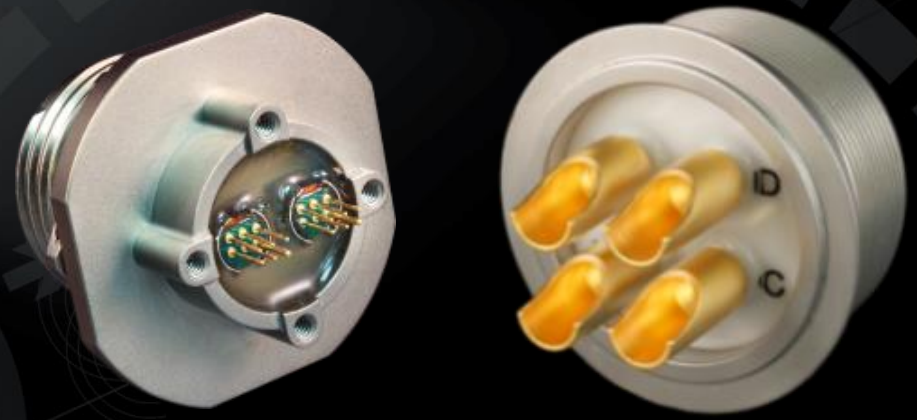
The widest range of mission-critical interconnect technologies in the world



Glenair®

Hermetic Connector Technology

Glass-to-Metal Seal • CODE RED Lightweight Hermetic

Hermeticity in Connectors

GLASS-SEALED Hermetic CONNECTORS

- Interconnection devices may be permanently sealed by fusion or other means to prevent the transmission of air, moisture and other gases across a bulkhead or other barrier
- Hermeticity is expressed as the rate of leakage volume of helium per second in time. Mil/aero-caliber hermetics perform at $1X10^{-7}$ He/CC sec.
- Glass-to-metal, or CODE RED encapsulant sealing technology, is preferred for robust, durable hermetic seals between contacts, insert assemblies and connector bodies and shells.

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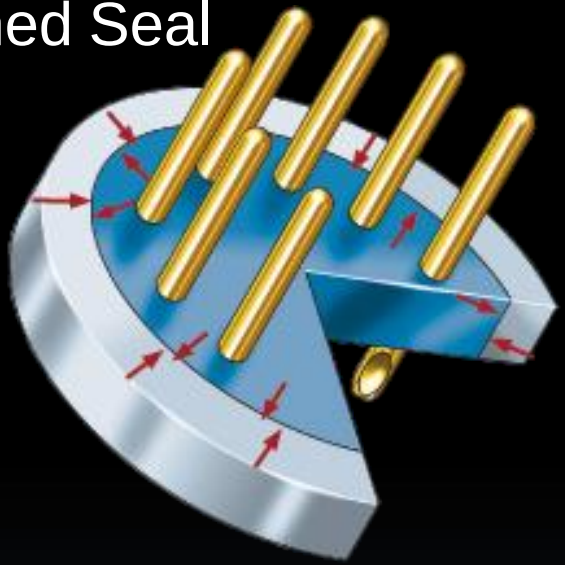
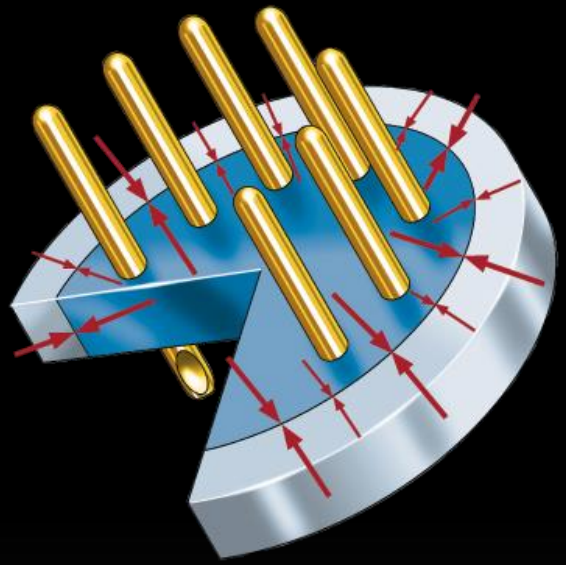
The traditional "Gold Standard" of Hermetic Seals: Glass-to-Metal

GLASS-SEALED Hermetic CONNECTORS

Matched Seal





Compression Seal

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Advantages of Glass-to-Metal Sealed Hermetic Connectors Compared to Legacy “Potted” Solutions

