



Lead-free soldering turns up the heat on PCB carriers

By: Alan Johnson

In the past, selecting a solder pallet material often required trade-offs between performance and manufacturability. A new glass-epoxy composite now offers both easy machining and long pallet life. Not surprisingly, manufacturers are embracing this new material option, that slashes the cost of pallet production while helping them meet the demands of soldering processes made hotter than ever by the banishment of lead.

In wave soldering processes, molten solder fuses the leads of electronic components to the underside of a printed circuit board (PCB). In this process, a pump produces a wave of molten solder that wets exposed leads as PCBs travel across the solder tank. The boards are carried on solder pallets that are specifically designed for each electronic assembly. The designs ensure that PCBs can be exactly positioned on the pallets and that only areas requiring solder are exposed to the solder wave.

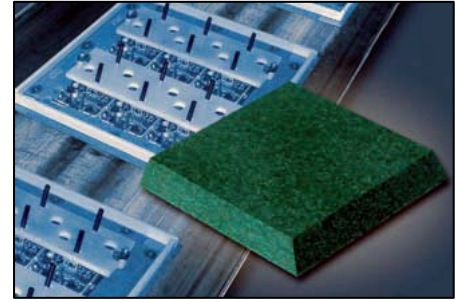
The pallets must also resist chemical degradation as they interact with the molten solder. They must remain flat so that PCBs sit properly and pass over the solder bath at exactly the right height. If pallets warp or twist over time, they may hold PCBs too far from the molten bath for optimal soldering of the electronic components.

Warping and twisting is caused by the extreme heat of the wave soldering process. Previously, pallets carried PCBs through baths of solder heated to temperatures as high as 230°C. New environmental regulations, such as Europe's Restriction of Hazardous Substances (RoHS) Directive, prohibit the use of lead in solder alloys, which raises the melting temperatures of soldering compounds. Without lead, solder must be heated to higher temperatures to lower the viscosity of the material enough that it will flow into vias of PCBs. As a result, solder baths now maintain temperatures as high as 315°C.

Cool pallets experience thermal shock when exposed to these hot solder baths. In addition, repeated cycles of heating and cooling cause thermal fatigue. Pallets may go through as few as 50 or as many as 10,000 soldering cycles in their lifetimes. Typically, though, they go through several thousand cycles, each time heating up in the solder bath for 2–12 seconds and then cooling back down to room temperature.

Manufacturing considerations

In addition to the soldering environment, engineers selecting a pallet material must consider issues related to pallet manufacturing. This process involves shaping materials into intricate patterns so that PCBs will fit properly into their pallets. One way to do this is by moulding pallet materials. But net-shape moulding is usually an impractical option because of the expensive tooling that is needed for pallet designs, as well as the frequent changes in pallet configurations due to rapid advances in the electronics industry.



WaveMax 6000 high-temperature thermoset composite solder pallet material

Therefore, most solder pallets are machined from sheets of glass-filled composite materials. Machining becomes more difficult as the glass content of the pallet material increases. However, the higher glass content of the material enables the pallet to maintain its rigidity and shape despite repeated exposure to hot solder baths.

So in choosing a pallet material, there is often a trade-off between ease of machining and pallet life. Generally speaking, materials that offer easier machining are designed for fewer soldering cycles, while materials that are more difficult to machine maintain their performance characteristics for 5,000 cycles or more.

No more trade-offs

Now, difficult trade-offs may no longer be necessary thanks to WaveMax 6000, a new, more cost-effective composite pallet material made by Norplex-Micarta and designed to offer both easy machining and long pallet lifecycles. While most pallet materials offer high glass-to-resin ratios to increase stiffness, this new epoxy-matrix composite contains less than 50% glass. With less glass content, the material is easier to machine than many alternatives. In fact, the new composite can usually be machined into precise and intricate patterns twice as fast as competitive materials. Besides helping pallet manufacturers that specialise in quick turnaround, faster pallet machining can significantly reduce production costs. With machining adding \$50–100 an hour to the cost of pallet production, it is not uncommon for manufacturers to spend three or four times as much to machine the materials as they spend on the materials themselves. By switching to a composite with lower glass content, manufacturers can halve their machining costs, while also slashing material outlays by up to 20%.

WaveMax 6000 has enough flexural strength to keep pallets flat through thousands of extreme thermal cycles. The key is in its special epoxy resin, which features improved chemical resistance to molten solder. There are many different solder formulations, each of which causes a different reaction when it comes in contact with the resin in a composite pallet



Lead-free solder pallet

material. Generally speaking, interaction with molten solder causes resins to dissolve. By holding up better than other resins when exposed to most types of solder, this new epoxy formulation helps close the performance gap left by high glass content materials.

In fact, the vast majority of users find that the new composite meets their performance requirements just as well as high-glass-content materials that cost 15–20% more. These users report that pallets made of the new composite stay flat enough to ensure soldering quality for thousands of cycles.

Besides taking the heat from lead-free soldering processes, WaveMax 6000 helps users cope with high-voltage static electricity produced during PCB manufacturing. Fast dissipation of static electricity (in millionths of a second) can cause sparking that damages PCB circuitry. But with its excellent static dissipative properties, WaveMax 6000 eliminates static electricity more slowly (in tenths or hundredths of a second), thereby minimizing the chances of harmful sparking.

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