



Product Data Sheet

Date: 01/03/06

Supersedes: 01/10/05

Product #: N5108, N5114, N5125 & N7108

CIRCUTEK PC-701

High Speed Electroless Copper Process

DESCRIPTION: A high speed, electroless copper process which is capable of depositing 80 - 100 millionths of copper in 30 minutes. *CIRCUTEK PC-701* deposits a dense, adherent copper film on catalyzed surfaces for the production of printed circuit boards.

The solution is easy to control and has a broad operating temperature range. The copper produced is a bright pink, fine-grained deposit, which is readily receptive to subsequent copper electrodeposition.

INSTRUCTIONS:

Bath Make-Up:

	<u>Percent</u>	<u>100 Gal. Tank</u>
<i>CIRCUTEK PC-701 HM*</i>	12% by volume	12 gals.
<i>CIRCUTEK PC-701 HA</i>	8% by volume	8 gals.
<i>CIRCUTEK PC-701 HB</i>	4% by volume	4 gals.
<i>CIRCUTEK EC-REDUCER</i>	3.8 mls/liter	1440 mls
Deionized Water	Balance	---

**CIRCUTEK PC-701 HM* is used only when making up a new bath, or if additional stabilization is required (by analysis).

1. Fill tank ½ full with deionized water.
2. While mixing, add required amount of *CIRCUTEK PC-701 HM*.
3. Add the required amount of *CIRCUTEK PC-701 HA*.
4. Add the required amount of *CIRCUTEK PC-701 HB*.
5. Add the required amount of *CIRCUTEK EC-Reducer*
6. Dilute to final volume with deionized water.

Operating Conditions:

Temperature:	90 - 115°F
Plating Speed:	80-100 microinches in 30 minutes at 90 - 115°F
Agitation:	Mechanical and air agitation are recommended
Filtration:	To remove particles over 5 microns. A weir overflow bag is preferred.
Bath Loading:	0.5 - 1.5 ft ² /gallon

BATH MAINTENANCE:

Maintenance can be based on square feet of work processed or by analytical control.

To achieve optimum results the bath should be maintained at the following concentrations:

CIRCUTEK PC-701 HA	90 - 110% (2.25-2.75 g/l)
CIRCUTEK PC-701 HB	90 - 110% (9-11 g/l)
CIRCUTEK EC REDUCER (Formaldehyde)	90 - 110% (9-11 ml/l)

Replenishment based on workload:

Addition per square foot:

<u>Plating Time</u>	<u>Additions of PC-701 HA</u>	<u>Additions of PC-701 HB</u>	<u>Additions of EC-REDUCER</u>	<u>Typical Thickness at 90-115°F</u>
30 min.	35 ml	16 ml	4 ml	80-100 μ inches

Additions should be made frequently, preferably after every rack.

To maintain the solution level, remove a volume of bath equal to the volume of **CIRCUTEK PC-701 HA**, **CIRCUTEK PC-701 HB** and **EC-REDUCER** to be added.

CIRCUTEK PC-701 HM is not consumed in the deposition of copper, it is lost by drag-out only.

Replenishment based on Analytical Control:

The methods for analysis for **CIRCUTEK PC-701 HA**, sodium hydroxide and formaldehyde are listed under Analytical Procedures.

To raise the concentration of copper by 10%, add 30 ml/gal of **CIRCUTEK PC-701 HA**. Make this addition before analyzing for sodium hydroxide and formaldehyde.

To raise the concentration of sodium hydroxide by 10%, add 15 ml/gallon of **CIRCUTEK PC-701 HB**.

To raise the concentration of formaldehyde by 10%, add 3.8 ml/gallon of **CIRCUTEK EC REDUCER**.

Inactive Period:

1. Make no further replenishment after the final plating period. Working baths should be stored at 80% concentration or less for overnight or weekends.
2. The bath should be filtered into a clean tank periodically to maintain bath life and stability.
3. To start the bath, analyze and adjust all components back to optimum conditions.

This product should be used only for its intended purpose. The information stated above is based on our laboratory tests and experience, and is accurate to the best of our knowledge. Since actual use is beyond our control, the recommendations or suggestions are made without warranty, expressed or implied.

EQUIPMENT: Tank should be made of PVC, polypropylene, high density polyethylene or fiberglass. An overflow weir is preferred.

