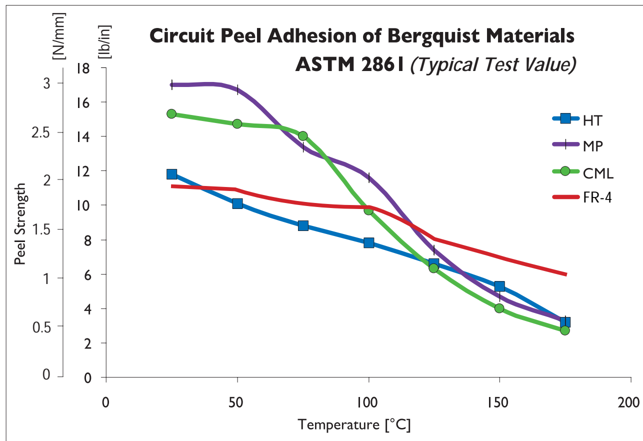
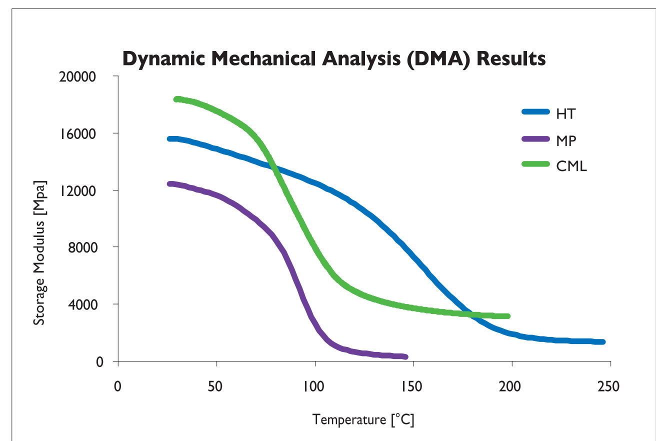
Dielectric Performance Considerations

Peel Strength



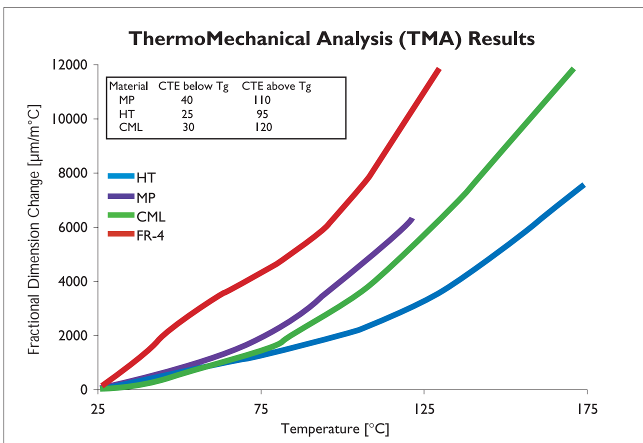
This chart graphs the stability of the bond strength between the dielectric and the circuit layer during temperature rise. Although bond strength goes down at higher temperatures, it maintains at least 3 lbs/inch (0.53 N/mm) even at 175°C.

Storage Modulus



This chart depicts the storage modulus of the material over a temperature range. All of our dielectrics are robust, but you will want to choose the one that best suits your operating temperature environment. See "Assembly Recommendations" on pages 18-19 for additional information.

Coefficient of Thermal Expansion

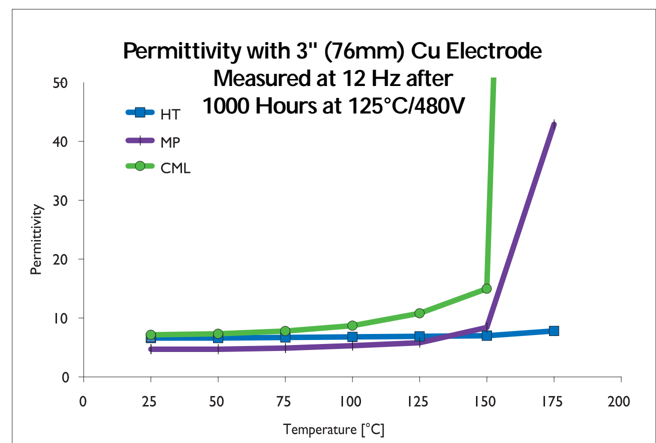


Material	CTE below Tg	CTE above Tg
MP	40	110
HT	25	95
CML	30	120

ThermoMechanical Analysis (TMA) measures the dimensional stability of materials during temperature changes, monitoring the Coefficient of Thermal Expansion (CTE). Note: In the application, the CTE of the base material is a dominant contributor to thermal mechanical stress. See pages 12-13 for base layer selection.

CTE OF IMS BOARDS - The concerns in exceeding T_g in standard FR-4 materials from a mechanical standpoint should be tempered when using Thermal Clad. The ceramic filler in the polymer matrix of Thermal Clad dielectrics results in considerably lower Z-axis expansion than in traditional FR-4 materials, while the low thickness of the dielectric means significantly less strain on plated-through-hole (PTH) connections due to expansion.

Dielectric Stability



This charts depicts the stability of the dielectric electrical properties over a range of temperatures. The flatter the line, the more stable. Note the stability of our high temperature dielectric, HT to a temperature of 175°C.

Operating Thermal Clad Materials Above T_g

Above the T_g of the material, mechanical and electrical properties begin to change. Mechanical changes of note are a reduction of peel strength of the copper foil, an increase in the CTE, and decreasing storage modulus. There is a potential benefit of relieving residual stress on the dielectric interfaces, in solder joints and other interconnects due to CTE mismatches by choosing a dielectric with T_g below the operating temperature. The dielectric material above T_g is in its elastomeric state (much lower storage modulus), allowing some of the stresses to relax. Changes in electrical properties must also be considered in operation above T_g, although they are typically only important at frequencies above 1 MHz. Effects to consider are changes in the permitivity, dielectric loss and breakdown strength of the material. **Important Note:** Many Thermal Clad products have U.L. rating up to 45% higher than their glass transition temperature and are used extensively in applications above rated T_g.