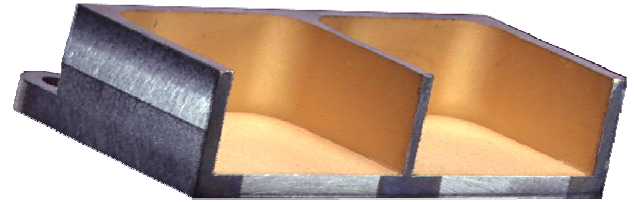


Lightweight, Low Expansion and Highly Thermally Conductive Packaging.

PA&E has been providing customers over the past decade with the most advanced hermetic connector and packaging technologies available. With the introduction of its new Titanium Composite packaging this trend continues. This new technology uses titanium as the primary housing material and integrates composite heatsinks composed of molybdenum/copper (Mo/Cu) or aluminum/silicon carbide (AlSiC) into strategic locations of the structure for excellent heat dissipation. The combination of titanium and Mo/Cu or AlSiC is ideal for achieving lightweight, low coefficient of thermal expansion (CTE), and high thermal conductivity electronic packages. Electrical feedthru pins can be hermetically sealed directly into the titanium using PA&E's proprietary Kryoflex[®] ceramic. Alternately, hermetic connectors made from explosively bonded dissimilar metals can be laser welded into position.



Titanium is the material of choice for housings because of its commercial availability along with its conventional machining and low-density attributes. The CTE of titanium is compatible with direct attachment of electronic circuitry such as aluminum oxide and gallium arsenide. Titanium is 300% stiffer than aluminum and can maintain hermeticity with walls as thin as .010". This means that an existing aluminum package can be redesigned to be stiffer, lighter weight, more reliable, and better thermally with the integration of PA&E's Titanium Composite technology. Titanium is compatible with both resistance and laser welding processes. This provides flexibility for connector integration and cover sealing. Titanium is also conducive to metal injection molding, making it a viable option for high volume manufacturing.

Titanium is an ideal material for electronic packages even though it has low thermal dissipation characteristics. Simply by utilizing our Titanium Composite packaging technology incorporating Mo/Cu or AlSiC composite heat sinks this characteristic becomes a non-issue. During the initial design phase, the electronic circuitry is mapped against the housing floor where hot spots are readily identified. The Mo/Cu or AlSiC composite heat sinks are then metallurgically bonded at only the locations of the housing that comes into contact with the high power devices. This limited use of the heat sink material minimizes the overall mass of the package.



PA&E has developed dissimilar metal connectors for years offering customers an alternative to traditional solder-in connectors and feedthrus. This technology is made possible by a process combination of explosion bonding and laser welding. Explosion bonding is a method of joining dissimilar metals by driving them together with an explosive detonation. The product of this procedure is a sheet consisting of atomically bonded layers of different metals. In the case of the Titanium Composite packaging, the connectors are fabricated from an explosion bonded sheet where one of the layers within the sheet is titanium and the other layer is a ferrous metal compatible with laser welding. This explosion bonded sheet is then used to fabricate connector shells containing titanium on one side and a ferrous alloy on the other side. The ferrous side receives a group of feedthru pins that have previously been hermetically sealed into a ferrous insert. This insert is then laser welded to the ferrous portion of the connector shell while the titanium portion is welded to the titanium package. This allows for a hermetic seal between the connector and the housing without the use of solder.

PA&E uses a dielectric ceramic sealing medium known as Kryoflex[®]. This patented material is a polycrystalline ceramic exhibiting excellent fracture resistance making it a very reliable alternative to standard glass-to-metal seals. Kryoflex[®] will directly seal into titanium as well as other metals such as stainless steel, copper, aluminum and more. This allows for added process flexibility by providing an alternative to using dissimilar metal connectors. Kryoflex[®] is a perfect choice for Titanium Composite packaging due to its compatibility with titanium.

The Titanium Composite package is the best solution for today's high power airborne electronic packaging demands which requires lightweight, low CTE and high thermal conductivity. Titanium has a low density and when integrated with Mo/Cu or AlSiC composite heat sinks the combination yields highly thermally conductive housings. The Titanium Composite material does not require mold tooling or diamond machining. Hence, the technology can be incorporated into new designs with very limited nonrecurring tooling. This makes the prototype phase more economical than competitive technology. A Titanium Composite package complete with cover and integrated hermetic connectors and feedthrus is now available through PA&E.



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