GLASS-SEALED Hermetic CONNECTORS

- High reliability
- Pressure resistance
- High operating temperature
- Mechanical strength
- Withstands the heat of soldering
- Easy final assembly (i.e. welding or wire bonding)
- No material breakdown/aging over time

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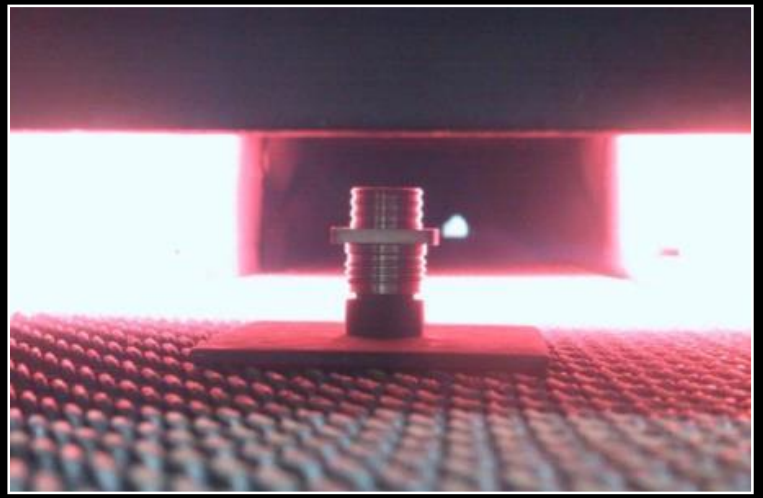
Hermetic Sealing Process: Sealing/Firing

- Components assembled (metal shell/contacts/glass) using carbon fixture plates to hold them in position
- Assembly placed in a controlled temperature furnace (~1700° F) and subjected to a gradually increasing temperature.
- At the sealing temperature, the glass melts and fills the space between the pin and the shell (chemical bond occurs)
- The assembly is then cooled.



Hermetic Sealing Process – Cleaning

- Sealed assemblies wired or racked based on their size and configuration.
- Processed for cleaning (oil removal)
- Descaling (multi-step process to remove oxidation)
- Brite-Dip process (passivation)
- Hydro Honed using a fine grit impact bead at low pressure, then rinsed and dried
- Final inspected and packed for return

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Hermetic Sealing Process – Plating

- Typically gold plating is required
- Contacts cannot be plated in large batches (barrel or vibratory process)
- Each contact is individually wired twice, once on each side
- Assembly is submersed into the plating solution
- Wiring can produce an area that is discolored where the wire was attached. “Wire marks” are common and are allowed for this type of plating

Hermetic Sealing Process – Final Assembly

- Insulators
- Interfacial seals/gaskets
- Socket components (design dependent)
- Crimp removable inserts
- Connector hardware

Hermetic Sealing Process – Test

- Leak Testing
  - 100% helium leak testing
- Electrical
  - Typically IR/DWV 100%
- Pressure Testing
  - In-house to 15,000 psi
  - Several labs available for > 15ksi

Hermetic Sealing Can Be Implemented for Any Circular Connector Package...

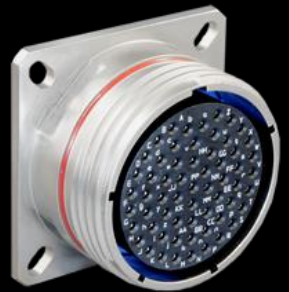
GLASS-SEALED Hermetic CONNECTORS

Technology supports both pin and socket contact in any receptacle style

MIL-DTL-26482

MIL-DTL-83723

MIL-DTL-38999



MIL-DTL-5015

Series 80 Mighty Mouse

These are all standard catalog product offerings at Glenair

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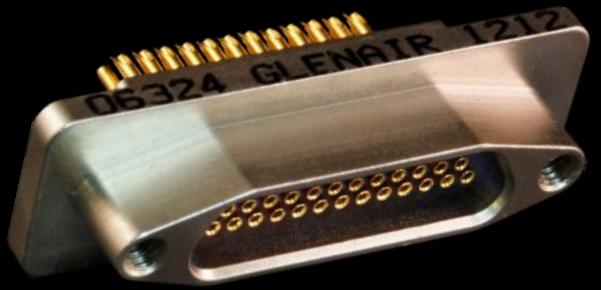
...And For All Rectangular Designs

