

## THE MG CHEMICALS ELECTROLESS COPPER-PLATING PROCESS

This process allows professional electronic engineers to prototype circuit boards with copper plated through holes themselves, avoiding having to send their designs to prototyping companies.

In the prototyping process, after drilling and de-burring the through holes in the copper clad board, the electroless plating process applies a thin layer of copper to the inside of every hole. This layer is not sufficient to carry the current in the finished circuit, but it is sufficient to plate to with a regular electroplating process, which normally would not adhere to the inside of the holes because the board is made of non-conductive material.

See the instructions for the MG Chemicals Professional Prototyping Process to understand the entire prototyping procedure, available at [www.mgchemicals.com](http://www.mgchemicals.com).

This electroless plating process may allow people to electroplate onto non-conductive surfaces other than circuit boards, but that is for the customer to determine through research and experimentation. MG Chemicals only guarantees the performance of this kit when used to plate through-holes in printed circuit boards.

### REQUIRED INGREDIENTS

#### ELECTROLESS PLATING CHEMICAL KIT

CAT. NO. 41600A

Quantity	Description
1	Alkaline Cleaner (CAT. NO. 41601-250ML)
1	Micro Etch Part A (CAT. NO. 41602-250ML)
1	Micro Etch Part B (CAT. NO. 41603-250G)
2	Catalyst Part A (CAT. NO. 41604-1L)
1	Catalyst Part B (CAT. NO. 41605-250ML)
1	Accelerator (CAT. NO. 41606-250ML)
1	Plating Solution Part A (CAT. NO. 41607-250ML)
1	Plating Solution Part B (CAT. NO. 41608-250ML)
1	Plating Solution Part C (CAT. NO. 41609-250ML)

*The Electroless Plating Chemical Kit contains enough chemicals to prototype five 5"x3" copper clad boards. Once mixed, two of the solutions will only last two days, so it is a good idea to have more than one prototype lined up before beginning, so the kits entire potential can be used before it expires. This kits needs to be repurchased to repeat the process.*

#### ELECTROLESS PLATING TANK KIT

CAT. NO. 41600B

Quantity	Description
5	1 gallon High Density Polyethylene tanks
5	1 gallon High Density Polyethylene lids
1	Copper Bar ( $\frac{3}{8}$ " x 8 $\frac{3}{4}$ " )
1	8 gauge copper hook
1	Air pump
1	Poly tubing ( $\frac{1}{4}$ " x 2")
1	Package of Nitrile Gloves (CAT. NO. 416-G)

*The Electroless Plating Tank Kit contains five tanks, one for each step in the process, each labeled with dilution instructions and immersion times, along with a hanging bar and hook, a package of nitrile gloves suitable for resisting the acid solutions in this process, and an air pump and tube to keep the solution in step 5 agitated. These tanks are designed to be used for boards that are 5"x3" or smaller. If you intend to plate larger boards, you will need to design your own tank system. This kit does not have to be repurchased to repeat the process.*

## OTHER INGREDIENTS RECOMMENDED (BUT NOT REQUIRED)

### OTHER INGREDIENTS

Ingredient	Description
Magnetic stirrer with stir bar (2 x 3/8")	Some users may find magnetic stirrers to be expensive, but it is strongly recommended that one be used in this process. Nearly every step in this process requires steady agitation for an extended period of time. Users might accomplish this by hand stirring with a rod, or by using air agitation, but one will generally not achieve professional results with those methods. These instructions are written assuming the user has a magnetic stirrer available.
Aqueous Heater (cat no. 416-H)	This process will function at room temperature; however, superior results are achieved if the solutions are slightly heated. The optimal temperature for each step is 25 °C, except for the last step where the optimal temperature is 30 °C. If your magnetic stirrer has built in heat, or you are in a reasonably warm climate, this will be unnecessary.
Hair dryer	For quickly drying the board after rinsing, to prevent water from corroding the board.
Measuring cup	For water, preferably about 1 liter capacity.
Rinsing tray	Large enough to fit the board being prototyped.

## SAFETY PRECAUTIONS

Read through the material safety data sheets's ("MSDS's") for all nine chemicals in the *Electroless Plating Chemical Kit*. These can be found at [www.mgchemicals.com/msds](http://www.mgchemicals.com/msds), where all of our MSDS are listed by part number. The part numbers for each chemical in this process is listed on the product label and earlier in these instructions.

