EXTREME 110
EXTREME 210
TRAINING MANUAL

Chloride Zinc Plating Process

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INTRODUCTION

This TRAINING manual is meant as a service tool for evaluating and troubleshooting EXTREME 110 and EXTREME 210 plating baths. These simple techniques require only standard laboratory plating equipment such as a Hull cell, Duplicell, rectifier, lab scale and burettes for wet lab analyses.

The main focus of this manual will be the proper use of the Hull cell. Arguably the single most important service tool, the Hull cell is a miniature plating tank requiring only 267 mL (8.75 fluid ounces) of plating solution. By using different techniques, the Hull cell can evaluate:

- Deposit brightness & appearance over a very wide current density range of 0 - 200+ ASF (0 - 22+ ASD)
- Carrier & Brightener content
- Bath chemistry such as zinc, ammonium chloride, total chloride, & pH
- Metallic & organic contamination
- Ductility
- Passivate adhesion
- Effects of temperature
- Effects of time and current
- Effects of addition agents
- Effects of treatments such as carbon, peroxide & potassium permanganate

This manual also contains a Troubleshooting Guide, and Analytical Procedures.

HULL CELL OPERATING PROCEDURE

PURPOSE

This section will cover the techniques needed to properly prepare a Hull cell and steel panel for testing plate distribution, deposit appearance, ductility and visual evaluation of EXTREME 110 and EXTREME 210 Carrier and Brightener content.

PROCEDURE

1. Thoroughly clean the Hull cell and zinc anode with warm tap water. If the zinc anode is dark or discolored, dip it in the 25 - 50% Hydrochloric Acid Pickle for 1 or 2 seconds and immediately rinse with tap water.

2. Add 267 mL of plating solution to the Hull cell.

3. Strip the zinc coated steel Hull cell panel in a 25 - 50% solution of Hydrochloric Acid Pickle. Immediately remove the panel when the gassing has stopped.

4. Holding the Hull cell panel along the top edge, place under cold tap water and thoroughly wipe with a clean paper towel to remove surface smut. A properly stripped and cleaned Hull cell panel should be water break free. Panels that are not properly cleaned will exhibit wipe marks, smears, fingerprints, and other blemishes.

   NOTE Most steel Hull panels have a polished front side and a dull backside after stripping. The polished side should always be cleaned and face toward the anode. See figure 1.

Figure 1

5. Attach the red (positive) lead from the rectifier to the zinc anode and the black (negative) lead to the steel panel (cathode). Set the timer and amperage to the appropriate levels and turn on the rectifier.

   NOTE: Agitation is required for Hull cell evaluation of acid chloride plating solutions.

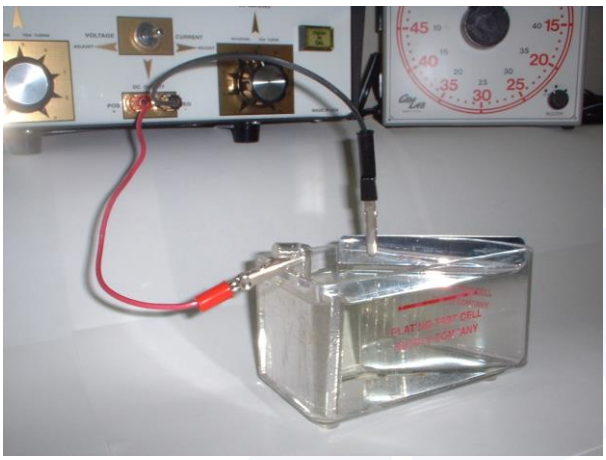


Figure 2

6. Upon completion of the test, remove the panel and thoroughly rinse under cold tap water. Next, half dip the panel for 4 seconds in a 0.5% solution of nitric acid to remove the yellow tarnished film on the zinc deposit surface. See Figure 3.

