRODUCTS COMPANY** for analysis.

NON-WARRANTY:

The data contained in this bulletin is believed by HAVILAND PRODUCTS COMPANY to be accurate, true and complete. However, since final methods of use of these products are in the hands of the customer and beyond our control, we cannot guarantee that the customer will obtain the results described in this bulletin. Nor can we assume any responsibility for the use of this product by the customer in any process that may infringe the patents of third parties.