

E-Brite™207

Acid Copper Plating for Gravure

E-Brite 207 produces ductile deposits with consistent hardness. With a hardness of 210 – 220 Hv which are highly resistant to self-annealing and have good engraving characteristics

It produces consistent results due to excellent bath stability which minimizes start-up problems eliminating the need for major adjustments after idle periods or weekend shut-downs.

There are no harmful breakdown products which eliminates the need for frequent carbon treatment. The bath is tolerant of variations in working conditions and impurities lending to ease of operation and process control.

In many applications, the bath is operated at 90-110°F, which helps to plate copper at high speed.

E-Brite 207 virtually eliminates nodulation (treeing and burning) in high current density areas even at Copper Sulfate concentrations as low as 25 oz/gal.

SOLUTION COMPOSITION

Range

Optimum

<u>SOLUTION COMPOSITION</u>	<u>Range</u>	<u>Optimum</u>
Copper Sulfate	27-35 oz/gal	30 oz/gal
Sulfuric Acid (by wt.)	7-11oz/gal	9 oz/gal
Chloride Ion	60-120 PPM	80 PPM
E-Brite 207M (make-up)	0.3-0.5% by volume	0.3%
E-Brite 207H	0.2-0.4% by volume	0.2%

Chloride Ion: Use C.P. Hydrochloric Acid. As a general rule, 10 ml of HCl per 100 gallons will raise Chloride Ion concentration by about 10 PPM. Always analyze solution for Chloride Ion before adding HCl.

NOTE: Do Not mix **E-Brite 207M** with **E-Brite 207H** prior to adding to the solution

OPERATING CONDITIONS

Cathode current density	100 - 250 ASF
Anode current density	20 - 80 ASF
Temperature	90°F - 110°F
Anodes	Phosphorized copper (0.025 - 0.06% Phos.)
Anode bags	Napped polypropylene
Anode: Cathode ratio	2-4:1
Filtration	1-2 turnovers per hour, continuous

NEW SOLUTION MAKE-UP

1. Charge mixing tank with water at approximately 3/4 of the final working volume of the plating tank.
2. Agitate the water mechanically or with air while slowly and carefully adding 66° Be Sulfuric Acid at a concentration of 0.56 pounds or 0.038 gallons per gallon of final tank working volume.

WARNING: Sulfuric Acid causes severe burns and a full-face shield, rubber gloves, rubber apron and rubber boots must be worn while making the additions. In case of contact with skin or eyes, flush thoroughly with running water and obtain immediate help from a physician.

Heat will be generated by the Sulfuric Acid addition, which will aid in dissolving the Copper Sulfate.

3. While mixing, slowly add and dissolve 1.7 pounds of Copper Sulfate Pentahydrate per gallon of final tank working volume.
4. Once all the Copper Sulfate is dissolved, the solution is treated with carbon at a rate of 0.03 pounds activated carbon per gallon. The solution is mixed for 1 to 2 hours and then allowed to settle before it is pumped through a filter into the plating tank. Make sure all carbon is removed from solution and filters before adding brighteners.
5. Add water to final working volume and mix well with air agitation. Analyze solution for Copper Sulfate, Sulfuric Acid and Chloride Ion and make additions if required.
6. Purify the solution by using pre-plated dummy cathodes at 10-30 ASF for 1-2 hours followed by 5-10 ASF for 1-2 hours.
7. Add **E-Brite 207** addition agents:

E-Brite 207M	0.3% by volume
E-Brite 207H	0.2% by volume

Solution is now ready for production.

CONVERSION OF EXISTING ACID COPPER SOLUTIONS

Conversions to the **E-Brite 207** process are easy to accomplish. A one-quart sample of the bath should be sent to **EPI's** Technical Service Laboratory for conversion, analysis and recommendations.

FUNCTION OF SOLUTION COMPONENTS

<u>Copper Sulfate</u>	<p>is normally added only during make up because the copper ions required for plating thereafter will be maintained by electrolytic and chemical dissolution of the copper anodes.</p> <p>Concentrations below 24 ounces per gallon can produce HCD burning, and reduced deposition rates. High concentrations (above 35 ounces per gallon) can cause Copper Sulfate crystals to form on the anodes and tank walls causing poor anode corrosion and rough plating. Extremely</p>
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	high concentrations can cause anode polarization due to crystals forming on the anodes.
<u>Sulfuric Acid</u>	provides conductivity to the solution and dissolution of the anodes. Concentrations below 7 ounces per gallon will result in a loss of conductivity.
<u>Chloride Ion</u>	concentrations higher than 200 PPM can produce striations, treeing, roughness and grainy deposits and can contribute to polarization of the anodes. Concentrations Lower than 30 PPM can produce rough or striated deposits. Poor response to additives can result from too low or too high concentrations of chloride ion.