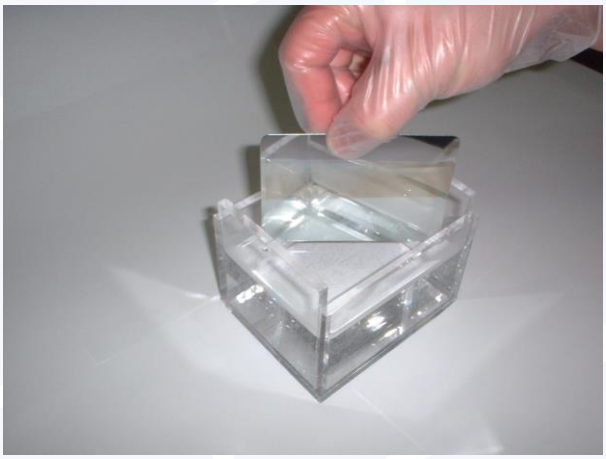


Figure 3

7. Immediately rinse the panel under cold tap water and dry. Panels can be dried using forced hot air from a blow dryer or by simply wiping with a clean paper towel. If using a paper towel, always wipe from right to left.

EVALUATING DEPOSIT BRIGHTNESS AND APPEARANCE

PURPOSE

The art of evaluating the general appearance of the zinc deposit on a Hull cell panel is critical for troubleshooting and determining the condition of the plating solution. This section covers one of the most important aspects of zinc plating, overall brightness and appearance of the deposit.

PROCEDURE

1. Prepare the Hull cell and panel by following the Hull Cell Operating Procedures in steps 1 through 5 on pages 4 and 5.

2. Heat the bath to 80° F (25° C) and run a 3 ampere-3 minute and 1 ampere-5-minute Hull cell panel using magnetic stir bar agitation. Rinse, nitric dip and dry the panels by following the Hull Cell Operating Procedures in steps 6 and 7 on page 5.

3. Satisfactory panels should be uniform in brightness and free of H.C.D. burning and mid to low current density bands and dullness. See figure 4.

Figure 4

4. Refer to the EXTREME 110 and EXTREME 210 Laboratory Troubleshooting Section on pages 9 through 11 if the Hull cell panels exhibit dullness, burning, bands, streaks, etc.

DUCTILITY (BRITTLENESS) TEST

PURPOSE

The ability to plate a thick, bright deposit that is ductile and free of cracks, chips and fractures is critical to the bright acid zinc plating process. This test will determine ductility of the deposit by placing physical stress on a zinc plated Hull panel. This physical stress will duplicate edge chipping and flaking that is commonly seen during tumbling of barrel plated work or packaging of rack plated work.

PROCEDURE

1. Prepare the Hull cell and panel by following the Hull Cell Operating Procedures in steps 1 through 5 on pages 4 and 5.

2. Heat the bath to 80° F (25° C) and run a 2 ampere-30-minute Hull cell panel using magnetic stir bar agitation.

3. Do not nitric dip this panel (skip step 6 in the Hull Cell Operating Procedure); rinse and dry the panel by following step 7 on page 5.

4. Place panel on a flat edge as indicated in figure 5 below.

5. Bend and fold the in half as indicated in figure 6 below.

NOTE: It is acceptable for the zinc deposit to fracture and crack along the bent edge. If the zinc deposit flakes and peels, refer to the EXTREME 110 and EXTREME 210 Laboratory Troubleshooting Section on pages 9 through 11.