Notice that many of these chemicals involve concentrated acids, and notice that the last step contains formaldehyde, a known human carcinogen. **The hazards associated with these ingredients should not be taken lightly.**

Proper planning must be done to ensure that there is adequate ventilation in place prior to beginning the process. A fume hood is recommended. At all times airborne concentrations must stay below the maximum allowed levels listed on the related MSDS. When adequate ventilation is not available, use a half mask with a cartridge suitable for acidic and organic vapors (available at your local industrial safety supply store).

Protective gloves and eyewear must be worn at all times, and a lab coat is strongly recommended because a drop of some of these solutions will easily create a hole in clothing.

## PROCESS OVERVIEW

These instructions assume that you have already started the prototyping process. You have designed your circuit, cut and routed your copper clad board, you've drilled and de-burred your through holes, and you have also drilled a hang-hole in the middle of one edge of the board, off to the side of your circuit design.

The strip of board containing this hang hole can be cut off of the finished board at the end of the prototyping process (after the entire process, not just this step, it is required for the electroplating steps as well). See the complete instructions for the MG Chemicals' Professional Prototyping Process for details, available on our website.

There are three steps to this process:

1. Cleaning the board,
2. Setting up the solutions, and
3. Immersing the board sequentially in each solution.

## PROCESS INSTRUCTIONS

### Step 1. Cleaning the board

Ensure your pre-drilled board is cleaned using an abrasive powder and an abrasive pad. Rinse with water and quickly dry using a hair dryer. Keep board in a dust free area until you are ready to begin step 3.

### Step 2. Setting up the solutions

In this step you prepare your working solutions by mixing each chemical with water in the appropriate tank using the magnetic stirrer.

Each chemical bottle and plating tank has been clearly labeled as to what step it relates to, so start by taking the bottles of the chemical kit and placing them next to the tank they belong with.

Generally, in each step you put the specified amount of water into the tank, place that on the magnetic stirrer, insert the stir bar into the middle of the tank, turn the stirrer to medium power to create a vortex, add in the chemicals required by that tank, and then mix for the specified amount of time. However, each step has its own specific requirements, so follow these exact steps:

#### Tank #1

1. Place Tank 1 on the magnetic stirrer
2. Fill tank to with 2250 mL of room temperature water.
3. Insert the stirring bar, turn magnetic stirrer to medium power and create a vortex
4. While mixing, add entire content of *Alkaline Cleaner (CAT. NO. 41601-250ML)*
5. Mix entire solution for 2-3 minutes.

## Tank #2

1. Place Tank 2 on the magnetic stirrer
2. Fill tank to exactly 2150 mL with room temperature water.
3. Insert the stirring bar, turn magnetic stirrer to medium power and create a vortex
4. While mixing, add entire content of *Micro Etch Part A (CAT. NO. 41602-250ML)*. This may increase the temperature of the solution.
5. While mixing, slowly add *Micro Etch Part B (CAT. NO. 41603-250G)*  
**Caution:** Before adding *Micro Etch Part B*, make sure the solution is at room temperature. Adding content when the water is above room temperature may cause a reaction.
6. Mix until all crystals from *Micro Etch Part B* have been totally dissolved.

## Tank #3

1. Place Tank 3 on the magnetic stirrer
2. Fill tank with 250 mL of room temperature water.
3. Add both bottles of the *Catalyst Part A (CAT. NO. 41604-1L)*.
4. Insert the stirring bar, turn magnetic stirrer to medium power and create a vortex
5. Mix for 2 minutes.
6. While mixing, add the entire content of *Catalyst Part B (CAT. NO. 41605-250ML)*.
7. Mix entire solution for 2-3 minutes.

## Tank #4

1. Place Tank 4 on the magnetic stirrer
2. Fill tank with 2250 mL of room temperature water.
3. Insert the stirring bar, turn magnetic stirrer to medium power and create a vortex
4. While mixing, add entire content of *Accelerator (CAT. NO. 41606-250ML)*.
5. Mix entire solution for 2-3 minutes.

## Tank #5

This solution must be kept under constant agitation using the Air Pump supplied in *Electroless Plating Tank Kit* or it will degrade and not function properly.

