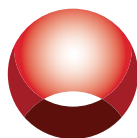


HAVILAND COPPERS



Haviland
PRODUCTS COMPANY

ACID COPPER

HP Sapphire Elite | (Dye –Free)

- An ultra-high performance, dye free bright acid copper plating on metal or plastic substrates.
- Low stressed deposits.
- Excellent brightness and leveling across all current density ranges allowing for faster plating rates.
- One component system suited for automatic amp-hour feeders.
- Ideal for heavy copper builds requiring subsequent copper buff.

OPERATING PARAMETERS

1. <65-85°F
2. 20-100 ASF CCD
3. 2:1 Anode/cathode ratio

RECOMMENDED EQUIPMENT

- Tanks: PVC or rubber-lined mild steel
- Agitation: Mechanical or air
- Anodes: Phosphorized copper (0.035-0.065%)
- Filtration: continuous DE with no carbon
- Anode bags: polypropylene

SOLUTION MAKE-UP

Product	Optimum	Range
Copper Sulfate	24.0	22-27 oz/gal
Sulfuric Acid	10.0	9-12 oz/gal
Chloride Ion	90.0	50-150 ppm
Make-up	0.6%	0.5-0.7% by vol
Brightener	0.1%	0.05-0.15% by vol

1. Slowly add 66° Be sulfuric acid to apporox. 75% of total volume of deionized water required.
This solution will get very hot. Please refer to SDS for proper hazard analysis.
2. While mixing, slowly add appropriate amount of electroless grade copper sulfate to tank.
3. Add 90 mL of reagent grade HCl per 100 gallons of tank volume.
4. After solution has cooled, filter through a carbon filter.
5. Add water to adjust final working volume and mix well with air agitation. Check and adjust chemistry.
6. Use plating dummy cathodes at 10-30 ASF for 1-2 hours followed by 5-10 ASF for 2 hours.
7. Add Make-up and Brightener. Mix well. Test with hull cell (2amperes for 10 minutes on a brass panel).

MAINTENANCE AND PROCESS CONTROL

- TYPICAL BATH OPERATION:

HP Sapphire Elite Brightener
12,000-20,000 Ampere Hours/Gallon
- HIGH CURRENT COPPER BUILD OPERATION:

HP Sapphire Elite Brightener
12,000-20,000 Ampere Hours/Gallon
HP Sapphire Elite Make-Up
12,000-20,000 Ampere Hours/Gallon

FUNCTION OF SOLUTION COMPONENTS

Copper Sulfate: Normally added only during make-up. Dissolution of the copper anodes provide copper content during plating.

Sulfuric Acid: Provides conductivity to the solution and assists in dissolution of the phosphorized copper anodes

Chloride Ion: Concentrations higher than 150 ppm can produce grainy deposits, reduced leveling, and can contribute to the passivation of the anodes. Concentrations lower than 50 ppm can produce rough or striated deposits and cause step plating in the high current density areas.

FUNCTION OF ADDITION AGENTS:

HP Sapphire Elite Brightener: Primary maintenance component to control brightness and leveling.

HP Sapphire Elite Make-up: used for make-up of new bath or conversion of existing bath. Reduces high current density burning due to the overdosing of the brightener.

Recommended for heavy copper build operations or elevated current densities.

Note: Do not mix Brightener and Make-up in feed reservoir.

DYE SYSTEM

HP TOPAZ

- Ultra-high leveling, dye-containing brightener system for bright acid copper plating on metal or plastic.
- High Leveling and ductility, low stress deposit.
- Excellent brightness and leveling across all current density ranges.
- One component system suited for automatic amp-hour feeders.
- Ideal for copper builds requiring subsequent copper buff.
- Fully consumed by electrolysis (providing consistent results.) It is also less sensitive to higher temperatures, both of which minimize the need for frequent carbon purifications.