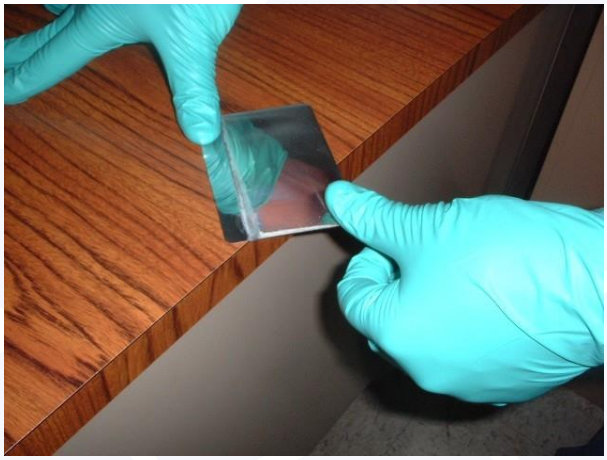


Figure 5

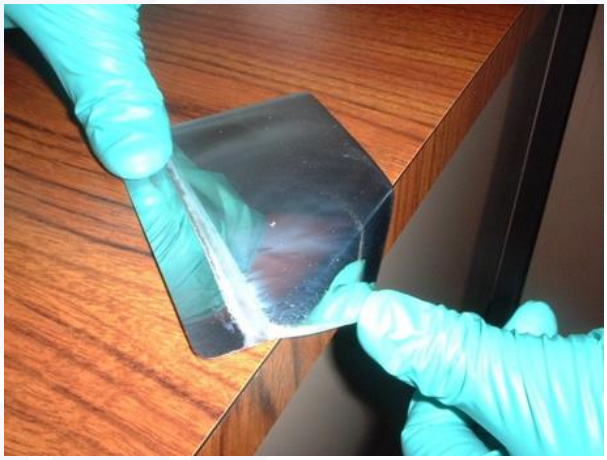
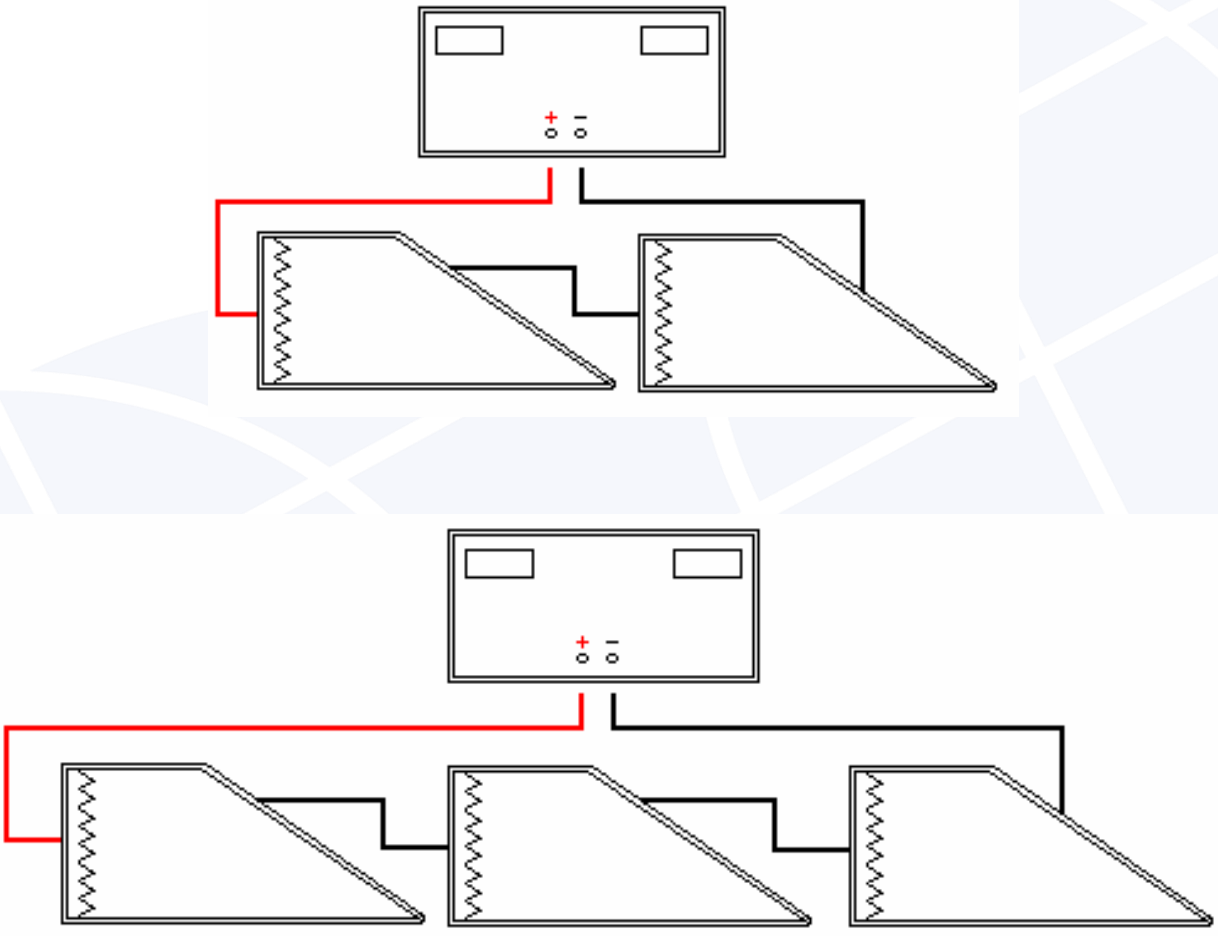


