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## TECHNICAL DATA

### E-Brite™ PC

## High Throw Bright Acid Copper and Through-Hole Plating of Printed Circuit Boards

**E-Brite PC** produces copper deposits that are low in stress and ductile when operated within the recommended brightener range and exhibit excellent brightness and throwing power in extreme low current density areas.

### SOLUTION COMPOSITION

	<u>Range</u>	<u>Optimum</u>
Copper Sulfate	8.0 - 12.0 oz/gal	10.0 oz/gal
Sulfuric Acid (PC or Reagent Grade)	22.0 - 30.0 oz/gal	28.0 oz/gal
Chloride Ion	40 - 70 PPM	50 PPM
<b>E-Brite PC</b>	0.6 - 0.8% (by vol.)	0.7% (by vol.)
<b>E-Brite 200 Booster</b>	0.1 - 0.3% (by vol.)	0.2% (by vol.)
Cathode CD	1 - 40 ASF	3 - 20 ASF
Temperature	70 - 85°F	75°F

### TANKS

Tanks, filters and other equipment which come in contact with the plating solution should be constructed of acid resistant materials such as polypropylene or hard rubber.

### HEATING & COOLING EQUIPMENT

Equipment for these purposes should be constructed of Titanium, Teflon, Quartz or Karbate and should have the capacity to maintain the solution temperature between 70 - 80°F.

### NEW SOLUTION MAKEUP

1. In a separate mixing tank, add two-thirds of the water required for the final volume.
2. Turn on agitator and add 10 oz/gal of plating grade Copper Sulfate Pentahydrate. Use of purified liquid copper sulfate concentrate can eliminate steps 4 and 6 below. Ask your **EPI** representative for further information.
3. Very **CAREFULLY** and **SLOWLY**, and with good agitation, add 11.4% by volume of PC or Reagent Grade Sulfuric Acid (Sp.GR. - 1.84).

Heat will be generated, which will help dissolve the Copper Sulfate. The addition rate of Sulfuric Acid should be controlled so that the temperature of the solution does not exceed 150°F. This is to protect the equipment linings.

**WARNING:** **Never** add water to Sulfuric Acid!!!! **ALWAYS ADD ACID TO WATER!!!** The mixing of these two generates tremendous heat which may cause the solution to erupt if good stirring and a slow addition rate are not used!!!

**WARNING:** Sulfuric Acid causes severe burns and is extremely corrosive. When handling, use rubber gloves, face shield, rubber footwear and apron.

In case of contact with skin or eyes, flush thoroughly with large amounts of water and obtain the immediate services of a physician.

4. Add 0.03 lbs/gal (3 pounds per 100 gallons) of activated carbon and agitate for four hours at 120°F maximum.
5. Turn off agitation and allow the carbon to settle for two to four hours.
6. Filter to the clean plating tank.
7. Cool temperature of solution to operating range. Analyze the concentrations of Copper Sulfate, Sulfuric Acid and Chloride. If necessary, adjust to the range shown above. Based on analysis, add Hydrochloric Acid to bring the Chloride Ion concentration to 50 - 60 PPM. (See section on Chlorides).
8. Dummy for one to two hours at 9 -12 asf.
9. Add 0.7% by volume of **E-Brite PC** and 0.2% **E-Brite 200 Booster** and commence plating.

## **SOLUTION OPERATION**

### **Agitation**

Agitation should be vigorous and only low pressure blower air should be used, rather than compressor air, to avoid possible oil contamination. The degree of agitation provided will affect the amount of burning at higher current densities.

### **Anodes**

Anodes should be 0.03% - 0.05% Phosphorized Copper (CDA-12220). Napped polypropylene bags, which have been previously leached, should be used. Hooks should be fabricated from Titanium. Anode area should normally be 1.5 - 2.5 times greater than the cathode area.

### **Filtration**

Filtration should be continuous and of a sufficient rate to turn over the solution twice per hour. Filter aid, if used, should be diatomaceous earth. Cellulose, paper or cotton products should not be used since they dissolve, causing serious organic contamination problems. Continuous filtration through carbon is not recommended since it will remove a portion of the brighteners, which not only increases consumption, but also makes control more difficult.

### **Chloride**

The presence of Chloride Ions is mandatory for the **E-Brite PC** process and 40 - 70 PPM is the preferred concentration range. Concentrations of 20 PPM or less may result in high current density burning, overall loss of brightness and increased brightener consumption.

