

ENTEK® PLUS CU-106A REPLENISHER



PWB copper protective coating

ENTEK PLUS CU-106A Replenisher is part of the ENTEK PLUS family of high performance copper protective coatings for use on printed wiring boards (PWBs) and is utilized for make-up and replenishment of ENTEK PLUS CU-106A working solutions. ENTEK PLUS CU-106A working solution creates a high performance copper protective coating for use on printed wiring boards. ENTEK PLUS CU-106A is a replacement for hot air solder leveling (HASL) and other metallic PWB surface finishes. When used with the ENTEK PLUS Process, copper pads and through-holes are coated with a durable film which maintains surface planarity and inhibits copper oxidation.

The ENTEK PLUS Process produces a coating that provides excellent protection against copper solderability degradation caused by exposure to multiple heat cycles during SMT and mixed technology PWB assembly. The ENTEK PLUS Process consists of ENTEK Cleaner SC-1010DE, ENTEK Microetch ME-1020, a sulfuric acid rinse, and ENTEK PLUS CU-106A. **READ ENTIRE TECHNICAL DATA SHEET BEFORE USING THIS PRODUCT.**

MATERIALS REQUIRED

1. ENTEK PLUS CU-106A Replenisher is used for make-up and replenishment of the Organic Solderability Preservative (OSP) concentration in the working solution. For every liter of ENTEK PLUS CU-106A Replenisher add 3.7 mL reagent grade ammonium hydroxide.
2. ENTEK PLUS CU-106A Additive is used to replenish excessive loss of acids in the ENTEK PLUS CU-106A working solution. Under normal conditions the total acidity of the working solution will drop slowly. Reduction in total acidity or an increase in pH can occur more rapidly in equipment with a high evaporative loss. For precise control of total acidity see the analytical section of this data sheet.
3. Reagent Grade Ammonium Hydroxide is used to increase pH. It is typically used on start-up of a new solution and with additions of ENTEK PLUS CU-106A Replenisher. Continued drop in pH does not occur in normal operation of ENTEK PLUS CU-106A. If a continuous drop in pH occurs, this indicates a possible contamination problem.
4. Reagent Grade Formic Acid is used **only on start-up of a new solution** in adjustment of initial pH. This should only be necessary if excessive ammonium hydroxide is added.

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EQUIPMENT REQUIRED

Tanks	Polypropylene, linear polyethylene, PVC
Stirrers	Polypropylene, Teflon
Heaters	Teflon, quartz
Exhaust	Exhaust ventilation is recommended
Racks	Plastisol coated, polypropylene, polyethylene
Pumps	Polypropylene, Teflon; Do not use stainless steel

OPERATING CONDITIONS

	<u>Nominal</u>	<u>Range</u>
Concentration	100%	90 to 110%
Temperature	110 °F(43 °C)	105 to 115 °F (40 to 46 °C)
Agitation		Continuous recirculation 3 to 4 turnovers/hour (Do not use Aeration)
Time	60 seconds	30 to 90 seconds
Total Acidity	100%	90 to 120%
pH @ 72 °F(22 °C)	2.6	2.5 to 2.8
Coating Thickness Range	0.35 microns	0.2 to 0.5 micron

OPERATION

Process Cycle

Variations in process equipment and line speed can affect deposit thickness. Immersion time is determined by running thickness coupons as outlined in the "Control" section. Select dwell time to achieve desired coating thickness. Thickness should be checked periodically during operation.

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OPERATION (Cont.)

Operating Parameters

<u>Process Step</u>	<u>Chemistry</u>	<u>Vertical</u>	<u>Horizontal</u>
Cleaner	ENTEK Cleaner SC-1010DE	120 °F (49 °C), 5 min 5 to 20% volume	110 °F (43 °C), 30 sec. 10 to 20% volume
Rinse	City Water	1 to 2 min.	30 sec.
Microetch	ENTEK Microetch ME-1020	80 °F (27 °C), 1.5 min. 90 gm/L	80 °F (27 °C), 30 sec. 60 gm/L
Rinse	City Water	1 to 2 min.	30 sec.
Acid Rinse	Sulfuric Acid	5 to 10%, 1 min.	5 to 10%, 30 sec.
Rinse	City Water	1 to 2 min.	30 sec.
Organic Coating	ENTEK PLUS CU-106A	30 to 90 sec. 105 to 115 °F(41 to 46 °C)	30 to 90 sec. 105 to 115 °F(41 to 46°C)
Air Dry		2 min. drip	Clean Air Knife
Rinse	Deionized Water	1 to 2 min.	30 sec.
Final Dry		Forced Air Dry	Forced Air Dry

