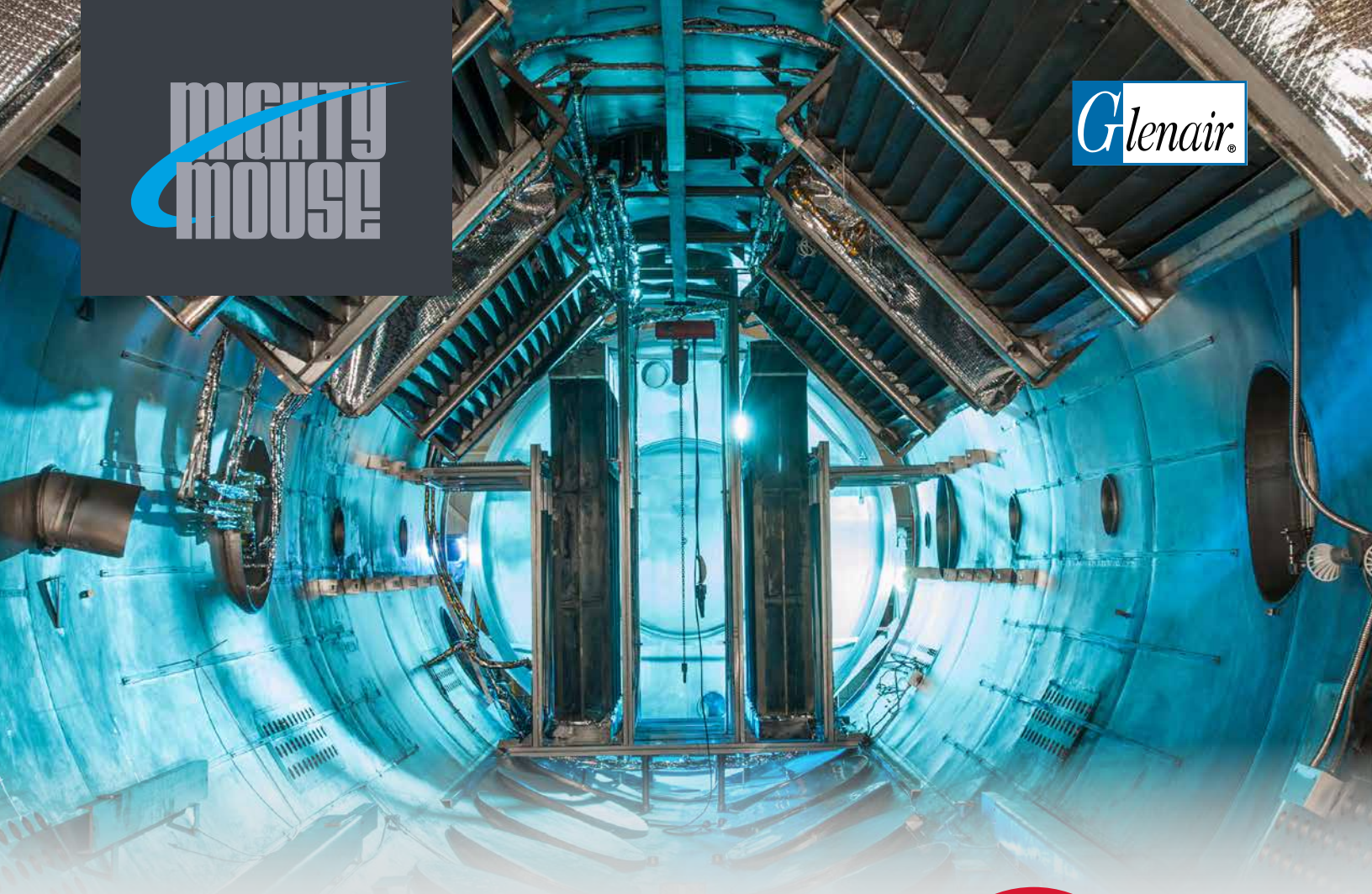


GLASS SEAL HERMETIC CONNECTORS

Mighty Mouse

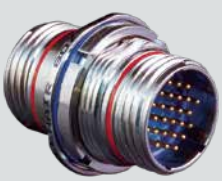
Hermetic Connectors

GLASS-SEALED Hermetic CONNECTORS

Series 80 Glass-to-Metal seal hermetic connectors with five connector styles

Glass-to-metal seal hermetic connectors are designed for use in harsh application environments. Such applications are exposed to severe weather conditions, at high altitudes, under extremes of atmospheric pressure and in rapidly changing temperature gradients and are often subjected to fluid immersion within corrosive substances such as acids and oils. Hermetic connectors are selected for their ability to protect control equipment environments by maintaining an air-tight seal between severe conditions that would otherwise subject sensitive equipment to moisture, air, or corrosive gases.

