

### Fabrication Guidelines for CLTE™, CLTE-LC™ and CLTE-P™

The Arlon CLTE family of laminate and bonding products is designed to be physically and electrically stable for use in high frequency applications where low loss, dimensional stability, thermal stability of dielectric constant, low water absorption and low Z axis CTE are needed.

CLTE materials used in stripline or microstrip applications can be processed using conventional PTFE board fabrication processes and techniques. CLTE can be processed using typical FR-4 process parameters with few in-line modifications.

#### Process Guidelines for CLTE Materials

**Storage:** Store the material flat in a cool dry area away from direct sunlight, avoiding copper oxidation and material contamination.

**Bonding:** Stripline or Buried Microstrip bonding can be accomplished using Arlon's 6700 or 6250 bonding films, CLTE-P or FR-4 prepregs. Copper oxide treatments can be used when bonding with FR-4 prepregs. It is best to laminate directly after copper etching. Adhesion to the laminate surface can be improved with sodium or plasma etch prior to bonding. Adhesion to the copper surface can be improved with an aggressive (i.e. ammonium persulfate) micro-etch prior to bonding. (Detailed process information for CLTE-P bonding ply is included below. See separate data sheets or contact Arlon Technical Service for processing Arlon 6250 or 6700 bonding films.)

**Drilling:** Drill CLTE materials using highly polished carbide tools. It is not recommended to use repointed tools. Panels can be drilled in stacks based on total thickness. The use of rigid entry (.020"-.030") and exit (.060"-.093") material is recommended. The following feeds and speeds are recommended as a beginning point to develop specific process parameters.

**Chip load:** 0.002-0.003 inch/revolution  
**Surface speed:** 400-450 surface feet/minute  
**Retract rate:** 500-600 inch/minute  
**Tool life:** 500-1000 hits (depending on stack height)

**Deburring:** Optimization in drilling will eliminate the need for aggressive deburring. If deburring is necessary, properly support the back side of the panel and apply light circular motion with wet 600 grit sandpaper. Use a high pressure spray to remove loose debris in the holes.

**Through Hole Preparation:** Hole wall resin activation is necessary to ensure coverage with electroless copper deposition. This can be done with plasma or sodium etchants. The following is a typical plasma cycle for PTFE materials:

Step	Gas Mixture	Time/Power
Heat-up	80% O <sub>2</sub> /20% N <sub>2</sub>	To reach 70-90°C Material temp
Surface Etch	80% H <sub>2</sub> /20% N <sub>2</sub> or 80% N <sub>2</sub> /20% O <sub>2</sub>	30 minutes @ 75% of full power
O <sub>2</sub> Burn	100% O <sub>2</sub>	50% power / 5min to remove residue

Hold time after plasma may be limited. The plasma process should be repeated if hold time extends beyond 12 hours. Commercially available sodium etchants are commonly used. Contact the following suppliers to obtain the processing guidelines for their products:

<b>Acton Technologies, Inc.</b>	<b>Product: Fluoroetch®</b>	Phone: 717-654-0612
<b>Matheson Gas Products</b>	<b>Product: Poly-Etch® and Poly-Etch W®</b>	Phone: 978-283-7700
<b>W.L. Gore &amp; Associates</b>	<b>Product: Tetra-etch® and Tetra-Prep®</b>	Phone: 800-344-3644

It is important to rinse the CLTE products using an organic solvent and hot water, following the sodium vendor process guidelines. Arlon recommends a bake step to thoroughly dry the product after rinsing. This bake should be performed in a vented oven for 90 minutes at 225°-250°F (110°-120°C).

**Surface Prep:** Standard chemical cleaning techniques are recommended. It is not recommended to mechanically scrub PTFE materials, due to the dimensional change that may occur when force is applied to the surface of the copper.

**Copper Plating:** Conventional electroless or direct plate technologies and electrolytic copper chemistries may be used.

**Etching:** Conventional ammoniacal or cupric etchants may be used to remove unwanted copper. Rinse thoroughly with warm water after processing.