OPERATING PARAMETERS

1. 65-80°F
2. 20-100 ASF
3. 2:1 Anode/cathode ratio

RECOMMENDED EQUIPMENT

- Tanks: PVC or rubber-lined mild steel
- Agitation: Mechanical or air
- Anodes: Phosphorized copper (0.035-0.065%)
- Filtration: continuous DE with no carbon
- Anode bags: polypropylene

SOLUTION MAKE-UP

Product	Optimum	Range
Copper Sulfate	24.0	22-27 oz/gal
Sulfuric Acid	10.0	9-12 oz/gal
Chloride Ion	90.0	50-150 ppm
HP TOPAZ CARRIER	0.5%	0.4-0.6% by vol
HP TOPAZ BRIGHTENER	0.1%	0.05-0.15% by vol
HP TOPAZ LCD	0.03%	0.01-0.05% by vol

1. Slowly add the 66° Be sulfuric acid to about 75% of the total volume of deionized water required.
This solution will get very hot. Sulfuric acid is a strong acid and proper PPE must be worn while handling this material. Please refer to the SDS for proper hazard analysis.
2. While mixing, slowly add the appropriate amount of electroless grade copper sulfate to the tank.
3. Add 90 mL of reagent grade HCl per 100 gallons of tank volume.
4. When the solution has cooled, filter through a carbon filter to remove impurities.

5. Add water to adjust final working volume and mix well with air agitation. Checking and adjust chemistry.
6. Use plating dummy cathodes at 10-30 ASF for 1-2 hours followed by 5-10 ASF for 2 hours.
7. Add Make-up and Brightener. Mix well. Test with hull cell (2 amperes for 10 minutes on a brass panel).
8. Add **HP TOPAZ BRIGHTENER** addition agents:

HP TOPAZ CARRIER. 0.5% by volume
HP TOPAZ BRIGHTENER 0.1% by volume
HP TOPAZ LCD (Optional) 0.03% by volume

FUNCTION OF SOLUTION COMPONENTS

Copper Sulfate: Normally added only during makeup. Dissolution of the copper anodes provide copper content during plating.

Sulfuric Acid Provides conductivity to solution and assists in dissolution of phosphorized copper anodes

Chloride Ion: Concentrations higher than 150 ppm produces grainy deposits, reduces leveling, and can passivate anodes. Concentrations lower than 50 ppm can produce rough or striated deposits and cause step plating in the high current density areas.

Analysis: Test via spectrophotometer.

FUNCTION OF ADDITION AGENTS

HP TOPAZ BRIGHTENER

- The primary maintenance component used at approximately 1 gallon per 7,000-15,000 ampere hours.
- Used to maintain brightness and leveling.

HP TOPAZ CARRIER

- Used on make-up of a new bath or conversion of an existing bath.
- High current density burning due to overdosing of the **HP TOPAZ BRIGHTENER** can be diminished by the addition of HP TOPAZ CARRIER.
- If **HP TOPAZ BRIGHTENER** additions are properly maintained, **HP TOPAZ CARRIER** should not be needed.

HP TOPAZ LCD

- Improves brightness and leveling in low current densities.

HIGH SPEED BRIGHT COPPER CYANIDE PROCESS

HAVAPLATE CNCU

- High speed cyanide copper plating process designed for plating bright, fine-grained and uniform deposits over a wide range of current densities.
- Ideal copper over zinc die-castings. Excellent buffing properties. Can be used in barrel and rack operations.
- Applied via direct current, interrupted current, or periodic reverse.

OPERATING PARAMETERS

Potassium Formulation	Range	Typical
Copper as Metal (Cu)	4 - 6 opg (30 - 45 g/l)	5 opg (37.5 g/l)
Copper Cyanide (CuCN)	6.0 - 8.0 opg (45 - 60 g/l)	7.0 opg (52 g/l)
Total Potassium Cyanide	11 - 15 opg (83 - 113 g/l)	13 opg (98 g/l)
Free Potassium Cyanide	2.0 - 3.0 opg (15 - 23 g/l)	2.5 opg (19.0 g/l)
Potassium Hydroxide	1.5 - 3.5 opg (11 - 26 g/l)	2.5 opg (17 g/l)

Sodium Formulation

Copper as Metal (Cu)	4-6 opg (30-45 g/l)	5 opg (37.5 g/l)
Copper Cyanide (CuCN)	6.0-8.0 opg (45-60 g/l)	7.0 opg (52 g/l)
Total Sodium Cyanide	8-12 opg (60-90 g/l)	10 opg (75 g/l)
Free Sodium Cyanide	2.0-3.0 opg (15-23 g/l)	2.5 opg (19.0 g/l)
Sodium Hydroxide	1.0-3.0 opg (11-26 g/l)	2.5 opg (17 g/l)

OPERATING CONDITIONS:

Cathode Current Density	5 - 60 ASF (0.5 - 6.0 A/dm2)
Anode Current density	6 - 20 ASF (0.6 - 2.0 A/dm2)
Anodes	Anode:Cathode Ratio: 2:1
Operating Temperature	140 - 160°F (60 - 80°C)

RECOMMENDED EQUIPMENT

- Tanks: mild steel
- Agitation: mechanical
- Anodes: OFHC
- Filtration: continuous DE with carbon
- Anode bags: nylon

SOLUTION MAKE-UP

ADDITION AGENTS:

HAVAPLATE CNCU BRIGHTENER

0.1 – 1.0% by vol

HAVAPLATE CNCU GRAIN REFINER

3.0 – 5.0 % by vol

HAVAPLATE CNCU BRIGHTENER may be employed to produce uniform brightness and leveling of the copper deposits. Anode:Cathode Ratio: 2:1.

