

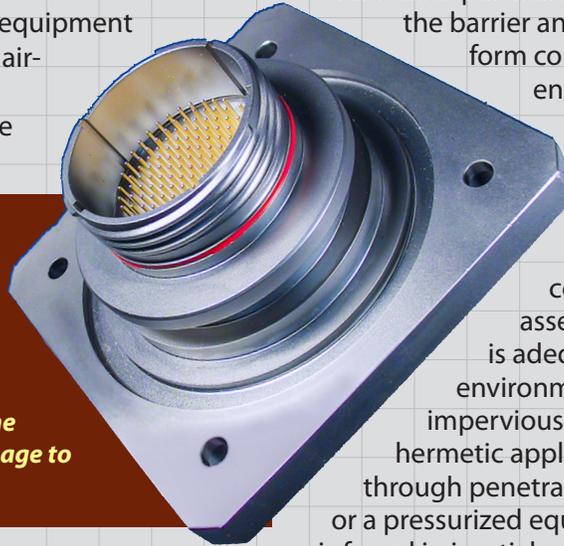


Introduction to Glenair Hermetic Connector Products

A Glenair In-House Hermetic Solutions

Hermetic connectors are designed for use in harsh application environments. Sensitive photographic, sensor and surveillance equipment mounted in the tactical Unmanned Aerial Vehicle for example, must be able to operate in severe weather conditions, at high altitudes, under extremes of atmospheric pressure and in rapidly changing temperature gradients. Hermetic connector devices interconnecting the vacuum sealed black box equipment are selected for their ability to protect the controlled equipment environment by maintaining an air-tight seal between severe flight conditions and aircraft's sensitive payload.

Glenair typically specifies stainless steel, titanium or Kovar® for its hermetic products to provide an effective barrier against gas ingress and corrosion caused by dew point condensation. The hermetic sealing prevents damage to sensitive electronic systems.



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

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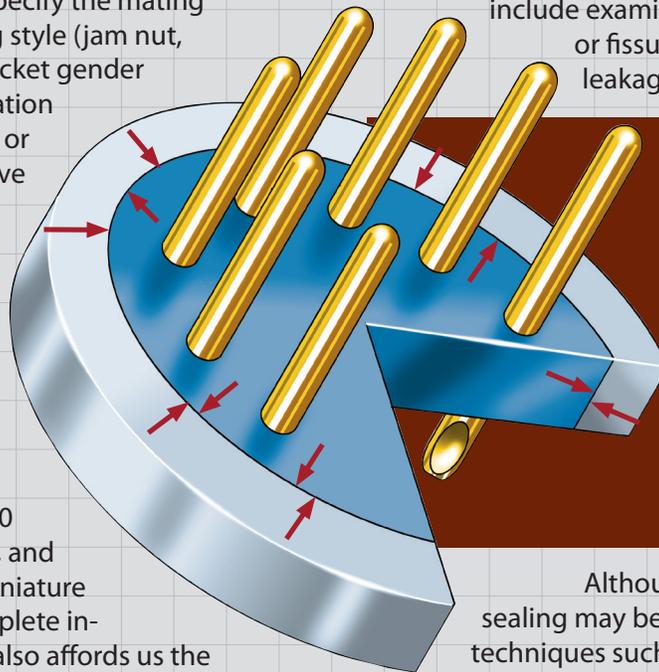


The connectors enter the furnace on a conveyor belt and a gas-tight hermetic seal is formed around all contacts, and between the glass seal and the connector shell, when the vitreous glass is melted in the furnace and then cooled under controlled conditions.

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.

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.



In Matched Seal hermetics, thermal expansion of the glass and metal materials is relatively small—an important factor in the design of Micro-D hermetic connectors, due to varying degrees of stress on the glass caused by the rectangular shape.

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.

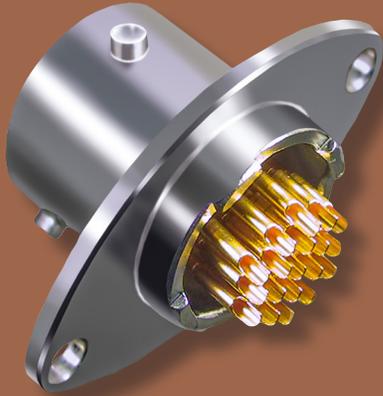
Kovar® is a registered trademark of Westinghouse Electric Company.

Connector Hermeticity

Connector Hermeticity may be negatively affected both by the permeability of shell materials and the quality of the sealing technology.

