PHIBRO-TECH, INC.

Ac-Cu-Fine® 9 Alkaline Etchant

For the volume production of printed wiring boards

Description

Ac-Cu-Fine® 9 is a highly buffered alkaline etchant for the volume manufacture of high quality, copper metallic resist plated-through-hole or print-and-etch type (inner-layer) printed wiring boards. The product is formulated to be compatible with totally aqueous dry film photoresists.

This product is also available employing TFT®, Phibro-Tech's technology, containing an additive system designed to take the place of thiourea. Both products have the same operating parameters and general specifications. Both **Ac-Cu-Fine® 9** and TFT® will produce finer etched lines and spacings when proper equipment controls are maintained.

Excessive ventilation or evaporation is not required to maintain the pH of the etchant at the proper operating level. **Ac-Cu-Fine® 9** provides an etchant product with a well stabilized pH and does not attack aqueous photoresists. The product offers an etch rate of .0019 INCHES per minute at an operating temperature of 120° (49°C) and average copper yield of 18.6 ounces per gallon. Higher speed is commonly achieved with optimal operating conditions for both the chemistry and the etching equipment.

Reduced undercut or lateral etch of the copper circuitry can result in higher etch factors—a significant improvement over other chemistries. **With Ac-Cu-Fine® 9** ammonia fuming is reduced, due to controlled levels of ammonia and the higher buffering salt ratio which require less ventilation. After etching, use **Ac-Cu-Brite** to neutralize and brighten tin/lead plated-through-hole boards (with no hole darkening).

Ac-Cu-Fine® 9 is formulated to ensure processing latitude over a wide variety of operating conditions in the printed wiring board industry. Strict manufacturing, quality assurance, and evaluation procedures contribute to the consistent performance of the product.

Ac-Cu-Fine® 9 is compatible with processes where alkaline chemistries are used. Due to its high speed, the product provides greater throughput at an operating temperature of 120°F as compared with other alkaline products operating at 130°F. When extra speed is not required or if more undercut protection is necessary, the temperature can be reduced to 110°F.

Print and Etch Requirements

Ac-Cu-Fine® 9 is compatible with most dry films, including fully aqueous films, most liquid photoresists, and most plated materials: tin/lead, gold, and nickel.

Universal Etchant for Copper Circuits

An alkaline/ammonia based etchant, **Ac-Cu-Fine® 9** etches both inner layers and plated outer layers. It is a highly versatile etchant—processes plated, screen, and dry film imaged printed wiring boards. Features include inner layer high speed, undercut protection, quality of output, controllability, reasonable cost, and safer operation.

Properties

	Ac-Cu-Fine® 9 Working Solution	**Ac-Cu-Fine® 9 Replenisher**
Physical Characteristics	Liquid aqueous/ alkaline solution	Liquid aqueous/ alkaline solution
Appearance	Clear deep blue	Clear light blue
Odor	Strongly ammoniacal	Strongly ammoniacal
Specific Gravity (20/4°C)	Approximate Baumé In still graduate: 19° to 23° @ 20°C (68°F)	1.029=+/-0.020
Copper Content	17 to 20 oz/gal	
Crystallization Point	-12.2°C to -6.7°C (10°F to 20°F)	Approximately 7.22°C (45°F)

Applications

Ac-Cu-Fine® 9 should be used in printed wiring board facilities which have significant output of high density boards, with close line-to-line spacing, especially inner layers using totally aqueous photoresist and that have rigorous tight controls and operating parameters.

Print and Etch Requirements

The low operating pH of **Ac-Cu-Fine® 9** eliminates the tendency to strip or degrade totally aqueous resists. The incoming level of free ammonia is 30% less than most other high speed ammoniacal etchants. This allows utilization of the replenishing rinse module after the etch chamber as an anti-pollution device.

Etcher Recommendations

The Phibro-Tech line of etchants are designed for use in conveyorized spray etching equipment that has thermostatic temperature controls and proper ventilation. The venting system must be capable of creating a slight air flow to help concentrate the buffering salts in the etching chamber. To prevent excessive loss of ammonia, damper valve in the vent stack is recommended; vent stack should be located at the entrance of the etching chamber and after the replenisher rinse. For best results, the etcher chamber (either new or used) should be equipped for alkaline etchants.

The replenisher rinse functions to minimize copper salt residues on the circuits, and improves insulation resistance and reflow/solder characteristics. In addition, the rinse reduces copper concentration of dragout to drain.

A water rinse is necessary after the etchant and before any finishing solution rinse.

Cleaning

Before installation of **Ac-Cu-Fine® 9** the etcher must be cleaned and neutralized by the following procedure:

1. Empty the etcher down the inside and outside with tap water, avoiding the electrical and electronic controls.
2. If sediment is present, remove from the bottom of the etcher sump.
3. Fill the etcher with water and recirculate it through pumps, spray system, etc.
4. Empty the etcher and remove the etcher pump filters from sump; clean filter screens and replace. (See etcher manufacturer's manual for location of filters.) Clean out high pressure lines to gauges and hydrometer stack. Check nozzle orifices for restrictions.
5. Fill etcher with a 3% solution (by volume of etcher sump) of 20° Baumé Hydrochloric acid* (or 1% solution of 66° Baumé Sulfuric acid*) and recirculate for 15 minutes. Drain the etcher.
6. Repeat steps if necessary.
7. Repeat Step 3 and completely drain sump.

* Caution is advised when working with full strength acid solutions.

Refer to Manufacturer's Material Safety Data Sheet for recommendations on personal protective equipment under normal handling and use.

