CASE STUDY

Explosion Bonded Thermal Battery Hermetic Headers

Customer Challenge

A manufacturer of thermal batteries, used in Missile Systems, completed a new battery design and was concerned about stress to its hermetic glass seals in its D38999 style header. This header acts as a connector/battery cover and protects the battery's critical components. Historically, exotic titanium sealing glass material has been used, but given the higher voltage needs of this new battery, the increased stress on the header forced the customer to pursue glass seal alternatives to meet its hermeticity requirements.

Challenge Review

Thermal batteries provide a high burst of power for a short period of time with power output ranges from a few watts to several kilowatts. The batteries are designed to be rugged and have a long shelf life in storage, making them ideal for missile system applications. Each battery has a hermetically sealed header to protect the internal components of the thermal battery. During the manufacturing process of the battery, anodes, cathodes, electrolytes and a heating mass are pressed together to create a series of cells or battery stack (see Figure 1). The actual number of cells in the battery stack varies depending on the required voltage level of the battery. As batteries require higher voltage levels, such as with the increasing power requirements of missile systems, more cells are added to the stack, which puts additional pressure on the header. Historically, thermal battery headers have utilized either a stainless steel, titanium, or Inconel® material "housing" with Alloy 52 pin/contact material. The new battery design required higher power and would use additional power pins within the design to help meet this requirement.

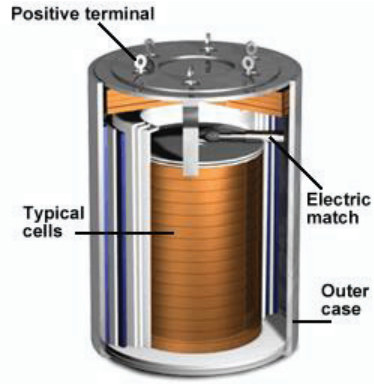

Figure 1

Winchester Solution

Winchester Interconnect™ proposed a solution that maintained the titanium header and standard alloy pin material design, but optimized performance by utilizing a standard compression glass seal instead of an exotic titanium sealing glass solution. Winchester was able to offer the standard glass seal by creating a two-piece insert construction that utilizes dissimilar metals. Specifically, Winchester used a bi-metal, explosion bonded, Stainless Steel/Titanium insert that was laser welded into the center of the connector body. This unique construction allows for significant performance improvements including:

1. The stainless steel portion of the insert is now sealed with a more reliable compression glass seal, instead of an exotic titanium glass seal.
2. The titanium portion of the insert is now affixed to the connector body with a laser weld. This isolates the glass seals from the immense bending forces across the connector flange caused by the internal pressure of the battery. This isolation protects the glass integrity from stress-induced cracks that can compromise hermeticity.

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3. The connector shell is no longer forced to undergo the process temperatures associated with an exotic titanium sealing glass, which are known to degrade the grain structure and physical properties of the wrought titanium material.
4. The pins/contacts used are common Alloy 52, the same material used in historical stainless steel battery connectors today, allowing the customer to process them using standard methods and techniques.
5. Although the standard compression glass seal used in Winchester's design is superior to the exotic titanium sealing glass solution, this material configuration also allows for the use of Winchester's exclusive Ceramax® technology as a higher reliability sealing alternative. Ceramax, a ceramic dielectric, combined with explosion bonded material would offer superior hermeticity performance, but the customer was required to continue using a glass seal as its hermetic solution.

Customer Improvement

The Winchester Interconnect Explosion Bonded Thermal Battery Header solution provides:

- Improved design to withstand pressure
- 100% hermetic seal/reliability without cracking
- A solution that allows the customer to continue using glass for its hermetic solution
- Increased flexibility to use compression glass seals or to use the higher reliability Ceramax, ceramic sealing material

Contact our Winchester Interconnect Experts for your custom solution!

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