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Series 80 Mighty Mouse Hermetic Connectors



Series 80 Mighty Mouse Hermetic Mighty Mouse Hermetic Receptacles feature stainless steel shells and Alloy 52 iron alloy contacts. The compression glass seal is rated at 1×10^{-7} cc/second helium leak rate. Coupling styles include double-start stub acme, quick disconnect and bayonet.

Receptacles are available in four mounting styles:

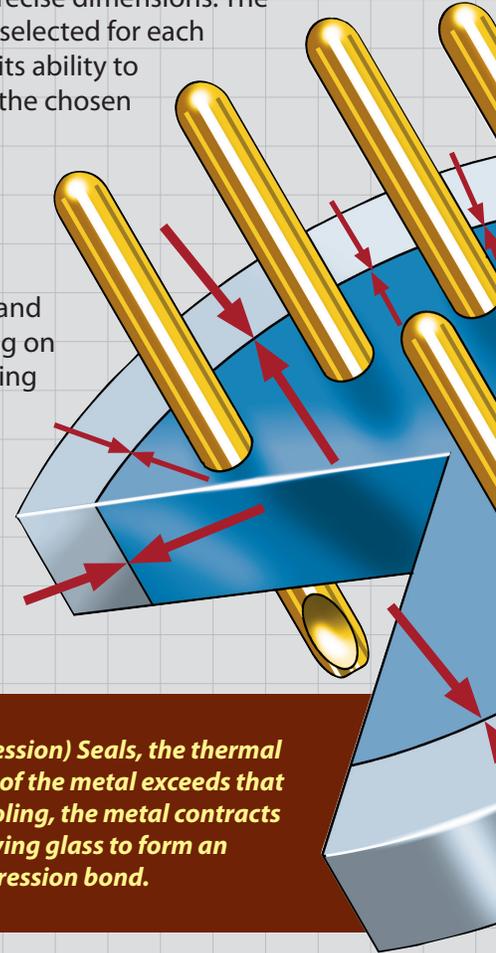
- Solder Mount ■ Square Flange
- Jam Nut ■ Weld Mount

Technical Specifications

- 3 Through 130 Contacts
- Hermetically Sealed
- 5 Amp Contact for #22 thru #28 Wire
- .076" (1.9) Contact Centers
- 500 Volt AC
- Printed circuit board or solder cup contacts.

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 exactly 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.



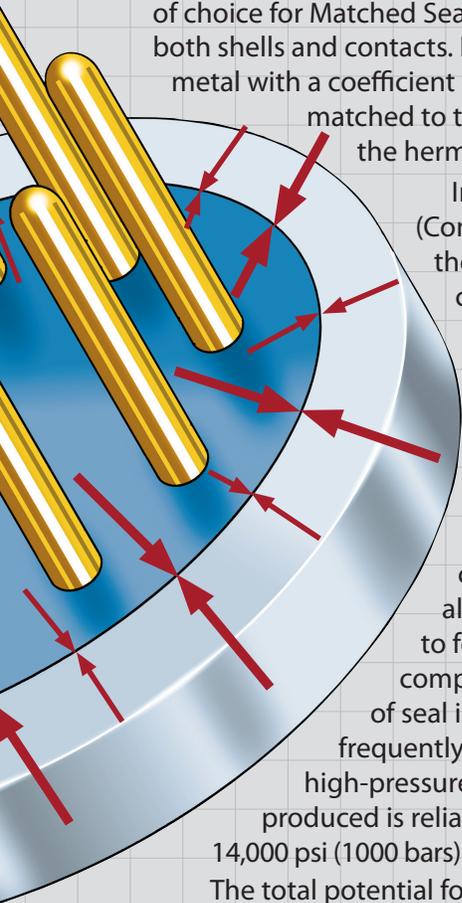
In Mismatched (Compression) Seals, the thermal expansion/contraction of the metal exceeds that of the glass. During cooling, the metal contracts into the already solidifying glass to form an extremely robust compression bond.

In Matched Seal hermetics, the thermal expansion of the glass and metal materials are relatively close, usually within 10% of each other. This results in a product in which the stress in the glass is relatively small, since the expansion and contraction of both materials during manufacture is closely matched. This is extremely important in glass hermetic connectors such as the Micro-d since the rectangular shape of the connector shell

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can exert varying degrees of stress on the glass. At ambient temperatures, the glass is chemically wetted (bonded) to the metal shell and contacts, but under little or no pressure or stress. Matched Seals can withstand high thermal and mechanical shocks, and are generally easier to manufacture than Mismatched (Compression) hermetic seals. Kovar[®], a combination of iron, nickel and cobalt, is the material of choice for Matched Seal hermetic receptacles—both shells and contacts. Kovar[®] is a low-expansion metal with a coefficient of expansion rating matched to the glass material that forms the hermetic seal.