Racks should be constructed of type 316 stainless steel, polypropylene, polyethylene or PVC. Boards should be racked vertically and angled 5-10 degrees to permit solution flow through the holes.

Heaters should be made of quartz or Teflon.

Work bar agitation of the rack during the plating cycle is recommended. A 3 - 5 inch stroke agitating at 15 - 25 cycles/minute is adequate. A solution sparger aimed at the tank bottom can also be utilized for agitation.

Constant air agitation is required. The air must be supplied by a blower. **DO NOT USE COMPRESSED AIR**, which can be contaminated by oil.

Continuous filtration is recommended to prevent particles from settling on the work and causing roughness. The solution should be turned over 5 - 8 times per hour through a 10 - 25 micron wound polypropylene filter. An overflow weir with a bag is also recommended.

WASTE DISPOSAL: Add 1% by volume formaldehyde, 2 oz/gallon sodium hydroxide, 1 g/l ferrous sulfate, and heat to 160°F (71°C) until the solution is decomposed and the copper precipitated.

Neutralize the supernatant liquid and dispose of in accordance with all local, state and federal regulations.

CAUTIONS: **CIRCUTEK PC-701 HA** contains copper salts and reducing agents, and should not be mixed with oxidizing agents. Avoid breathing vapor and contact with skin and eyes. In the case of contact, wash with copious amounts of water for at least 15 minutes. For eyes, get immediate medical attention. Do not store near heat or in direct sunlight. Flush all spills with water. Do not take internally.

CIRCUTEK PC-701 HM is slightly alkaline. **CIRCUTEK PC-701 HB** is strongly alkaline and toxic. Avoid eye, skin and oral contact. Wear goggles, rubber gloves, and protective clothing. In case of contact, immediately flush skin and eyes with copious amounts of water for at least 15 minutes. Get immediate medical attention.

Analytical Procedures for *CIRCUTEK PC-701*

CIRCUTEK PC-701 HA Copper Analysis

Reagents: 0.1N Sodium thiosulfate Potassium iodide, 10%
 Sulfuric acid, 20% by volume Starch Indicator
 Potassium thiocyanate, 10%

- Procedure:**
1. Pipette a 20 ml sample of bath into a 250 ml Erlenmeyer flask.
 2. Add 50 ml of deionized water.
 3. Add 10 ml of 10% potassium iodide.
 4. Add 15 ml of 20% sulfuric acid.
 5. Add 20 ml of 10% potassium thiocyanate.
 6. Add 2 – 3 ml starch indicator.
 7. Titrate with 0.1N sodium thiosulfate to a white end point. Titrate slowly as the end point is approached.

Calculation:

$$\begin{aligned} \text{ml of sodium thiosulfate} \times \text{N of sodium thiosulfate} \times 127 &= \% \text{ copper content} \\ \text{ml of sodium thiosulfate} \times \text{N of sodium thiosulfate} \times 3.18 &= \text{g/l of copper} \end{aligned}$$

$$\left[\frac{100\% \text{ Copper} - \% \text{ Copper}}{\text{from Analysis}} \right] \times 3.50 \times \text{Tank Volume} = \text{mls of } \mathbf{PC-701 HA} \text{ to add in Gallons}$$

$$\text{mls of } \mathbf{PC-701 HA} \text{ added} \times 0.42 = \text{mls of } \mathbf{PC-701 HB} \text{ to add}$$

The percentage of copper content of the working bath must not drop below 80% during bath operation. While analysis and additions should be made after every workload according to the analysis, they may be made less frequently depending on workload size.

Maintain the level of plating solution by removing a volume of bath equal to the volume of *CIRCUTEK PC-701 HA* and *CIRCUTEK PC-701 HB* to be added. Add *CIRCUTEK PC-701 HA* and *CIRCUTEK PC-701 HB* according to the chart below or the calculation above.

