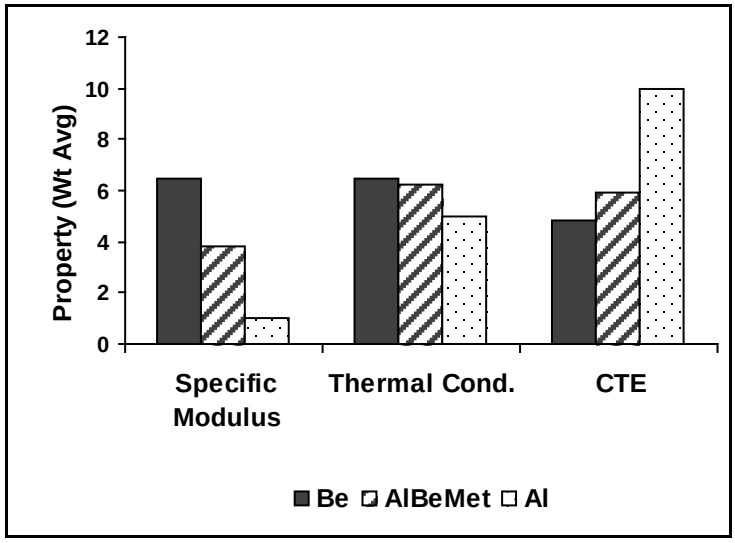
MATERION

DATA SHEET

Aircraft Electronic Modules
AlBeMet® - A Key Ingredient in the F-22 Central Computer

Abstract

The family of beryllium alloys has traditionally been used in performance demanding applications. Beryllium's well-recognized combination of low density and high stiffness (Specific Modulus) is unmatched by any other structural material. Even the well-publicized family of composite materials being developed for the last 35 years, fails to match beryllium's efficiency and performance.



Beryllium, AlBeMet® and Aluminum Property Comparison

F-22 Aircraft

Materion Beryllium & Composites' latest addition to our family of engineered materials, AlBeMet® (Aluminum Beryllium Metal) offers very similar mechanical and physical property advantages over competing materials. But these materials also offer superior performance in several other property comparisons. Materion Beryllium & Composites' families of beryllium-containing materials have significantly better thermal performance. Two key properties are thermal conductivity (ability to transfer heat) and thermal expansion (amount the material grows under exposure to temperature). Both beryllium and AlBeMet® have significantly improved properties over the traditional metals.

Aircraft electronics, especially military tactical aircraft, benefit directly from all of these improved properties. Most electronic printed wire boards are bonded to a metal plate that serves as the "core" of the component. These metal cores are used to structurally support the electronics and at the same time provide a thermal path to cool the electronics. A traditional board is about 6" x 6" x 0.05"-0-100" thick.

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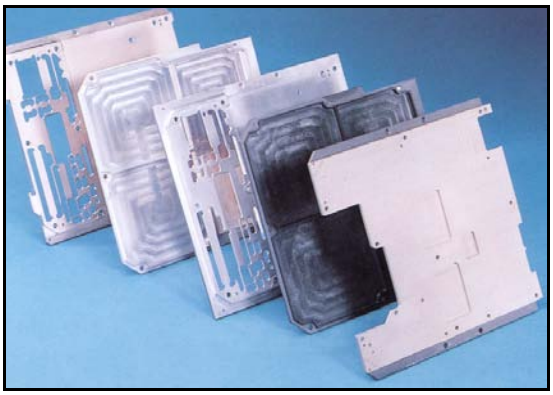
As modern tactical aircraft have developed, electronics have become a key portion of the cost and capability of the new platforms. Electronics represent over 50% of the cost of the new F-22 Tactical Fighter. The electronics are becoming more and more sophisticated and they are dictating the performance capability of the weapon system.
AlBeMet® provides better performance properties on all fronts. The material's low density offers components that weight significantly less. The high stiffness drives up the resonance frequency, which protects the electronics from large vibration amplitudes. AlBeMet®'s composite construction also damps out vibration better (2-5 times better damping) this protects the sensitive electronic chips. The high thermal conductivity keeps the electronics cooler. This significantly improves the performance and speed of the electronic components. And finally, the lower coefficient of expansion keeps the constant temperature cycles from fatiguing the delicate solder joints that attach the electronic components.



AlBeMet® Electronic Components

Multiple electronic suppliers have been attracted to this unique set of properties and have applied the material to the F-22 and Comanche programs. The low CTE was the driving factor to the application of AlBeMet® to the F-22 Liquid Flow Through Module (LFTM). This electronic unit was so hot that the design required a thermal core with passages to allow fluid flow to cool the electronics. It operates similar to a car radiator.

The computer chips used on this board are so large that the core material had to have low CTE. The low CTE keeps the core from expanding too much during the temperature swings. Large core growth compared to the ceramic chip that does not grow significantly, would break the brittle solder joints. AlBeMet®'s CTE is much closer to that of the electronic chip. This kept the stress in the solder joint to a minimum.

Brush Wellman has helped the manufacture of over a thousand of these complicated cores. The parts have been vacuum brazed together creating the internal cavity that the fluid flows through. These cores have been fully qualified.

The Brush Wellman LFTM is used in the central processing computer of the F-22. This computer is that makes the F-22 a lethal weapon. In essence, it is the brain of the most sophisticated tactical weapon system in the world. This, one of many AlBeMet® components on the F-22, not only makes it possible, but also provides the lifetime reliability demanded.

Note: Handling Aluminum-Beryllium Alloys in solid form poses no special health risk. Like many industrial materials, beryllium-containing materials may pose a health risk if recommended safe handling practices are not followed. Inhalation of airborne beryllium may cause a serious lung disorder in susceptible individuals. The Occupational Safety and Health Administration (OSHA) has set mandatory limits on occupational respiratory exposures. Read and follow the guidance in the Material Safety Data Sheet (MSDS) before working with this material.For additional information on safe handling practices or technical data on Aluminum Beryllium Alloys, contact Materion Brush Beryllium & Composites.

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