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.

Mil-Aero Cylindricals:

**QPL MIL-DTL-38999
MIL-DTL-26482 Type
MIL-DTL-83723 Type
Hermetic Connectors**



Various styles of standard and high-density cylindrical connectors are manufactured using glass seal hermetic technology. These hermetic connectors are ideally suited for high-pressure/low leakage applications in air, sea and space environments. Glenair is on the Qualified Product List (QPL) for all families of MIL-DTL-38999 Series I, II, III and IV Hermetic Connectors. We also offer lower density cylindrical connectors from the MIL-DTL-26482 and MIL-DTL-83723 families. The latter two series are non-QPL products.

- DSCC Approved MIL-DTL-38999
- Compression Glass Seals
- Alloy 52 Gold-Plated Contacts
- Four Coupling Styles: Scoop-Proof Bayonet, Low-Profile Bayonet, Triple-Start Threaded Coupling, and Scoop-Proof Breach Coupling
- Fluorosilicone Interfacial Seals
- Passivated and Nickel-Plated SS Shells



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MIL-DTL-5015 Type "H" Class Hermetic Connectors



Considered the "Granddaddy" of all connector specifications, MIL-DTL-5015 covers power connectors available in contact sizes ranging from #16 up to #0. Operating voltages range from 200 up to 3000 volts AC (rms).

Currently there is not a Qualified Parts List (QPL) with Defense Supply Center Columbus (DSCC) for the MIL-DTL-5015 hermetic product. However, Glenair has designed and tooled these products to meet or exceed the current Mil-Spec requirements.

Features:

- Box Mount and Solder Mount
- Shell sizes 8 through 36
- CRS with Fused Tin plating or stainless steel with a Passivate finish
- All appropriate contacts in solder cup and pierced contact styles
- Supplied with a bonded interfacial seal to improve moisture resistance
- Custom configurations available
- Commercial equivalents available

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.

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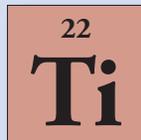


The individual parts are mounted into special fixtures that align them during the exothermic atmosphere firing process. A conveyor belt transports the work through the furnace chamber, where a reducing atmosphere prevents oxidation of the metal components. As discussed above, a gas-tight hermetic seal 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 such as interfacial seals, O-rings, jam-nuts and so on are assembled to the connector body.

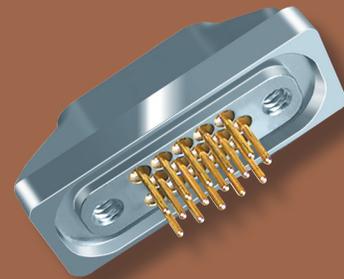
Quality control is a critical step in hermetic connector manufacturing. Connectors are not only subjected to a rigorous leak test, but are also visually inspected to ensure all components are seated in their correct positions and no surface imperfections or micro-cracking is evident. The connectors are also subjected to electrical testing as required by military and industry standards and by customer requirements.

Dating back to our first hermetic order, Glenair has been in the hermetic connector business for over 30 years. Today, our capabilities are an arm and a leg greater than they once were, but our commitment to high-quality and outstanding availability has remained constant. As you can see from the wide range of commercial and military standard hermetic products we now produce, Glenair is positioned to service an incredibly broad range of both commercial and military standard hermetic packaging requirements.

Glenair now offers shells in Inconel® and Titanium; built to meet the demands of extreme pressure differentials and corrosion resistance. Consult the factory for product ordering information.



MIL-DTL-24308/9 QPL D-Subminiature Hermetic Connectors



These hermetically sealed connectors are specifically designed for applications where conditions of extreme pressure differentials exist, or where an inert gas atmosphere must be maintained.

Glenair is currently qualified for the MIL-DTL-24308/9 -1 through 20 and M24308/9-21 through 40.

Features:

- One-piece machined shell for both the Solid Flange Mount (Type A) and Jackpost Mount (Type B) configurations
- Shell sizes 1 through 5
- CRS with Fused Tin plating, "H" Class, stainless steel with a matte nickel finish ("K" Class), or Aluminum Alloy Electroless Nickel w/ Hermetic Epoxy Seal
- Space Grade Versions
- All appropriate contacts in solder cup or pierced contact styles
- Many custom configurations available



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Micro-D O-Ring Sealed and Weld Mount Hermetic Receptacles



These high contact density hermetic connectors feature .050 inch contact spacing, rugged construction for demanding applications and glass hermetic sealing for severe environmental and pressure differential operating conditions. Designed for use in missile systems and other high altitude aerospace applications, Glenair's Micro-D Hermetic Connectors offer outstanding performance in a lightweight microminiature package. The two basic mounting configurations, a weld-mount or O-ring mount design may be customized for unique application requirements.