Concentrations of 100 PPM or more may cause a loss of brightness and increased brightener consumption.

In general, there will be little response to brightener additions when the Chloride Ion concentrations are beyond the recommended range.

CP grade Hydrochloric Acid should be used, and an addition of 10 ml per 100 gallons will raise the chloride content approximately 10 PPM.

### **E-Brite PC Control**

The average consumption rate of **E-Brite PC** addition agent is one gallon per 30,000 ampere hours. Brightener consumption is related to the average current density, type of work, chloride content and temperature of the bath. Due to the unusual stability of **E-Brite PC**, maintenance replenishments of **E-Brite 200 Booster** are all that are normally required, even after idle periods such as long weekends. The **E-Brite 200 Booster** is normally consumed at 8000 - 12000 ampere hours per gallon. If required, additions of **E-Brite PC** may be made once a shift. Care must be taken not to overdose **E-Brite PC** which can cause LCD dullness which will require higher usage of **E-Brite 200 Booster** to maintain brightness.

1. Concentration of **E-Brite 200 Booster** in the bath can be controlled by the use of an air agitated 267 ml or a 1000 ml Hull Cell and supported by visual production results. A typical Hull Cell panel plated at 3 amps (267 ml) or 5 amps (1000 ml) at 75-80°F will have a slight burn at the high current density edge and will be bright across the rest of the panel.
2. Dullness in the low current density area, on a Hull Cell panel or on production work, is generally an indication of low **E-Brite 200 Booster** content which is in no way harmful to the physical properties of the deposit. However, to increase the LCD area brightness, add 0.1% of **E-Brite 200 Booster** or 0.2% if required. An overdose of **E-Brite PC** may also cause dullness in LCD areas in which case adding **E-Brite 200 Booster** may have a limited brightening effect.

Whenever a new bath is made up, or when bags and filter media are changed, the initial addition of **E-Brite PC** may have to be increased slightly. Additions should be in increments of 0.1% by volume until normal deposits are obtained.

In order to insure uniform and consistent production results, it is recommended that additions of **E-Brite 200 Booster** be made on an hourly basis or with an amp hour feeding system.

3. Hull Cell analysis can be very easy and exact if the user plates a series of panels with varying conditions and keeps them as permanent record for reference. A standard solution with the exact formulation of the production bath should be made up and carbon treated.

A Hull Cell panel should be plated from this standard solution and used for reference. Then subsequent panels should be plated after adding **E-Brite PC** in increments of 0.2% until a total of 0.8% has been added. It will be evident that lower concentrations of **E-Brite PC** show striated deposits and at higher concentrations these are eliminated. In addition, a panel should be plated at 1.5% addition to show the effect of over addition of **E-Brite PC** which is a stress

reliever and will have no adverse affect on the physical properties of the copper plate. (If **E-Brite PC** is accidentally “overdosed” it can be plated down rather than requiring carbon treatment.) Then, to a solution containing 0.7% **E-Brite PC**, adds of **E-Brite 200 Booster** should be made in increments of 0.1, 0.2 and 0.3% to demonstrate its brightening effect.

The Hull Cell panels must be run at 5 amps for 5 minutes in 1000 ml cells or 3 amps for 5 minutes in 267 ml cells. Visible results of panels run at lower amperages will be misleading. They could be cosmetically bright but still be too low in **E-Brite PC** concentration. This is due to the very wide operating bright range of **E-Brite PC**.

The **E-Brite PC** addition agent is formulated to produce optimum physical properties between 0.6% and 0.8% by volume and should be maintained in this range. Therefore, the Hull Cell tests must be run at the recommended amperage.

## **SOLUTION PURIFICATION**

If organic contamination is encountered, the bath should be pumped into a separate suitably-lined tank. While the solution is being agitated, very carefully and slowly add one pint/100 gallons of Hydrogen Peroxide (35%) and agitate for one hour. The routine practice of using peroxide on all carbon treatments is not recommended. It is advisable to first prove in the laboratory on a small sample that peroxide aids in the treatment, as it can break down some organics to a point they are no longer absorbable on carbon.

Heat the solution to 120°F and add three pounds of activated carbon per 100 gallons, stir for three to four hours, then turn off heat and allow the carbon to settle. Cool the solution and then filter back to the production tank as soon as possible. Analyze and adjust the Copper Sulfate, Sulfuric Acid and Chloride concentrations to the ranges shown on page 1. When the temperature is within the operating ranges, add an original makeup charge of **E-Brite PC** and **E-Brite 200 Booster**. At this point, a Hull Cell test should indicate that the bath is now ready for production.

