

Arlon's CLTE-P Pre-Preg Bonding Layer is a ceramic filled PTFE coated glass coated stock that is used as a bonding ply for CLTE, CLTE-XT or CLTE-AT laminates. CLTE-P is a pre-preg material that consists of woven fiber-glass fabric coated with a proprietary resin formulation. As received, the pre-preg is approximately 0.0032" thick. After lamination, the thickness is compressed to approximately 0.0024". The proprietary resin is thermo-plastic not thermoset in nature.

| <b>Typical Properties: CLTE-P*</b>                                                                                                         |                                                                |                               |                                |
|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-------------------------------|--------------------------------|
| <b>Properties</b>                                                                                                                          | <b>Test Method</b>                                             | <b>Condition</b>              | <b>Typical Values</b>          |
| Dielectric Constant (10GHz)                                                                                                                | IPC TM-650 2.5.5.5                                             | C23/50                        | 2.94                           |
| Dissipation Factor (10GHz)                                                                                                                 | IPC TM-650 2.5.5.5                                             | C23/50                        | 0.0025                         |
| Thermal Coefficient of E <sub>r</sub> (ppm/°C)                                                                                             | IPC TM-650 2.5.5.5 Adapted                                     | -10°C to +140°C               | -12                            |
| Peel Strength (lbs/inch)                                                                                                                   | IPC TM-650 2.4.8                                               | After Thermal Stress          | 7                              |
| Volume Resistivity (MΩ-cm)                                                                                                                 | IPC TM-650 2.5.17.1                                            | C96/35/90                     | 1.4 x 10 <sup>8</sup>          |
| Surface Resistivity (MΩ)                                                                                                                   | IPC TM-650 2.5.17.1                                            | C96/35/90                     | 1.3 x 10 <sup>6</sup>          |
| Arc Resistance (seconds)                                                                                                                   | ASTM D-495                                                     | D48/50                        | >180                           |
| Tensile Modulus (kpsi)                                                                                                                     | ASTM D-638                                                     | A, 23°C                       | 471, 462                       |
| Tensile Strength (kpsi)                                                                                                                    | ASTM D-882                                                     | A, 23°C                       | 8.2, 7.0                       |
| Compressive Modulus (kpsi)                                                                                                                 | ASTM D-695                                                     | A, 23°C                       | 225                            |
| Flexural Modulus (kpsi)                                                                                                                    | ASTM D-790                                                     | A, 23°C                       | 375                            |
| Dielectric Breakdown (kV)                                                                                                                  | ASTM D-149                                                     | D48/50                        | > 45                           |
| Specific Gravity (g/cm <sup>3</sup> )                                                                                                      | ASTM D-792 Method A                                            | A, 23°C                       | 2.38                           |
| Water Absorption (%)                                                                                                                       | MIL-S-13949H 3.7.7<br>IPC TM-650 2.6.2.2                       | E1/105 + D24/23               | 0.04                           |
| Coefficient of Thermal Expansion (ppm/°C)<br>X Axis<br>Y Axis<br>Z Axis                                                                    | IPC TM-650 2.4.24<br>Mettler 3000<br>Thermomechanical Analyzer | 0°C to 100°C                  | 10<br>12<br>35                 |
| Thermal Conductivity (W/mK)                                                                                                                | ASTM E-1225                                                    | 100°C                         | 0.50                           |
| Outgassing<br>Total Mass Loss (%)<br>Collected Volatile<br>Condensable Material (%)<br>Water Vapor Recovered (%)<br>Visible Condensate (±) | NASA SP-R-0022A<br>Maximum 1.00%<br><br>Maximum 0.10%          | 125°C, ≤10 <sup>-6</sup> torr | 0.02<br><br>0.00<br>0.00<br>NO |
| Flammability (UL File E 80166)                                                                                                             | UL 94 Vertical Burn<br>IPC TM-650 2.3.10                       | C48/23/50, E24/125            | UL94-V0                        |

\* Test Data was conducted on a 0.062" laminate made of pre-preg sheets.

## Multilayer Lamination Recommendations

- Following the use of conventional imaging and etching processes, successful fabrication of multilayer circuit assemblies using the CLTE Series pre-pregs (designated CLTE-P) with the CLTE, CLTE-XT and CLTE-AT series laminates can be achieved through use of the following recommendations.

## Prepreg Material (CLTE-P)

- The Prepreg material consists of woven fiberglass fabric coated with a proprietary resin formulation that is matched in DK to the CLTE-XT, CLTE-AT and CLTE laminates. As received, the thickness of pre-preg is  $\approx .0032$ ". After lamination, the thickness is compressed to  $\approx .0024$ ".

## Surface Preparation

- Substrate surface- No additional surface treatment, either mechanical or chemical, should be necessary to achieve good adhesion. However, this recommendation is based upon laboratory conditions where multilayer lamination was performed immediately after etching of the copper surface. For panels which have a long wait time between etching and lamination, a sodium etch (or plasma etch process appropriate for PTFE) of the CLTE-XT laminate surface will provide optimal results.
- Copper surfaces - Microetch and dry the inner layer copper surfaces immediately prior to lay-up and lamination. Standard FR-4 black oxide processes may not provide optimal results due to the high lamination temperatures required to bond CLTE-P. Brown or red oxide treatments may improve the bond to large copper plane areas.

## Lamination

- Equipment- A press which has heat and cool cycles in the same opening is recommended. This ensures that constant pressure can be maintained throughout both the heat-up and cool-down cycle.
- Temperature- CLTE-P requires a lamination temperature of 550°F/288°C to allow sufficient flow of the resin. The lamination temperature should be measured at the bond line using a thermocouple located in the edge of the product panel.
- Because of the high temperatures required for lamination, noncombustible peripheral materials, such as separator sheets and press padding material, should be used. Epoxy separator sheets are not recommended as they may char or burn. Paper and certain rubber press padding materials are also not recommended for similar reasons.
- Pressure (400 psi actual)- A pressure of 400 psi is recommended to remove any entrapped air and force the flow of the prepreg into the exposed "tooth" present on the surface of the laminate. This pressure must be maintained throughout the full extent of the heating and cooling cycles.
- Heat up and cool down rate - Since CLTE-P is a thermoplastic material, precise control of heat up and cool down rates is not critical.
- Time at laminating temperature (45 minutes)- Good adhesion will be achieved by maintaining the recommended laminating temperature for a period of 45 minutes.

## Shelf Life and Storage

- Maximum recommended shelf life for CLTE-P is two years when material is stored away from direct sunlight and in the original sealed package at no greater than 25°C (77°F) and 70% relative humidity. The film rolls should be stored on edge (standing upright) or suspended by the roll cores to avoid creating creased areas or flat spots due to roll weight.

## Alternative Bonding Materials

Arlon also offers the CuClad 6250 or 6700 thermoplastic bonding films. WL Gore's Speedboard®C thermoset prepreg provides thermoset properties that are ideal for sequential lamination while maintaining a relatively low dielectric constant and thin bond line. It is widely used with CLTE products. Fluoropolymer bonding films such as FEP and PFA are also widely used in the boardshop industry. Contact Arlon for more information.



**MATERIALS FOR ELECTRONICS**

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