TABLE 2. Critical base material properties for lead-free assembly applications.

PROPERTY	DEFINITION	ISSUE
Decomposition Temperature, Td	Measures weight loss from resin degradation as a function of temperature. Td is typically defined as the point at which 5% of the original mass is lost to decomposition, but other levels can also be reported, e.g. 1,%, 2% or "onset."	Resin decomposition can result in adhesion loss and delamination. A 5% level of decomposition is severe, and intermediate levels are important for assessing reliability since peak temperatures in lead-free assembly can reach onset points of decomposition. A high Td by the 5% definition does not guarantee performance. Conversely, a low Td by the 5% definition is not necessarily bad if the onset temperature of decomposition is high enough.
Glass Transition Temperature, Tg	Thermodynamic change in polymer from a relatively rigid, glassy state, to a softened, more deformable state.	Several properties change as the Tg is exceeded, including the rate at which a material expands vs. temperature. Modulus also decreases significantly as Tg is exceeded.
Z-Axis Expansion	Change in physical dimension (in Z-axis) as a function of temperature, expressed as a "coefficient of thermal expansion" (CTE) or percentage expansion over a temperature range.	CTE values above Tg are much higher than below Tg. Expansion induces stress on plated vias. The higher temperatures of lead-free assembly result in more total expansion for a given material. Several mature lead-free compatible materials incorporate inorganic fillers that reduce CTE values.
Moisture Absorption	Tendency of a material to absorb moisture from the surrounding environment. Can be assessed by more than one method, including water soak or in an increased pressure & humidity environment.	Vapor pressure of water is much higher at lead-free assembly temperatures. Absorbed moisture can volatilize during thermal cycling and cause voiding or delamination. PCBs that initially pass lead-free assembly testing may exhibit defects after storage in an uncontrolled environment, as a result of moisture absorption. This should be considered when evaluating materials and PCB designs.
Time to Delamination	While not a fundamental property, measures the time for delamination to occur at a specific temperature, e.g. 260°C (T260) or 288°C (T288).	Related to decomposition temperature and adhesion between material components. Thermal expansion and moisture absorption can also influence results. In multilayer PCBs, the treatment of the internal copper surfaces is also critical.