Make-Up Procedure

1. Thoroughly rinse process equipment. (NOTE: Equipment previously used for other chemistry must be leached with 5 to 10% formic acid for 24 hours. New equipment should be leached first with a mixture of 20 to 25 gm/L sodium hydroxide and 20 to 25 gm/L trisodiumphosphate for 4 to 8 hours at 100 to 120 °F (38 to 49 °C). After rinsing, leach with 5 to 10% Formic Acid for 4 hours and thoroughly rinse with DI water.)
2. Fill sump or process tank 2/3 full with D.I. water. With mixing add 100 mls of ENTEK PLUS CU-106A Replenisher for every liter of operating solution (0.1 gal/gal.). Bring sump or process tank to operating level with D.I. water.
3. With solution at 72 °F (22 °C) and with continuous agitation, slowly add 3.7 mL reagent grade ammonium hydroxide for every liter of ENTEK PLUS CU-106A operating solution (14 mL/gal). **NOTE:** Recirculation pump must be on if solution is heated.
3. Check pH and adjust to 2.6 ± 0.1 at 72 °F (22 °C). (See "Analysis" section page 4). **NOTE:** Formic acid should be used to lower pH on start-up of a new solution only when necessary.
4. Heat solution to 105 to 115 °F (41 to 46 °C) while recirculation pump is on. Analyze operating strength after solution has reached operating temperature. Adjust to 100% with ENTEK PLUS CU-106A Replenisher or deionized water as required. If a replenisher add is required, recheck pH after addition has been made (See Analysis).

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Make-Up Procedure (Cont.)

5. Determine coating thickness, first ensuring that the solution is at proper operating temperature (refer to "Coating Thickness Determination" section). If thickness is not in the desired range, adjust pH. If thickness is low, add reagent grade ammonium hydroxide in 250 mL/100 gallon increments. If thickness is high, add 90% formic acid 500 mL/100 gallon increments. Repeat thickness analysis. Once coating thickness is in desired range, analyze for total acidity (refer to "Total Acidity Analysis," Section B, for solution control) and use this as the target acidity for future analysis.

Temperature

ENTEK PLUS CU-106A performs best when run at a consistent temperature between 105 and 115 °F (41 to 46 °C). The optimum operating temperature is 110 °F (43 °C). Actual operating temperatures may be slightly higher or lower, depending on equipment and desired coating thickness. The operating temperature must be controlled within 2 °F to minimize fluctuation in coating thickness. Good solution movement and low density type heaters are recommended for optimum solution life and consistent deposit performance.

Total Acidity

Accurate control of acidity is crucial to producing and maintaining a consistent deposit thickness over prolonged periods. The acidity is maintained by additions of ENTEK PLUS CU-106A Additive. The ENTEK PLUS CU-106A solution level must be within range to ensure accuracy of the total acidity. Therefore analysis for operating strength must be performed prior to the total acidity analysis. The total acidity of the solution should be analyzed daily (see Total Acidity Analysis section).

pH

The pH of the solution should be adjusted to a range of 2.5 to 2.8 upon initial make-up. Once the desired pH and thickness rate has been established, pH should be used as a tool to monitor the solution. Any adjustments should be made based on total acidity analysis.

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PRECAUTIONARY INFORMATION

CAUTION: Do not use high-speed transfer pumps, which cavitate and lead to solution decomposition.

DANGER!: ENTEK PLUS CU-106A REPLENISHER, ENTEK PLUS CU-106A ADDITIVE AND THE OPERATING SOLUTION CONTAIN FORMIC ACID WHICH MAY CAUSE SEVERE BURNS.

HAZARDS: ENTEK PLUS CU-106A REPLENISHER, ENTEK PLUS CU-106A ADDITIVE and the operating solution contain formic acid which upon contact may cause severe burns to skin and eyes. Inhalation of vapors or mist from ENTEK PLUS CU-106A REPLENISHER, ENTEK PLUS CU-106A ADDITIVE or the operating solution may cause severe irritation, or burns to respiratory tract. Ingestion may cause severe burns of mouth, throat, esophagus and stomach. Do not get in eyes, on skin, or on clothing. Do not inhale or take internally.