The Series 80 Mighty Mouse connectors offers comparable performance to MIL-DTL-38999 Series interconnects with up to 10-20% weight and 52% size savings for similar hermetic contact layouts. The six versions of the product offer a selection of styles and features to accommodate any application.



Features:

- **Highest reliability, performance and quality**
- **10^{-7} ccHe per sec at 1 atmosphere differential**
- **Pin and socket PC tail or solder cup contacts**
- **Coax and Hybrid layouts**
- **Independent keyed polarization**
- **Box mount, weld mount and jam-nut mount bulkhead feedthroughs**

Introduction to Series 80 Hermetic Connectors

Glenair In-House Hermetic Solutions

Hermetic connectors are specified for applications as divergent as submarines and orbiting satellites. They are deployed to resist moisture ingress in underground applications and to withstand pressure differentials in vacuum chambers, laboratory equipment and commercial and military aircraft. Hermetic connectors, such as the MIL-DTL-38999 Series I, II, III and IV supplied by Glenair, are principally designed for use in military aerospace—in fact, the requirement for connector hermeticity was originally driven by military electronic applications. But the products are equally at home in commercial applications such as oil-patch logging equipment or medical devices.

Hermeticity is generally defined as the state or condition of being air or gas tight. In interconnect applications, hermetic refers to packaging technology designed to prevent gasses from passing through pressure barriers via the connector. The reason this is important is to prevent any moisture in the leaked gas from condensing inside the pressurized enclosure. The point at which moisture will condense is called the "dew point"—or the precise moment when humidity, pressure, and temperature allows condensation to form.

When an electric current must pass through a high-pressure differential barrier, the potential exists for gases, moisture, and in some rare cases particulate matter, to also penetrate the barrier and, as described above, to form condensation in the equipment enclosure. In the receptacle cabling on the pressurized side of the barrier this may result in dielectric breakdown, corrosion, and loss of insulation resistance between conductors (a properly built plug assembly on the non-vacuum side is adequately sealed with conventional environmental protections and so is impervious to moisture ingress). The classic hermetic application is a receptacle feed-through penetrating a pressurized bulkhead, or a pressurized equipment housing—such as is found in inertial navigation units in aircraft. The introduction of moisture-laden air into such an enclosure may be enough to produce false readings and other malfunctions in the device. The ultimate purpose of hermetic sealing then is not merely to "avert the ingress of air or gas into pressurized environments to prevent corrosion resulting from dew point condensation," but more precisely to insure malfunctions do not occur in sensitive electronic systems due to said ingress. Hermetic connectors must perform their magic at extremely high pressure differentials, often as high as 20,000 psi, in order to prevent fluids and high pressure in one area from impacting normal environmental conditions and pressures in another. Hermetic customers may specify the mating connector series, mounting style (jam nut, weld mount, etc.), pin or socket gender and layout, contact termination type (solder cup, flat eyelet or PCB termination), conductive or non-conductive finish, polarization and so on. Glenair customers may also choose from a broad range of contact densities and package sizes, including standard-density MIL-DTL-38999 Series I, II, III and IV, our .76 in. contact spacing Series 80 "Mighty Mouse" Connector, and both Micro-D and D-Subminiature rectangulars. Glenair's complete in-house hermetic capability also affords us the ability to produce a wide-range of special purpose hermetic connectors designed to meet individual and unique customer specifications.

CONNECTOR HERMETICITY

Connector Hermeticity may be negatively affected both by the permeability of shell materials and the quality of the sealing technology. Metal materials are chosen due to their relative impermeability to gas, although certain plastics may also be used. Glenair typically specifies stainless steel, titanium or Kovar® for its hermetic products, as all three base materials provide an effective barrier against gas ingress and are able to withstand the high heat of the fabrication process. But even metal materials are permeable to gas leakage, and their permeability can be compromised when weld and solder joints are formed between connector shell materials and the base material of the bulkhead. Electrode coatings used in welding readily attract "moisture in the work which can result in micro-cracks and fissures. If other stresses are present, such as vibration and shock, micro-cracking can progress to fissures which are visible to the human eye. Optimizing hermeticity should therefore always include examination of welds for any cracks or fissures that could provide a leakage path.