Figure 6

RUNNING MULTIPLE HULL CELLS OR DUPLICELLS ON A SINGLE RECTIFIER

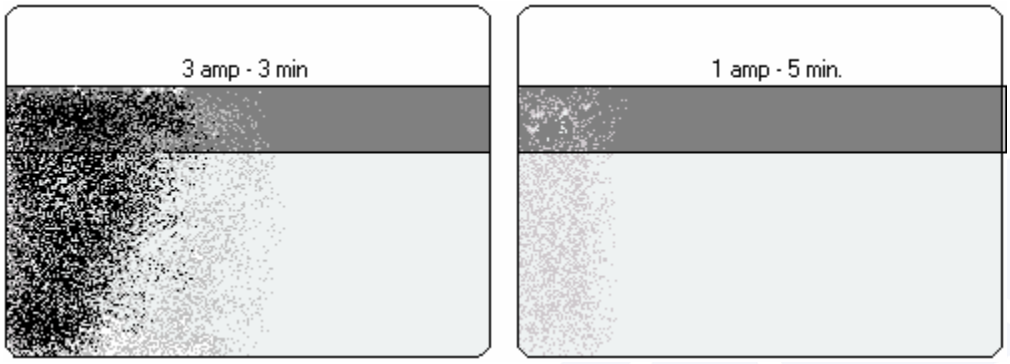
Multiple Hull cells can be wired in series to:

- Evaluate two or three baths in the time it takes to run one bath. This is especially important when running extended tests such as 2 amp-30-minute ductility (brittleness) panels.
- Evaluate two or three baths using identical current and time.
- Run side-by-side tests of a bath “as is” and a duplicate with addition agents or bath chemistry adjustments.



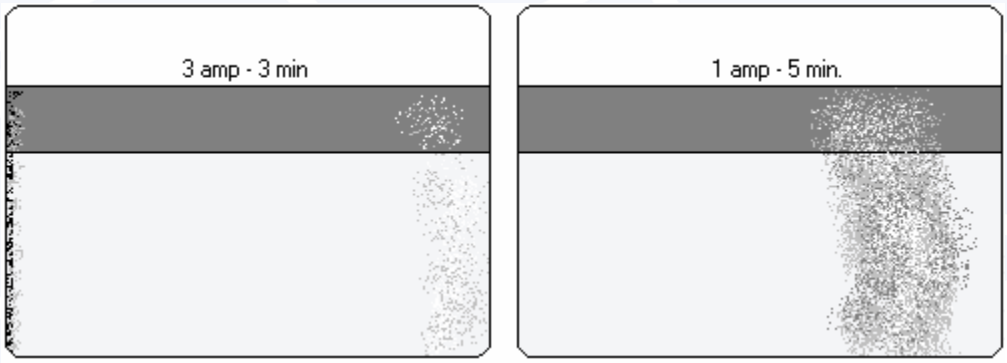
LABORATORY TROUBLESHOOTING GUIDE

1. HCD Burning



- Low Carrier/Wetter: Add 2.7 - 5.4 mL EXTREME Carrier 210 and EXTREME Wetter 110 to the Hull cell.
- Low zinc metal: Add 4.2 grams Zinc Chloride (solid) to the Hull cell to raise the zinc metal 1 opg (7.5 grams per liter)
- Low Ammonium Chloride (EXTREME 210 baths only): Add 2 grams Ammonium Chloride to the Hull cell to raise 1 opg (7.5 g/L)
- Low Boric Acid (EXTREME 110 baths only): Add 2 grams Boric acid to the Hull cell to raise 1 opg (7.5 g/L)

2. LCD Dullness



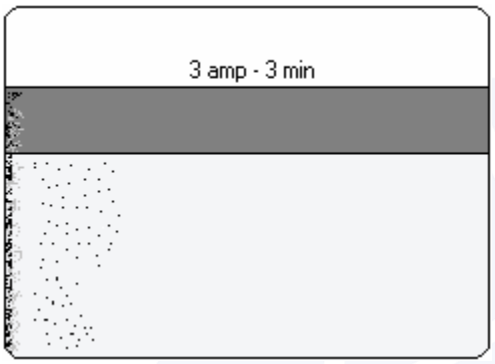
- Low Carrier/Wetter: Add 2.7 - 5.4 mL EXTREME Carrier 210 and EXTREME Wetter 110 to the Hull cell
- High pH: Slowly adjust to 5.0 - 5.8 with Hydrochloric Acid
- Metallic Contamination (<5 ppm): Add 0.1-gram Zinc Dust to the Hull cell, mix for 15 minutes, allow to settle, and decant clean solution into another Hull cell.