1. Fill tank with 1750 mL of warm water (30 °C / 86 °F).
2. Connect the 1/4" Poly Tubing to the air pump and place the other end into the warm water tank. Plug air pump in to start the agitation. Keep pump above the solution level to avoid siphoning of solution back to pump.
3. Add the entire contents of *Plating Solution Part A (CAT. NO. 41607-250ML)*. Allow mixture agitation for 2 minutes before adding the next bottle.
4. Add the entire content of *Plating Solution Part B (CAT. NO. 41608-250ML)*. Allow mixture to agitate for 2 minutes before adding the next bottle.
5. Add the entire contents of *Plating Solution Part C (CAT. NO. 41609-250ML)*.
6. KEEP UNDER CONSTANT AGITATION – Do not remove the air agitation from this tank unless it is to replace it with the magnetic stirrer, or you are done with the process.

### Step 3. Immersing the board sequentially in each solution

In this step you immerse the board in each tank in numerical order, always under agitation, for a specified amount of time. The board hangs off of the copper hook, which hangs off of the copper bar, by which you pick up and move the board from tank to rinsing solution to tank, as the process goes on.

To begin, thread the copper bar through the eye of the hang hook then hang your board on it. Note the location of the notches at the top lip of each tank. These notches are to hold the bar in place when you immerse the board in that tank. When the following instructions say to immerse your board, place the bar on that tank so that the board hangs down into the solution. Make sure the board is completely submerged but not so deep that it interferes with the magnetic stir bar. When it is time to remove the board from the solution, lift the bar off of the tank and move to the rinsing tray, rinsing both board and hook.

After threading the hook on the bar and hanging your board on the hook, follow these steps in order:

#### Tank #1

1. Place tank 1 on the magnetic stirrer.
2. Place the magnetic rod in the center of the tank.
3. Turn on magnetic stirrer and set at medium speed.
4. Immerse your board into the solution.
5. Continue to immerse the board for a total of at least 7 minutes.
6. Take board out of solution, rinse the hook and board with water, and quickly move to the next tank.

#### Tank #2

1. Place tank 2 on the magnetic stirrer.
2. Place the magnetic rod in the center of the tank.
3. Turn on magnetic stirrer and set at medium speed.
4. Immerse your board into the solution.
5. Continue to immerse the board for exactly 1 minute.
6. Take board out of solution, rinse the hook and board with water, and quickly move to the next tank.

#### Tank #3

1. Place tank 3 on the magnetic stirrer.
2. Place the magnetic rod in the center of the tank.
3. Turn on magnetic stirrer and set at medium speed.
4. Immerse your board into the solution.
5. Continue to immerse the board for 7-9 minutes.
6. Take board out of solution, rinse the hook and board with water, and quickly move to the next tank.

**Tank #4**

1. Place tank 4 on the magnetic stirrer.
2. Place the magnetic rod in the center of the tank.
3. Turn on magnetic stirrer and set at medium speed.
4. Immerse your board into the solution.
5. Continue to immerse the board for 5-6 minutes.
6. Take board out of solution and rinse with water and quickly move to next tank.

**Tank #5**

1. Place tank 5 on the magnetic stirrer.
2. Place the magnetic rod in the center of the tank.
3. Turn on magnetic stirrer and set at medium speed.
4. Immerse your board into the solution.
5. Continue to immerse the board for 30 minutes.
6. Take board out of solution, rinse the hook and board with water.
7. Dry the board quickly using a hair dryer, and place in a dust free area.

Observe board after the electroless process. Both the surface of the board and the interiors of the through-holes should have light brown color.

If you feel that there are some dark spots, residue on the board after you finished the electro-less process, then gently clean the board using an abrasive powder such as Comet and an abrasive pad. Rinse it with water and then quickly dry it using a hair dryer. Keep the board in a dust free area until you are ready to begin the lamination process.

## **DISPOSAL CONSIDERATIONS**

Some chemicals in this kit are toxic and corrosive. Step 5 contains both dissolved copper ions, which are highly toxic to aquatic life, and formaldehyde, a carcinogen. Dealing with these used chemicals is not a simple matter and deserves planning. **DO NOT DISPOSE OF THESE DOWN THE DRAIN.**

Waste disposal must be in accordance with appropriate Federal, State, and Municipal regulations, which vary widely region to region, as do the quality of available facilities.