As a guide, HAVAPLATE CNCU BRIGHTENER is consumed at the approximate rate of 1 gallon / 20,000 amp hours. Continuous filtration through a light carbon pack may be employed without brightener loss.

Excessive amounts of HAVAPLATE CNCU BRIGHTENER will cause a dull band in the low current density area. If this should accidentally occur, the color may be restored by temporarily increasing the free cyanide level by 1.9- 3.8 g/l (0.25 –0.50oz/ gal.).

HAVAPLATE CNCU GRAIN REFINER is used to impart improved tolerance of the bath to organic contamination, grain refinement of the deposit, as well to promote uniform corrosion of the anodes.

HAVAPLATE CNCU PURIFER is used to overcome organic and sulfur impurities that can cause LCD dullness. Typical additions will be in 0.1% increments up to 0.3%.

HP DISPERSANT is used to improve bath tolerance to organic contamination. It is not recommended that HP DISPERSANT be added on an ampere hour basis, but used as needed basis. Typical additions will be in 0.025% - 0.05% increments.

SOLUTION MAINTANCE:

Continuous quality is dependent on solution control within the recommended ranges. Periodic analysis and additions are required.

FILTRATION: Continuous filtration through filter aid and activated carbon at an hourly rate equal to the capacity of the tank is essential in order to ensure high quality, smooth copper deposits. Pre-coat the filter with filter aid, followed by an activated carbon slurry of 12-26 g/100 liters (1 -3 lbs./100 gallons) of plating solution. Smaller weekly additions of carbon are recommended as filter capacity permits. The filter should be inspected, cleaned and repacked periodically when the flow rate decreases to approximately one-half of the rated capacity.

ANODES AND ANODE CURRENT DENSITY:

A high purity grade copper anode free of oxide inclusions is preferred. Electrolytic sheet copper is not recommended. The anode area should be balanced so that the amperage requirements will be obtained within the recommended voltage limits. The upper limit of the anode current density will vary with the type of agitation employed and if the anodes are bagged or un-bagged. It is suggested that the anode current density be maintained between 1.0-1.5 A/cm² (10-15 ASF). The anodes should be replenished as frequently as necessary in order to maintain sufficient anode area.

COPPER CONTENT:

The copper concentration greatly influences the operating limits of the process and it should be held within the specified range for optimum performance. A low metal concentration will cause burning of the deposit in the high current density areas. This may be corrected by a reduction of amperage but results in a proportional loss of plating speed.

“FREE” CYANIDE CONENT:

The optimum “free” cyanide concentration will generally be found in the range of 18.75-26.25 g/l (2.5-3.5oz/gal.). Once this value has been established, it should be maintained by analysis and expressed in terms of either the sodium or potassium salt.

ALKALI CONTENT:

Use caustic potash for makeup and maintenance of the hydroxide content . A low hydroxide concentration may result in inferior anode corrosion and poor conductivity. High hydroxide concentration may negatively influence the hardness and brightness of the deposit.

OPERATING PRECAUTIONS:

Carbonate Contamination: Carbonates lower efficiency of plating bath. Consult your HPC representative for treatment options.

Organic Contamination: Grease and oils are very harmful to the plating solution. Care should be exerted against the introduction of contaminants into the plating solution. Most organic contamination can be controlled by HP DISPERSANT.

Chromium Contamination: Chromium contamination will cause dull streaks, step plate in the low current density area or possibly an overall dullness. **CHROME REDUCER G** contains a sufficient amount of chromium reducer to accommodate normal amounts of chromium ..contamination when dosed at 1lb/1,000 gallons. Sodium hydrosulfite is not recommended for chromium contamination control in this process.

NON CYANIDE COPPER STRIKE

HP COBRE STRIKE

- CYANIDE FREE pyrophosphate-based copper plating system.
- Produces low-stressed and ductile copper deposits.
- Excellent throwing power and adhesion.
- Strikes on steel, zinc, zincated aluminum, and plastic.
- Suitable for rack and barrel operations.
- Complies with RoHS/WEEE
- Addition agents are dosed on an ampere-hour basis.