**Resist Strip:** Conventional resist strippers may be used to remove unwanted resist.

**Soldermask:** For SMOBC parts it is recommended that soldermask coating take place within 12 hours after copper etching for best adhesion. To improve soldermask adhesion, sodium or plasma etch will prepare the laminate surface, and a micro-etch will prepare the copper surface. If required, bake CLTE for one hour at 225°-250°F (110°-120°C) to remove residual moisture before soldermask processing.

**Hot Air Leveling:** Bake CLTE boards for one or two hours at 225°-250°F (110°C-120°C) prior to solder leveling. It is recommended that boards be racked to ensure proper air circulation around the parts to fully remove any residual moisture.

**Electroless Gold:** It is important to employ adequate rinsing procedures according to the chemical vendor processing guidelines, to ensure reliable process yields for chemical plating.

**Routing:** It is recommended to use commercially available two-flute, slow spiral, micro-grain carbide, upcut endmills. Support the PTFE product with rigid entry and back-up materials. It is important for the router pressure foot to exert sufficient clamping pressure to the material stack. Typical rout parameters for an 0.062" cutting tool are:

Spindle Speed: 15,000 rpm Table Feed Rate: 15 inches/minute

## Multilayer Lamination of CLTE and CLTE-LC with CLTE-P Bonding Materials

CLTE-P is a bonding material for use with CLTE and CLTE-LC laminates to manufacture Stripline, Buried Microstrip and other multilayer assemblies. Arlon's CLTE-P employs a woven fiberglass reinforced, ceramic powder-filled, proprietary resin system to duplicate the mechanical and electrical properties of CLTE and CLTE-LC.

Bonding is usually accomplished using one sheet of CLTE-P between the dielectric surface and the copper microstrip. Additional sheets of CLTE-P may be used if required.

Nominal pressed thickness per ply is .003" but effective dielectric spacing will depend on the specific PWB design.

CLTE-P materials used in Stripline or Buried Microstrip applications can be processed after lamination using conventional PTFE and typical FR-4 process parameters with few in-line modifications as noted above.

## Process Guidelines for CLTE-P Bonding Material

**Storage:** Store the material flat in a cool dry area away from direct sunlight, avoiding material contamination. Keep bonding material in its original package after opening.

**Handling:** The material should be handled so as to prevent surface damage and creasing or breaking the woven glass reinforcement. Gloves should be worn to prevent the transfer of contaminants from skin to the bonding material.

**Pinning:** Clearance holes may be punched, drilled, or cut into the bonding material.

**Layer Preparation:** The inner layer details should be handled in a manner to prevent surface damage and creasing or breaking the woven glass reinforcement. Gloves should be worn to prevent the transfer of contaminants from skin to the layer material.

It is best to bond immediately after etching. Improved adhesion to the laminate surface can be obtained by using a sodium or plasma etch prior to bonding. Improved adhesion to the copper surface can be obtained by using a micro-etch prior to bonding. Black or Brown Oxide processes are not recommended due to the high temperatures reached during the bonding process.

Layer material must be clean and dry prior to bonding. To ensure the absence of moisture, layer material may be baked in an air-circulating oven for up to one hour at 225°-250°F (110°-120°C) immediately prior to lay-up. Excess baking will degrade the material.

**Lay-up:** Standard lay-up procedures should ensure product cleanliness. Due to the high temperatures reached during the bonding process, peripheral lay-up materials such as press padding must use noncombustible materials.

**Lamination Presses:** CLTE-P can be processed in hydraulic or vacuum assisted lamination presses having the capability to reach 550°F product temperature and to maintain up to 400 psi during the heating, dwell, and cooling cycle.

**Bonding:** Bonding is accomplished by raising the product temperature to 525°-550°F, when measured by thermocouple at the bond line, holding for 45 minutes, and then cooling below 150°F before removing from the press.

Full lamination pressure must be maintained throughout the cycle. Full pressure may range from 400 psi for a hydraulic press to 200 psi for a vacuum-assist press, depending on the specific application.

*The information and data contained herein are believed reliable, but all recommendations or suggestions are made without guarantee. You should thoroughly and independently test materials for any planned applications and determine satisfactory performance before commercialization. Furthermore, no suggestion for use, or material supplied shall be construed as a recommendation or inducement to violate any law or infringe any patent.*

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