FUNCTION OF E-BRITE 207 ADDITION AGENTS

E-Brite 207M is used for new solution make up, following carbon treatment and upon conversion of other systems. It is the primary grain refiner and high current density brightener. It is used at approximately 40ml-70ml per 1000 ampere hours.

E-Brite 207H is another maintenance additive for brightness especially at low current density area. It also contains hardeners and is used at approximately 35-50ml per 1000 ampere hours.

EQUIPMENT

- **Tanks:** Tanks should be constructed of PVC, PVDC, or polypropylene. Such tanks should be reinforced to prevent bulging. Rubber, PVC or polypropylene lined steel tanks are also satisfactory.
- **Filtration:** Continuous filtration is necessary for the production of smooth deposits from the **E-Brite 207** acid copper system. The filtration rate must be a minimum of one turnover per hour.
- Filter parts that come in contact with the solution must be acid resistant. Polyethylene, polypropylene, 316 stainless are recommended. Acid resistant filter bags, discs, or cartridges must also be used. The filter media should be diatomaceous earth. Cellulose type materials **should not** be used.

A carbon pack on the filter should not be used during production periods because it will remove some of the brightener additives.

- **Anodes:** Phosphorized copper anodes are essential for satisfactory operation. Rolled Phosphorized copper anodes or phosphorized copper nuggets in titanium baskets or trays may be used.

The phosphorous content of the anodes should be within a range of 0.025% to 0.06%. Other types of copper anodes should not be used as they can cause roughness, high additive consumption and increased copper build up. Consult your **EPI** representative for recommendations on sources of anodes.

- **Anode Bags:** If anode bags are used, 10–12-ounce napped polypropylene is the recommended material.

NOTE: New anode bags and filter cartridges must be leached before using by soaking in a 2 oz/gal solution of Sodium Hydroxide followed by a water rinse, a 5% Sulfuric Acid soak and another water rinse. This will prevent a very fine pitting condition caused by the sizing material (in the cloth or filter cartridges) which is not soluble in the acid copper solution.

TEMPERATURE

The solution temperature will depend upon the ambient temperature and the number of amperes per gallon used for plating. The solution temperature is maintained in the 70-90° range. Operating at a higher temperature will result in increased brightener consumption to achieve comparable results.

ANALYTICAL METHODS

Copper Sulfate

1. Pipette a 2 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 of 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 1.68 = oz/gal CuSO₄.

Sulfuric Acid

1. Pipette a 2 ml sample of plating solution into a 500 ml Erlenmeyer flask and add 100 ml of distilled water.
2. Add 3-4 drops of Methyl Orange Xylene Cyanole Indicator solution.

3. Titrate with 0.1N Sodium Hydroxide (NaOH) until the solution changes from purple to greenish yellow:

Calculations: Sulfuric Acid in oz/gal (wt) = ml of 0.1N NaOH x 0.329
FI oz/gal Sulfuric Acid = oz/gal (wt) Sulfuric Acid x 0.522

Chloride Ion

1. To each of two glass stoppered 25 ml graduated cylinders, add 5 ml 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 0.1N Silver Nitrate solution to sample B and mix well. Allow to stand in a dark place for at least 30 minutes.
7. Transfer each sample to a 0.5-inch Spectronic 20 tube and read the absorbance of sample B versus Sample A at 440 nm.

Calculations: Absorbance (B) - Absorbance (A) x 152 = PPM Chloride Ion

Note: A quick check procedure for testing Chloride Ion concentration, the newspaper method, is available from **EPI**.

CAUTION

The **E-Brite 207** Acid Copper plating solution is corrosive. A full-face shield, protective goggles or glasses must be worn to protect the eyes. In case of contact with the eyes, flush with running water for 15 minutes and call a physician. Rubber gloves and a rubber apron must be worn to protect the skin and clothing. In case of contact, flush skin with water and get medical attention. Wash clothing before reuse.

The **E-Brite 207M** and **207H** brighteners are relatively non-hazardous. However, good industrial hygienic procedures should be followed to include safety glasses. Solution contact with skin should be washed off with soap and water.

Do not work with the **E-Brite 207M** or **207H** without first reading and understanding the **MATERIAL SAFETY DATA SHEETS** furnished by **EPI**.

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.**