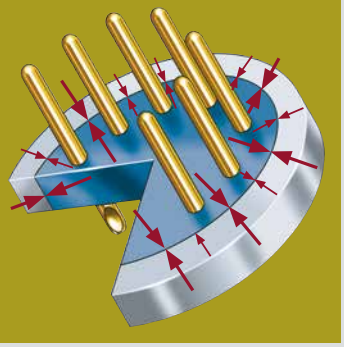
Although moderately effective sealing may be produced with simple techniques such as epoxy potting, fused glass-to-metal seals are usually specified in high-pressure applications. Glass is an excellent insulator, bonds well to metallic surfaces and is extremely corrosion resistant. And because of its robust mechanical strength and resistance to radical changes in temperature and pressure, glass seals are extremely resistant to any cracking which may introduce leaks into the hermetic package. Fused glass seals may be produced from various recipes of ground, non-crystalline solids such as silicates, borates and phosphates. When heated to high temperature and then cooled, these materials fuse into an amorphous solid called glass. In hermetic connector manufacturing, the glass material is typically introduced as a pre-formed

glass seal insulator tooled to precise dimensions. The glass must be exactingly selected for each application according to its ability to form a strong bond with the chosen metal materials.

Electrical properties, such as dielectric withstanding voltage and strength are also considered as is thermal and shock stability. Depending on the style of connector being produced (rectangular versus circular, for example) two categories of glass-seal hermetics may be specified. These are known as Matched and Mismatched (or Compression) Seals, the former is used in the production of Series 80.

MISMATCHED SEALS

In Mismatched (Compression) Seals, the thermal expansion/ contraction of the metal exceeds that of the glass. During cooling, the metal contracts into the already solidifying glass to form an extremely robust compression bond.



In Mismatched (Compression) Seals, the thermal expansion/ contraction of the metal exceeds that of the glass. During the firing process, the metal materials, usually stainless steel, expand at a greater rate than the glass. During cooling, the metals contract back into the already solidifying glass to form an extremely robust compression bond. This type of seal is consequently the most frequently specified for extreme, high-pressure applications since the seal produced is reliable to pressures as high as 14,000 psi (1000 bars).

The total potential for leakage in a hermetic connector is the sum of any permeation which may occur via the metal materials themselves (through cracks or open pores), and any leakage that may occur via the seal. An additional source of leakage—uncontrolled from the connector manufacturer's perspective—results from sub-standard mounting of the hermetic package on the bulkhead or enclosure. Depending on the surface material of the bulkhead, hermetic receptacles may be welded or soldered in place. Low temperature brazing is also possible in certain applications as is the use of adhesive sealants.Finally, mechanical mounting seals such as O-rings found on jam-nut mounts or drilled mounting flanges are used in applications where the cost or difficulty of welding or soldering is impractical. Regardless of the choice of mounting technology, care must be given to ensure inadvertent leakage paths are not introduced to the system. Vapor condensation in pressurized enclosures may also be affected by the material makeup of devices located inside the enclosure. Materials such as silicones, adhesives, lubricants and Teflon insulation can all outgas water vapor, and so contribute to the total vapor pressure inside the housing. As discussed above, this rise in vapor pressure will directly impact the condensation dew point of the protected environment.

Hermetic seals are qualified via various methodologies including helium testing and dye penetrant. The purpose of both types of tests is to detect and measure leakage under pressure. The dye penetrant method has the advantage of revealing the exact location of a full-scale leak, while helium testing measures overall leakage of the hermetic device. In helium testing, a pressure differential between the internal volume of the package and the external environment is created. The resultant pressure gradient causes the helium to diffuse through the connector shell, contacts and/or glass seals. Quantitative and qualitative measurements are then taken using appropriate sensing instruments.

MANUFACTURING CAPABILITY

Hermetic connectors are constructed from a core component-set that includes the connector shell, the vitreous glass insert and the selected contacts. Matched hermetic shells may be machined from Kovar®, an iron-nickel-cobalt alloy with a coefficient of expansion closely balanced to the glass inserts. Stainless and cold-rolled steels with 52 nickel-alloy contacts are suitable for compression-seal hermetics. Contacts used in hermetic connectors must be fabricated from Kovar® or from other high-grade materials that can withstand high-heat and bond effectively to the vitreous glass seal.

The individual parts are mounted into special fixtures that align them during the exothermic atmosphere firing process. A conveyor belt transports the work through the furnace chamber, where a reducing atmosphere prevents oxidation of the metal components. As discussed above, a gas-tight hermetic seal is formed around all contacts and the glass seal and connector shell when the vitreous glass is melted in the furnace and then cooled under controlled conditions. After firing, helium testing and finish plating are completed and the remaining connector components are assembled to the connector body.