Operating Instructions and Conditions

Start-Up

1. Fill the etcher sump to level with starter solution.
2. If the etcher is equipped with a replenisher module, fill the sump to level with **Ac-Cu-Fine® 9** Replenisher. Operate at room temperature or up to maximum temperature that will not cause attack on titanium parts in the rinse chamber.
3. If the etcher is equipped with a solder brightening module, fill the sump to the operating level with **Ac-Cu-Brite.** Operate at room temperature or up to maximum temperature. This will not cause attack on titanium parts in the recirculating module.
4. Turn on the etcher and bring etching solution to operating temperature.
5. Turn on the exhaust fan and open damper valve in vent stack just enough to prevent ammonia fumes from entering adjacent work area. Note: All venting should be done after the exit of the etch chamber.
6. Set the controller to the appropriate standards.
7. Open the water rinse valves.
8. Begin the etching operation and adjust the conveyor speed to achieve complete copper removal.

Caution: Some Titanium Heaters are Attacked at Welded Seams Due to Manufacturing Techniques.

Ac-Cu-Fine® 9 Etching Solution Operating Data

	Recommended Limits
pH	*8.0 to 8.4*
Density at 49ºC (120ºF) is 19° to 23° Baumé (1.179 to 1.198 Sp. G.)	
Copper as copper metal is 17 oz/gal to 19.5 oz/gal	
Temperature	45°C to 54°C (110°F to 130°F)
Chloride Level	4.5 to 5.5 moles per liter

Rinsing

All etched work must be thoroughly rinsed with water immediately after etching, and before any drying occurs, to achieve quality results.

Cleaning Solder Surfaces

Etched circuitry with plated tin-lead solder resists will also require a rinse with **Ac-Cu-Brite**, followed by a final water rinse. This final step removes a protective coating formed on the solder during the etching stage; leaves the solder bright and clean, and enhances reflow and solderability. The effectiveness of **Ac-Cu-Brite** is primarily dependent on the amount of plated tin-lead surface being processed. However, dilution resulting from excessive drag-in from a post-etch water rinse will decrease brightening and cleaning characteristics. Finishing Solution should be replaced when brightening action begins to diminish or when pH rises above 1.0.

Note: Contamination of metallic brightener by copper (evidenced by the formulation of a white precipitate in the solution, and caused by incomplete etchant removal in the post-etch rinse) will reduce effectiveness.

Enhanced Packing Density

If further reduction in undercut is desired (i.e., for extremely tight packing densities), the following operating parameters can be adjusted to achieve optimum balance between chemistry and equipment.

1. Copper Concentration-Maintain copper concentration at 19.5 oz/gal. Increasing the copper content from 17 oz/gal to 19.5 oz/gal should decrease undercut by approximately 20%. The ammonium chloride concentration should be maintained over 4.9 moles/liter.

   Feed work into the etcher steadily. When there is **no work** to run, and the machine has to remain on standby, shut off the spray manifolds and/or lower temperature to 110ºF.

2. pH Level-Maintain bath *pH* at 8.2 to 8.4. Reducing the pH from 8.6 to 8.2 (with all other factors constant) will reduce the undercut by approximately 35%. The etchant must be in balance with copper concentration and buffering salt content. Lowering the pH can be accomplished by increasing the evaporation rate slightly. The higher evaporation rate will cause the buffering salt concentration to increase, which will result in a lower pH reading. It is important that the pH meter and electrodes be accurate and standardized before use. Buffer the pH meter with pH 7.0 buffer and cross-check with pH 10.0 buffer. Control of the evaporation rate requires careful damper adjustment. The adjustment should be made at either vent. It is important to note that **Ac-Cu-Fine® 9** is optimized to provide improved undercut protection over the entire range of operating conditions and does not require the above described additional controls for conventional use. Even at pH readings of 8.6 to 8.8, good undercut protection is obtained; however, totally aqueous photoresist will be attacked.

Note: Running high copper concentration in excess of 19.5 ounces per gallon will result in lower pH reading. This is due to the much lower free ammonia level in the replenisher.

Safety Precautions

Harmful if **swallowed**. Avoid contact with eyes, skin or clothing. Upon contact with skin or eyes, wash off with **water**. Avoid breathing mist or vapor. Store in a cool, dry, well-ventilated place. Avoid contact with reducers. Wear goggles and face shield, rubber or neoprene gloves, and rubber or neoprene boots. Local exhaust ventilation is recommended to limit exposure to ammonia.

Consult Material Safety Data Sheet

Equipment Materials

Phibro-Guard® TFT®/Ac-Cu-Fine® 9 Replenisher, Starter and **Ac-Cu-Brite** are compatible with materials commonly used in present etching equipment (PVC, PVDC, titanium, Teflon, Tygon, glass).

Polyethylene and polypropylene may also be used as materials of construction.

Packaging and Storage

All products are available in 55 U.S. gallon drums. They can be stored over extended periods of time in original and unopened shipping containers if placed in a protected area with temperature range between 45ºF and 90ºF (4ºC and 32ºC).

Etchant replenishers are also available in bulk tankwagon shipments.

Spent Etchant

All spent etchant must be returned to Phibro-Tech at the time of delivery of the fresh etchant and must contain a minimum of 16 oz/gal of copper as copper metal.

The information herein is believed to be reliable. However, no warranty, express or implied is made as to its accuracy or completeness and none is made as to the fitness of this material for any purpose. The manufacturer shall not be liable for damages to person or property resulting from its use. Nothing herein shall be construed as a recommendation for use in violation of any patent. Consult the Material Safety Data Sheet for additional information.

Phibro-Guard® TFT® and Ac-Cu-Fine® 9 are registered trademarks of Phibro-Tech, Inc.

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