Features:

- Socket Receptacles
- Matched, Glass to Metal Seals,
- 1,000 PSI
- 9 through 100 Contacts
- Weld, O-Ring or Solder Mount;
Integral Jackposts
- 1.5 AMP; 150 Volt AC
- Solder Cup (#26 Gage Wire), PC Tails,
and Special Contacts for Wire Bonding

Hermetic Glossary

Air Leakage

The measure of gas ingress across an hermetic barrier. Total air leakage is the sum of the gas which passes through the seal itself, the permeable shell materials or via cracks or gaps in the mounting area.

Bonding

In hermetic glass-to-metal sealing, the permanent fusing of the constituent connector parts —contacts, connector body and glass seal—to one another using surface preparation techniques and high-heat.

Coefficient of Expansion

A mathematically derived value describing the dimensional change of a material when subjected to a measured change in temperature. Factored into hermetic connector fabrication to insure the glass and metal materials return to a known state of compression after the heating and cooling process is completed.

Compression Seal

The most effective glass-to-metal sealing. It is created by using metal shell and contact materials which expand at a greater rate than the glass during heating. During cooling, the metal materials contract back into the already solidifying glass to form a robust compression bond.

Environmentally Sealed

A class of interconnect components which are sealed against moisture ingress through the use of gaskets, O-rings, grommets or other means. Many applications that could use costlier hermetically-sealed connectors can be adequately protected using simpler environmental sealing techniques. The decision to use hermetics is generally made when the ability to withstand high-pressure differentials (32psi and up) is added to the application performance specifications.

Feedthrough

A double-sided receptacle connector device, mounted in a bulkhead or wall, used in interconnect

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systems to pass wires through barriers without creating an entry point for moisture, dust or chemical pollutants. Hermetic feedthrough connectors are used when the compartments on either side of a bulkhead must be maintained at different pressure levels.

Flange

Disc-shaped projection extending from or around the periphery of a receptacle connector designed to house O-ring sealing devices, fasteners or other mounting hardware. A flange may also be used to provide a greater surface area of metal material to aid in weld or solder mount attachment of receptacle connectors to bulkheads.

Hermeticity

The measure of a connector's permeability to gas ingress. In general terms, it means how "airtight" the device is when measured using a helium mass spectrometer leakage test. Since all materials are ultimately permeable to gas ingress at some point, hermeticity ratings are used to define acceptable performance levels as required by each individual application.

Hermetic Connector

Any of various forms of interconnect devices which are outfitted with specialized seals to prevent moisture and gas from passing through the connector and damaging sensitive electronic equipment. Glass sealed hermetic connectors are the most effective, with compression-glass sealed connectors providing the highest levels of protection.

Kovar®

An iron-nickel-cobalt alloy with a coefficient of expansion closely matched to certain glass seals commonly used in both connector bodies and contacts.

Matched Seal

A category of glass-to-metal sealing. In matched seals, the coefficient of expansion for the glass seal, contacts and connector body are relatively the same, resulting in a finished product with little or no built-in stress between the constituent parts.

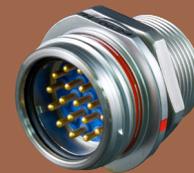
Mismatched Seal

Also known as compression sealing, the different material coefficient of expansion values in the glass and metal materials result in an hermetic seal that is under significant compression stress after cooling. Hermetics of this type can withstand higher-pressure differentials than matched seals.

Solder or Weld Mount

One of the most common mounting configurations for hermetic connectors, especially for electronic equipment such as switches and transducers. Unlike jam-nut mounted connectors, weld mount hermetics are permanently attached to the pressurized bulkhead, typically with laser, TIG or MIG welding technology.

Series 22 Geo-Marine® Hermetic Connectors



Series 22 Geo-Marine® Connectors offer high-density insert arrangements for a variety of oceanographic, geophysical and other severe commercial applications. The mated stainless steel plug and receptacle have a hydrostatic pressure sealing capability of up to 5000 psi (345 bar) and are available in either glass-seal hermetic or rigid dielectric environmental insulators.

- Single-start, stub-Acme thread reduces thread fouling and binding due to dirt, grit and other foreign matter. Castellated and knurled coupling ring provides easy mating and unmating—even with arctic gloves.