- High zinc metal: Increase total chloride to 22 opg (165 g/L)

- Low chloride: Add 4.2 grams Potassium Chloride to a Hull cell to raise the total chloride 1 opg (7.5 g/L)

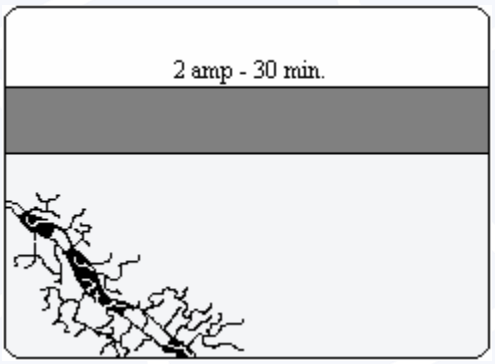
- Organic contamination: Add 6 mL of a 1% solution Potassium Permanganate to a Hull cell and mix for 15 minute and filter.

3. Mid to High Current Density Pitting



- High Brightener: Add 6 mL of a 1% solution Potassium Permanganate to a Hull cell and mix for 15 minutes and filter.

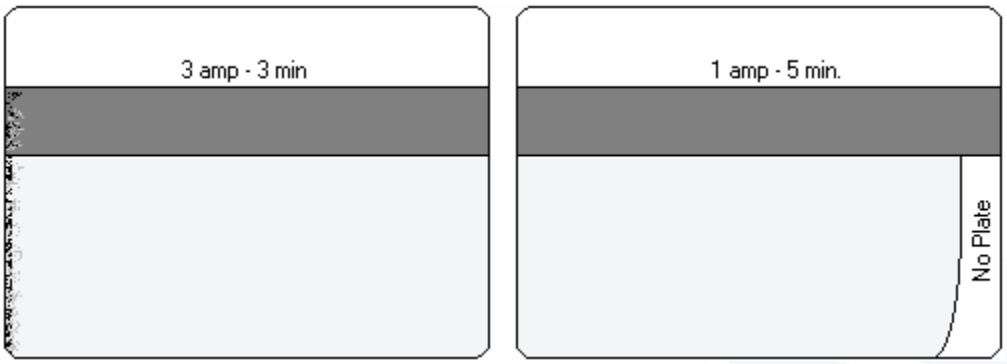
4. Brittle Deposit After Bending Hull Cell Panel



- High Brightener: Add 6 mL of a 1% solution Potassium Permanganate to a Hull cell and mix for 15 minutes and filter.

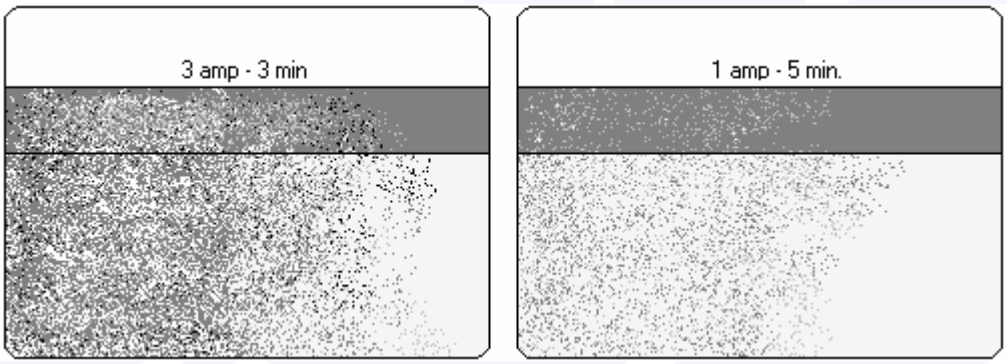
- Low Carrier/Wetter: Add 2.7 - 5.4 mL EXTREME Carrier 210 and EXTREME Wetter 110 to the Hull cell.