OPERATING PARAMETERS

Formulation	Range	Optimum
Copper as Metal (Cu) Copper	0.27 - 0.54 ios 2-4 g/ 35 - 55 ios	0.37 opg (2.8g/L)
TKPP Anhydrous	262.5 - 412.5g/L	45.0 opg (337.5 g/L)
CuPP Hydrated	0.7 - 2 oz gal 5.25 - 15 g/L	1opg (7.5 g/L)
HP Cobre MU	8 - 12 %	10%
HP Cobre GR	1 - 2%	2%
HP Cobre WA)	0.1 - 0.3%	0.2%

RECOMMENDED EQUIPMENT

- Tanks: PVC or rubber-lined mild steel
- Agitation: Mechanical or air
- Anodes: OFHC Copper
- Filtration: Continuous, DE, 5-8 turnovers/hr
- Anode bags: polypropylene

SOLUTION MAKE-UP

1. Fill a separate tank with 40% of working volume of deionized or RO water.
2. Under strong agitation, slowly add potassium pyrophosphate to tank. Maintain tank temperature below 115°F (45°C) to avoid building orthophosphates. Once addition is fully dissolved, allow to cool below 90°F (32°C)
3. Under agitation, make small additions of copper pyrophosphate until fully dissolved into solution. Maintain temperature below 115°F (45°C) to avoid building orthophosphates.
4. Add five pounds of activated carbon powder per 250 gallons (2.5 kg per 1000L) of final solution to the bath and stir for at least 60 minutes, then allow active carbon to settle.
5. Filter the solution through a 5 micron filter into the working tank. Make sure no active carbon particles are in the working solution.

6. Fill tank to 85% of working volume, and homogenize with agitation.
7. Add HP Cobre MU, HP Cobre GR, and HP Cobre WA to solution individually, allowing each component to fully homogenize before adding the next.
8. Dummy plate at 5 ASF (0.5 ASD) for approximately 15 to 20 AH per 250 gallon (1000L) tank solution.

MAINTENANCE AND PROCESS CONTROL

The HP Cobre additives can be added directly to the bath according to the following rates, with agitation.

Put this into a simple table:

Addition Agent	Per 1,000 Amp-Hour
HP Cobre MU	150 - 280 mL
HP Cobre GR	130 - 200 mL
HP Cobre WA	40 - 60 mL

Potassium Pyrophosphate and Copper Pyrophosphate are added according to analysis to maintain normal operation concentrations.

Copper: Copper pyrophosphate is the source of copper metal for plating. To increase copper content by 1 oz/gal, 2.82 oz/gal copper pyrophosphate is added. This also will raise the total pyrophosphate content 1.3 oz/gal. First, dissolve the salt in a small

container of working bath, then introduce through the filter. Low concentrations will cause high current density burning.

Potassium Pyrophosphate: Potassium pyrophosphate increases solution conductivity and lowers the voltage required to plate at a given current density. To increase only total pyrophosphate content by 1 oz/gal, 1.9 oz/gal potassium pyrophosphate is

required. Low concentrations will cause an increase in the operating voltage required to attain a given current density.

NOTE: Should copper and total pyrophosphate content be below recommended value, first determine pyrophosphate added from the copper pyrophosphate before determining the required potassium pyrophosphate addition.

COPPER PASSIVATE

CUPRASHEEN ANTI-TARNISH

- Tarnish preventative for use on copper, brass, bronze and silver substrates.
- Water based: contains no chlorinated solvents, flammable solvents, nitrates, chromates or heavy metal compounds.
- V.O.C. Free
- Provides a coating that is chemically bonded to the metal surface.
- A dip passivate that does not require a current in the solution.

OPERATING PARAMETERS

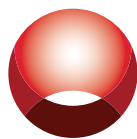
- 5% by volume
- 80-100°F
- 2-5 Minutes

OPERATING NOTES:

- Requires that parts must be clean, free from oils and greases and from any acid residues.
- If appearance after treatment looks spotty or blotchy, it is almost always due to improper cleaning.
- The coating does not rinse off after application so it is okay to dip the parts in a rinse tank before drying.

OPERATING CYCLE (RACK & BARREL)

- Replenish with 1 gallon of Cuprasheen Anti-Tarnish for every 13 ft² of parts processed.
- Recommended for both rack and barrel plated parts. Operating times do not change based on either method of application.



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