ADDITIONS:

<u>Copper Content</u>	<u>Bail Out</u>	<u>PC-701 HA</u>	<u>PC-701 HB</u>	<u>EC-REDUCER</u>
100%	-	-	-	-
90%	50 ml/gal	35 ml/gal	15 ml/gal	3.8 ml/gal
80%	100 ml/gal	70 ml/gal	30 ml/gal	7.6 ml/gal
70%	150 ml/gal	105 ml/gal	45 ml/gal	11.4 ml/gal
60%	200 ml/gal	140 ml/gal	60 ml/gal	15.2 ml/gal
50%	250 ml/gal	175 ml/gal	75 ml/gal	19.0 ml/gal
40%	300 ml/gal	210 ml/gal	90 ml/gal	22.8 ml/gal
30%	350 ml/gal	245 ml/gal	105 ml/gal	26.6 ml/gal

Make additions of *CIRCUTEK PC-701 HA*, *CIRCUTEK PC-701 HB* and *EC-REDUCER* to bath. Mix, and obtain a new sample for analysis of sodium hydroxide and formaldehyde. Add *PC-701 HB* if necessary to increase the level of sodium hydroxide, and add *CIRCUTEK EC REDUCER* if necessary to increase formaldehyde.

Sodium Hydroxide and Formaldehyde Analysis

Reagents: 0.1N Sulfuric Acid
1M Sodium Sulfite – Add 126 g sodium sulfite to one liter of deionized water and adjust the pH to 10.00 with dilute sulfuric acid.

Procedure:

1. Place a 5 ml sample of the bath in a 150 ml beaker.
2. Dilute the sample with 50 ml of deionized water.
3. Using a pH meter standardized at 10, titrate the sample with 0.1N sulfuric acid to a pH of 10.00.
4. Record the number of milliliters used to reach a pH of 10.00.
5. Add to the sample 25 ml of 1M sodium sulfite which has been buffered to a pH of 10.00.
6. Refill the buret with 0.1N sulfuric acid and titrate the sample back to a pH of 10.00. Record the volume of acid used.

Calculation: mls of 0.1N H₂SO₄ (from Step 4) X 0.8 = g/l NaOH

Make additions of *CIRCUTEK PC-701 HB* according to the following formula, or according to the chart below:

$$\left[\frac{10 \text{ g/l NaOH} - \text{g/l NaOH}}{\text{from analysis}} \right] \times 17.0 \times \frac{\text{Tank Volume}}{\text{in gallons}} = \text{mls of } \textit{PC-701 HB} \text{ to add}$$

<u>Sodium Hydroxide g/l</u>	<u>PC-701 HB Addition</u>
10	-
9	17 ml/gallon
8	34 ml/gallon
7	51 ml/gallon
6	68 ml/gallon

Calculation for Formaldehyde:

ml of 0.1N H₂SO₄ (from Step 6) X 1.5 = ml/L Formaldehyde

Make additions of *CIRCUTEK EC REDUCER* according to the following formula, or according to the chart below:

$$\left[\frac{10 \text{ ml/L Formaldehyde} - \text{ml/L Formaldehyde}}{\text{from analysis}} \right] \times 3.785 \times \frac{\text{Tank Volume}}{\text{in gallons}} = \text{mls } \textit{CIRCUTEK EC REDUCER} \text{ to add}$$

<u>Formaldehyde, ml/L</u>	<u>CIRCUTEK EC REDUCER Addition</u>
10	-
9	3.8 ml/gallon
8	7.6 ml/gallon
7	11.5 ml/gallon
6	15.3 ml/gallon

Total Chelator (*CIRCUTEK PC-701 HM*) Concentration

Materials 0.01M Copper Sulfate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$)

Required:

Murexide indicator tablets
2 ml pipet
250 ml Erlenmeyer flask

Procedure:

1. Pipet 2 ml of working bath into a 250 ml Erlenmeyer flask.
2. Add 1 tablet of murexide indicator and mix until dissolved.
3. Titrate with 0.01M CuSO_4 to a green end point.

Calculation:

$$\frac{[(\text{mls of CuSO}_4) \times (\text{M of CuSO}_4) + \frac{\text{g/l Cu}}{63.54}] \times 292.5}{2} = \text{g/l } \mathbf{PC-701 HM} \text{ (chelator)}$$

Maintenance:

$$(19.0 \text{ g/l} - \text{g/l from analysis}) \times \frac{(\text{Tank vol. in gals.} \times 3.785)}{0.175} = \text{mls } \mathbf{PC-701 HM} \text{ to add}$$

Maintain total chelator (*CIRCUTEK PC-701 HM*) between 17.5 to 26.5 grams per liter.

Copper concentration (*CIRCUTEK PC-701 HA*) and chelator concentration (*CIRCUTEK PC-701 HM*) must be determined by analysis of the sample in order to have accurate results.