MATERION

DESIGN GUIDE

Materion Electrofusion Design Guidelines

Metallurgical joining of high purity beryllium metal windows to dissimilar metal frames and housings has been a vital technology in the medical, analytical, and scientific industries for many years. The conventional method of achieving these high temperature joints is by means of liquidus brazing, which is done in a vacuum by melting a silver-based braze alloy, and then allowing it to resolidify, thus creating the beryllium-to-frame joint. Using this method, beryllium x-ray windows are brazed to a frame usually made of stainless steel, copper, Monel® or nickel.

Materion Electrofusion's diffusion bonding technique employs a combination of precisely controlled temperature, time, and pressure to create a metallurgical joint. By using all of these critical parameters, rather than just temperature alone, diffusion bonded windows have important advantages over conventionally brazed windows.

While high temperature liquidus brazing provides window joints that can withstand higher temperatures than diffusion bonded windows, it also induces structurally-weakening grain growth in the beryllium window material. Since diffusion bonding is accomplished at temperatures below the melting point of the braze alloy, it results in high temperature performance without compromising beryllium strength. Furthermore, by controlling the pressure in the process, diffusion bonding offers precise control over braze alloy flow, which means no high absorption alloy material contamination of the active window area (aperture). If your application requires a higher temperature resistance due to subsequent processing, and the grain growth is not a concern, Materion Electrofusion can produce window assemblies in this conventional method as well.

Since both high temperature brazing and diffusion bonding are vacuum furnace processes, 200 or more assemblies can be processed in one operation cycle, dramatically lowering the unit cost for larger quantities. The diffusion bonding process also works well with very thin beryllium foil, where 0.001 inch (25 μm) Be foil is consistently brazed leak tight. Prototypes with even thinner foils have been successfully manufactured.

There are many features and parameters that must be considered when designing a diffusion bond or high temperature braze joint. Braze alloys diffuse at different rates into the various frame materials. Common diffusion bonding design considerations include allowing sufficient area to join the beryllium to the frame, known as the "faying" surface, designing the joint for survivability under operating conditions and during subsequent manufacturing operations (such as welding or other joining processes), and thermal expansion matching.

High temperature liquidus braze joints require many of the same considerations, as well as techniques to limit the flow of alloy into the active area and methods to minimize the impact of grain growth.

Because Materion Electrofusion has over 40 years of designing these joints, we can help you early in the design phase of your product to make sure it will be a success.

Health & Safety Note:

Handling solid beryllium material poses no significant health risks. However, as with many other industrial materials—materials containing beryllium may pose a health risk, if and when recommended safe handling practices are not followed and adhered to. Inhalation of airborne beryllium may cause a serious lung disorder in susceptible individuals. The Occupational Safety and Health Administration (OSHA) have set mandatory limits on occupational respiratory exposures. Read and follow the guidance set forth in the Material Safety Data Sheet (MSDS) before working with beryllium. For additional information on safe handling practices or technical data on beryllium, contact Materion Electrofusion.

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