5. LCD Thin/Skip Plate



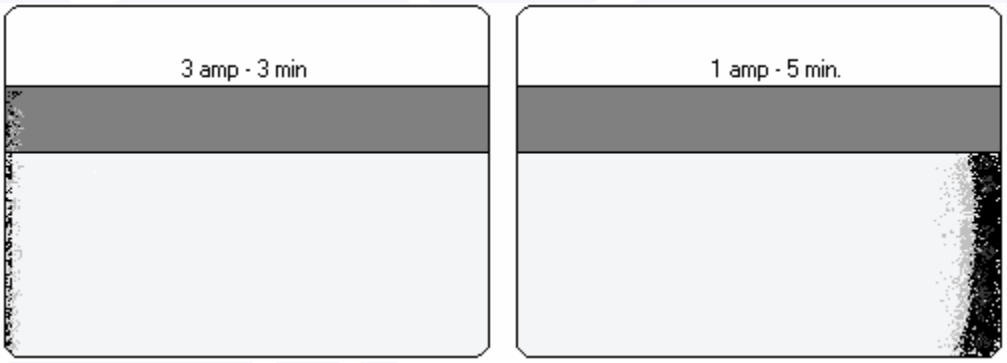
- Low chloride: Add 4.2 grams Potassium Chloride to a Hull cell to raise the total chloride 1 opg (7.5 g/L)

6. Overall Dullness



- Low brightener: Add 0.25 mL Brightener
- Low cloud point: Add 6 mL of a 1% solution Potassium Permanganate to a Hull cell and mix for 15 minutes and filter.

7. Gray to Black Discoloration of the Deposit After Nitric Dip from Metallic Contamination (>5 ppm Lead, Cadmium, and Copper)



- Add 0.1-gram Zinc Dust to the Hull cell, mix for 15 minutes, allow to settle, and decant clean solution into another Hull cell.

EXTREME 110 AND EXTREME 210 ANALYTICAL PROCEDURES

ZINC METAL ANALYSIS

1. Pipette a 2 mL bath sample into a 250 mL Erlenmeyer flask and add 100 mL of distilled water.

2. Add 20 mL Ammonium Hydroxide Buffer solution.

3. Add approximately 0.2 grams Eriochrome Black T Indicator to turn solution to a medium purple.

4. Add 20 mL 8% Formaldehyde.

5. Immediately titrate with 0.0575M EDTA to a blue endpoint.

   Calculation: Milliliters 0.0575M EDTA x 0.25 (factor) = OPG Zinc Metal (OPG x 7.5 = g/L)

TOTAL CHLORIDE ANALYSIS

1. Pipette 10 mL bath sample into a 250 mL volumetric flask. Dilute to 250 mL with distilled water.

2. Pipette 10 mL of above dilute solution into a 500 mL Erlenmeyer flask and add 100 mL distilled water.

3. Add 5 mL Sodium Passivate Indicator.

4. Titrate with Standard Silver Nitrate 0.153N to a reddish-brown endpoint. (The first permanent brown color is the endpoint.)

   Calculation: Milliliters Standard Silver Nitrate 0.153N X 1.82 = OPG Total Chloride (OPG x 7.5 = g/L)

BORIC ACID ANALYSIS (EXTREME 110 Baths Only)

1. Pipette a 5 mL bath sample into a 250 Erlenmeyer flask.

2. Add Mannitol to form a thick slurry.

3. Add 3 - 5 drops Bromcresol Purple Indicator Solution.

4. Titrate with Sodium Hydroxide 0.1N to a purple endpoint.

   Calculation: Milliliters Sodium Hydroxide 0.1N x 0.16 = OPG Boric Acid (OPG x 7.5 = g/L)

CLOUD POINT

1. Add 100 mL of plating bath to a 150 mL beaker. The solution must be clear, filter through 5-micron paper if necessary.

2. Place a thermometer in the beaker and using magnetic stir bar agitation, slowly heat the solution until it becomes cloudy/turbid. Record the temperature at the point at which the solution first turns cloudy/turbid