The easiest course of action is usually to store the used chemical solutions individually, and then call a local waste management facility for drop off or pickup. These can usually be found in the local Yellow Pages, and many local governments provide telephone hotlines to help people locate disposal facilities. Be ready to supply our MSDS's so the facility can determine the proper disposal method.

Used solutions should be stored in plastic or glass containers. Do not mix the solutions because reactions can result. All solutions should be sealed tight, to prevent hazardous gasses from escaping, with the exception of tank number 2, which contains ammonium persulfate, which gasses off after use. Sealing the solution from this tank will cause a slight pressure build up.

Remember that empty containers may contain corrosive liquids or vapors and must be handled with care.

**Material safety data sheets can be downloaded from [www.mgchemicals.com/msds](http://www.mgchemicals.com/msds)**

## MG CHEMICALS ELECTROLESS PLATING SYSTEM QUICK REFERENCE CHART

Tank Number	Mixing Instructions	Solution Operating Temperature	Product Name, Cat. No., Formulation	Package Size	Time in Solution (minutes)
Tank 1	1. Fill tank to with 2250 mL of room temp. water. 2. While mixing, add entire content of <i>Alkaline Cleaner</i> 3. Mix entire solution for 2-3 minutes.	Room temperature (25 °C / 77 °F)	Alkaline Cleaner Cat. No. 41601-250ML  Shelf Life After Mixing: 1 week	1 x 250 mL bottle	7
Tank 2	1. Fill tank to exactly 2150 mL with room temp. water. 2. While mixing, add entire content of <i>Micro Etch Part A</i> . This may increase the temp. of solution. 3. Caution: Before adding <i>Micro Etch Part B</i> , make sure the solution is at room temp. Adding content to above room temp. water may cause a chemical reaction. 4. While mixing, slowly add <i>Micro Etch Part B</i> . 5. Mix until all crystals from <i>Micro Etch Part B</i> have been totally dissolved.	Room temperature (25 °C / 77 °F)	Micro Etch Part A Cat. No. 41602-250ML  Micro Etch Part B Cat. No. 41603-250G  Shelf Life After Mixing: 2 days	1 x 250 mL bottle  1 x 250 g bottle	1
Tank 3	1. Fill tank with 250 mL of room temp. water. 2. While mixing, add both bottles of the <i>Catalyst Part A</i> . Mix for 2 minutes. 3. While mixing, add the entire content of <i>Catalyst Part B</i> . 4. Mix entire solution for 2-3 minutes.	Room temperature (25 °C / 77 °F)	Catalyst Etch Part A 2 x Cat. No. 41604-1L  Catalyst Etch Part B Cat. No. 41605-250ML  Shelf Life After Mixing: 1 week	2 x 1 L bottle  1 x 250 mL bottle	8
Tank 4	1. Fill tank with 2250 mL of room temp. water. 2. While mixing, add entire content of <i>Accelerator</i> . 3. Mix entire solution for 2-3 minutes.	Room temperature (25 °C / 77 °F)	Accelerator Cat. No. 41606-250ML  Shelf Life After Mixing: 1 week	1 x 250 mL bottle	5
Tank 5	<p><b><i>This solution must be kept under constant agitation using Air Pump supplied in Electroless Plating Tank Kit or it will degrade and not function properly.</i></b></p> 1. Fill tank with 1750 mL of warm water (30 °C / 86 °F). 2. Connect the ¼" Poly Tubing to the air pump and place the other end into the warm water tank. Plug air pump in to start the agitation. Keep pump above the solution level to avoid siphoning of solution back to pump. 3. Add the entire contents of <i>Plating Solution Part A</i> . Allow mixture agitation for 2 minutes before adding the next bottle. 4. Add the entire content of <i>Plating Solution Part B</i> . Allow mixture to agitate for 2 minutes before adding the next bottle. 5. Add the entire contents of <i>Plating Solution Part C</i> . 6. KEEP UNDER CONSTANT AGITATION.	Warm (30 °C / 86 °F)	Plating Solution Part A Cat. No. 41607-250ML  Plating Solution Part B Cat. No. 41608-250ML  Plating Solution Part C Cat. No. 41609-250ML  Shelf Life After Mixing: 2 days	1 x 250 mL bottle  1 x 250 mL bottle  1 x 250 mL bottle	30