CONSULT SUPPLIERS MSDS FOR INFORMATION ON AMMONIUM HYDROXIDE AND FORMIC ACID.

FIRST AID: In case of contact of ENTEK PLUS CU-106A REPLENISHER, ENTEK PLUS CU-106A ADDITIVE or the operating solution with skin or eyes, flush with plenty of clean, cool water for 15 minutes; for eyes get immediate medical attention. Remove contaminated clothing and shoes.

HANDLING INFORMATION: When preparing or maintaining solutions, always add ENTEK PLUS CU-106A REPLENISHER and ENTEK PLUS CU-106A ADDITIVE slowly and cautiously. Avoid breathing vapors or mist. When handling ENTEK PLUS CU-106A REPLENISHER, ENTEK PLUS CU-106A ADDITIVE or the operating solution, wear protective clothing, chemical safety goggles, respirator, face shield and rubber gloves. Avoid contact with oxidizers, alkalis or any other foreign material. Avoid storage above 100 °F. Formic acid decomposes to carbon monoxide and may cause pressure build-up in closed containers. Also carbon monoxide is a highly toxic gas. Exhaust ventilation is required to remove vapors or mist that may be generated during make-up and operation.

CONTAINER INFORMATION: Keep containers tightly closed. Store indoors in a cool, dry area away from alkalis and oxidizers. Loosen closure cautiously when opening. Wash thoroughly after handling. Do not reuse containers, wash before disposal. Improper disposal or reuse of container may be dangerous and illegal.

REFER TO MSDS FOR FURTHER SAFETY AND HANDLING INFORMATION

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CONTROL

Prior to any analysis insure that solution level has been properly adjusted and that operating solution has been thoroughly mixed at operating temperature. The following analytical procedures are recommended for use by personnel who have been trained to use laboratory practices which are considered safe and prudent by chemical industry standards. Such practices include suitable personal protective equipment, the use of proper equipment, the use of proper methods of handling all chemicals and proper laboratory procedures.

CAUTION: The following procedures involve the use of potentially hazardous chemicals; manufacturer's material safety data sheets should be consulted and the appropriate safety precautions followed.

Control of the ENTEK PLUS CU-106A operating solution is accomplished through measurement of total acidity, solution pH, operating strength and coating thickness.

ANALYSIS FOR pH ON START-UP

Equipment Needed

pH meter with 0.01 accuracy

Reagents Needed

pH 4 buffer solution

pH 2 buffer solution

Procedure

1. Following manufacturer's recommendation, calibrate the pH meter at pH 4 and pH 2 using the appropriate buffer solutions.
2. Bring ENTEK PLUS CU-106A solution to operating temperature with good mixing before sampling.
3. Cool a 250 mL sample to 72 °F (22 °C) and measure pH.

Adjustments

To increase pH add reagent grade ammonium hydroxide in 250 mL increments for every 100 gallons of ENTEK PLUS CU 106A operating solution. Recheck pH at 72 °F (22 °C) after each add. Allow sufficient time for complete mixing. Make sure solution is circulating and mixing for at least one half hour before rechecking pH.

ANALYSIS FOR SOLUTION CONTROL: OPERATING STRENGTH, TOTAL ACIDITY AND COATING THICKNESS

A U.V. Spectrophotometer capable of 270.0 nm wave length is required for "Operating Strength Analysis" and "Coating Thickness Determination," detailed below. Because variations exist between different spectrophotometers, the analysis factors (F(s), F(t)) must be determined for each individual unit. This procedure is outlined in Section D, "Calibration of Spectrophotometer."

A. Operating Strength Analysis

Equipment

UV Spectrophotometer

1 cm UV Quartz/UV Silica Spectrophotometer Cells

1 liter volumetric flask

4 mL volumetric pipet

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Operating Strength Analysis (Cont.)

Procedure

1. Turn on spectrophotometer and allow to warm up for 10 minutes.
2. Pipet a 4 mL sample of ENTEK PLUS CU-106A operating solution into a 1.0 liter volumetric flask. Fill to mark with distilled water and mix well.
3. Adjust wavelength of spectrophotometer to 270.0 nm. Fill a 1.0 cm quartz cell with distilled water (two cells for dual beam instruments) and adjust to 0.00 absorbance.
4. Remove cell from sample compartment, rinse with dilute ENTEK PLUS CU-106A from step #2 and fill with dilute ENTEK PLUS CU-106A.
5. Place filled cell into the sample compartment and record absorbance reading.