If batch treatment is impossible, the following procedure will usually suffice:

Remove tank from service. Pack filter with diatomaceous earth and the maximum quantity of activated carbon consistent with good flow, and then circulate the solution. Change the pack every four to six hours, or until a Hull Cell test panel is completely dull across the entire surface. Adjust all chemicals, clean and repack the filter, and add back 0.6 - 0.7% by volume **E-Brite PC** and 0.1% - 0.2% **E-Brite 200 Booster**.

In order to insure consistent quality, a carbon treatment every four to six months is recommended as a good housekeeping practice. This will remove extraneous organic materials and permit tank and equipment inspection.

## **ANALYTICAL PROCEDURE**

### **Copper Sulfate**

1. Pipette a 5 ml sample of plating solution into a 250 ml Erlenmeyer flask.
2. Add, drop by drop, concentrated Ammonium Hydroxide to a deep blue color.

3. Swirl flask as you add 10 ml concentrated Acetic Acid.
  4. Add 50 ml deionized water.
  5. Add 10 ml 20% Potassium Iodide Solution.
  6. Titrate with 0.1N Sodium Thiosulfate to a yellow straw color.
  7. Add 1 ml FRESHLY MADE STARCH INDICATOR - solution is now a dark blue color.
- Continue titrating with the Sodium Thiosulfate to a white end point.

**CALCULATION:** ml of Sodium Thiosulfate (total) x 0.672 = oz./gal. CuSO<sub>4</sub>.

### **Sulfuric Acid**

1. Pipette a 5 ml sample into a 500 ml Erlenmeyer flask.
2. Dilute to 275 - 300 ml with distilled water.
3. Add 10-20 drops of Methyl Orange - Xylene Cyanole Indicator, and titrate with 1 N Sodium Hydroxide until the color changes from purple to green.

**CALCULATION:** ml NaOH x 1.31 = oz./gal. H<sub>2</sub>SO<sub>4</sub>

### **Chloride**

1. To each of two glass-stoppered 25 ml graduated cylinders, add 5 ml of concentrated Nitric Acid and a 5 ml sample of the bath.
2. Stopper and mix well.
3. Add 10 ml of Ethylene Glycol to each.
4. Dilute one cylinder to 25 ml (Sample A) and the other to 24 ml (Sample B) with distilled water.
5. Stopper and mix.
6. Add 1 ml of 0.1 N Silver Nitrate solution to Sample B and mix well. Allow to stand in a dark place for thirty minutes.
7. Transfer each sample to a 0.5 inch Spectronic tube. Adjust the instrument for zero transmission at a wavelength of 440 nm. Adjust for 100% transmission with the blank Sample A and then read and record the absorbance of Sample B.

CALCULATION: Absorbance of (B) x 152 = PPM Chloride Ion (Cl<sup>-</sup>)

### **HANDLING PRECAUTIONS**

The **E-Brite PC** acid copper plating solution is acidic in nature; therefore, precautions for the safe handling of acid solutions should be observed. The proper protective clothing, including rubber gloves, rubber footwear, rubber apron and goggles should be worn to prevent eye and skin contact. In case of eye contact, flush with plenty of water for at least 15 minutes and call a physician. Flush skin with a large quantity of water. Wash clothing before reuse.

Under normal conditions, **E-Brite PC** and **E-Brite 200 Booster** are stable and have good shelf life, but prolonged storage in an area where temperatures exceed 100°F should be avoided. Keep containers closed when not in use. Freezing does not affect its performance. If freezing does occur, allow the **E-Brite** to thaw at room temperature and mix thoroughly to prevent stratification.

### **PACKAGING**

Five (5) gallon and 55 gallon non-returnable containers.

### **IMPORTANT NOTICE: For Industrial Use Only**

The following is made in lieu of all warranties, expressed or implied, including the implied warranties of merchantability and fitness for purpose: seller's and manufacturer's only obligation shall be to replace such quantity of the product as proved to be defective. Before using, user shall determine the suitability of the product for its intended use, and user assumes all risk and liability whatsoever in connection therewith.

**Neither seller nor manufacturer shall be liable either in tort or in contract for any loss or damage, direct, incidental or consequential, arising out of the use or the inability to use the product.**

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