Calculation

$$\text{Absorbance} \times F(s) = \% \text{ ENTEK PLUS CU-106A}$$

Adjustments

If operating strength is over 105% due to evaporation losses, add distilled water slowly while stirring to reduce the operating strength to 100% \pm 5%. If operating strength is below 95% due to consumption losses, add an appropriate amount of ENTEK PLUS CU-106A Replenisher. For every 1% low add 1.0 mL ENTEK PLUS CU-106A Replenisher per liter of operating solution.

If operating strength is considerably below 80% or if the solution is old and visibly contaminated, discard and replace with a new solution.

B. Total Acidity Analysis

Scope

This procedure is designed to measure total acidity of the ENTEK PLUS CU-106A which will aid in maintaining a consistent coating thickness.

Equipment

25 mL pipet
250 mL Erlenmeyer flask

Reagents Needed

1N sodium hydroxide (NaOH)
0.1% Neutral Red Indicator Solution, dissolve 1 gm of Neutral Red Indicator in 1 liter of 50/50 ethanol water mixture.

Procedure

1. Pipet 25 mL of ENTEK PLUS CU-106A solution from process tank into 250 mL beaker.
2. Add approximately 150 mL of deionized water and 1 to 2 mL of Neutral Red Indicator.
3. Titrate with 1.0N NaOH till all traces of red disappear.

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Total Acidity Analysis (Cont.)

Calculation

Solution acidity(%) = mL of 1.0N NaOH titrated x Normality of NaOH x 4.35.

Total acidity should be maintained within a range of 90 to 120% to ensure consistent coating thickness. Target total acidity (90 to 120%) is based on the level established upon initial make-up and adjustment for desired coating thickness.

Replenishment

If the solution acidity is greater than the target acidity no replenishment is required. If the solution acidity is less than the target acidity, replenishment should be made according to the calculation below:

$$\text{Volume of ENTEK PLUS CU-106A Additive needed (gallons) =} \\ \frac{[\text{Target Acidity (~90-120\%)} - \text{Solution Acidity (\%)}] \times \text{Tank Capacity (gallons)}}{1215}$$

An alternate procedure using a pH meter is available as a customer bulletin from Enthone-OMI.

C. Coating Thickness Determination

Scope

This procedure is designed to measure the thickness of the corrosion inhibitor film deposited by ENTEK PLUS CU-106A.

Equipment

UV Spectrophotometer
Copper clad single sided laminate precisely cut to 30 x 50 mm strips
5.0% Hydrochloric acid solution
1 cm UV Quartz/UV Silica Spectrophotometer Cells
25 mL volumetric pipet
250 mL beaker

Procedure

1. Process a 30 x 50 mm single-sided copper (electroplated) clad coupon using the ENTEK PLUS Process cycle. Be certain that the process times and temperatures are strictly followed.
2. Place the treated coupon in a dry, clean 250 mL beaker.
3. Pipet 25 mL of 5.0% HCl solution into the beaker and agitate gently for 3 minutes. **Coupon must be removed after 3 minutes.**
4. Zero the UV Spectrophotometer with 5.0% HCl solution at 270.0 nm wavelength.
5. Carefully decant a portion of the solution in the beaker into a 1 cm quartz cell and record the absorbance.

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Coating Thickness Determination (Cont.)

Thickness Calculation

Absorbance x F(t) = thickness of ENTEK PLUS CU-106A in microns.

D. Calibration of Spectrophotometer

1. Pipett 10 mls of ENTEK PLUS CU-106A Replenisher into a 100 ml volumetric flask. Fill to the mark with DI water and mix thoroughly.
2. Repeat steps 1 through 5 of the "Operating Strength Analysis" procedure.

Calculation of Analysis Factors

Operating strength factor F(s) = 100/Absorbance

Thickness factor F(t) = F(s) /157.4

These factors will vary from one spectrophotometer to another and should be periodically rechecked.

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MATERIAL SAFETY DATA SHEETS

For more detailed information on the toxicological properties of the products described herein, reference can be made to the Material Safety Data Sheet (MSDS) for each product. If you do not have the proper MSDS, it can be requested from: Enthone Inc., attention: Regulatory Affairs Department, 350 Frontage Road, West Haven, CT 06516. For emergency assistance call CHEMTREC (800) 424-9300.

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