GLASS-SEALED Hermetic CONNECTORS

MIL-DTL-24308

MIL-DTL-83513



Again, standard catalog product offerings at Glenair

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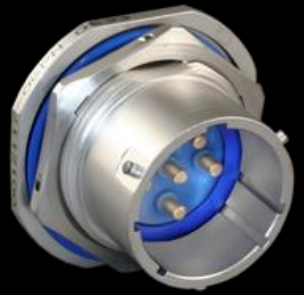
Design Features of Standard MIL-DTL-38999 Hermetics

Glenair is QPL'd for both pin and socket contact types

Series I



Bayonet
Scoop-Proof

Series II

Bayonet
Low-Profile

Series III

Triple-Start Stub ACME

Series IV

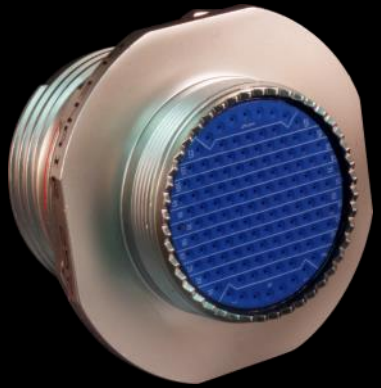
Breech Lock

SuperNine®

GLASS-SEALED Hermetic CONNECTORS

Better than QPL glass-to-metal seal hermetic solutions, catalog hermetic specials, hybrid contact hermetics, and more

233-100 IAW MIL-DTL-38999 Series III hermetic



Hermetic receptacles with crimp contacts

Hermetic bulkhead feed-thrus

Hermetics with high-speed contacts

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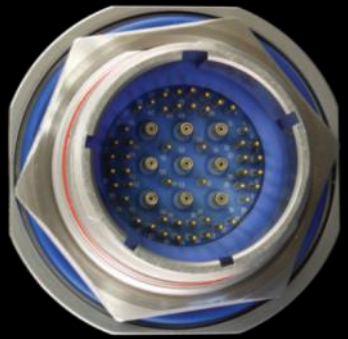
Special RF Pin-Contact Hermetics with Hybrid Coax/Twinax/Signal Inserts

GLASS-SEALED Hermetic CONNECTORS



1 x 10^{-7} cc/sec

9 # 16 Coax contacts and 48 #23 contacts

1 x 10^{-7} cc/sec

19N17 arrangement with 2 #8 Twinax

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Single-Way Hermetic Triax Connectors

1 x 10^{-8} cc/sec, 2 milliohms

GLASS-SEALED Hermetic CONNECTORS

Glenair

Special Hermetic Quadrax Connectors

-50°C to +200°C, 1x10^{-7} cc/sec rated

GLASS-SEALED Hermetic CONNECTORS

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Special Fiber Optic Hermetics

GLASS-SEALED Hermetic CONNECTORS

1×10^{-8} cc/sec

- Fiber/signal combinations (no fiber-only arrangements)

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Design Opportunities in Custom Glass-to-Metal Seal Hermetic Connectors

GLASS-SEALED Hermetic CONNECTORS

- Flange dimensions and mounting
- Length of bulkhead penetration
- Connector-to-panel sealing
- Unique contacts / insert arrangements
- Shell and contact materials
- Contact wire termination type
- PCB mounting design
- Other

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<1X10^{-7} HERMETIC SEALING

CODE RED

LIGHTWEIGHT HERMETIC CONNECTORS

Glenair®

The Lightweight Hermetic Challenge

Full hermetic sealing (10^{-7}) in a lightweight connector shell package, with low contact resistance AND mission-critical durability

- Glass-to-metal seal furnace temperatures are too high for lightweight aluminum and low-resistance copper contacts
- Conventional epoxy potting lacks sealing strength and mission-critical durability

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Introducing CODE RED

When the mission demands hermeticity, and you can't afford the weight and electrical resistance of steel or Kovar

CODE RED

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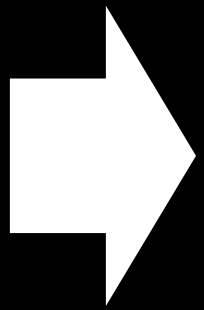
Glass-Seal Hermetics Drawbacks vs. CODE RED Benefits

CODE RED

Glass-to-Metal Seal Hermetic Drawbacks

- Excessive weight
- High contact resistance
- Expensive process with high fallout
- Long lead times and expensive tooling



Code Red Benefits

- Light weight
- Low resistance copper Contacts
- High yield
- Value stream: process can make 80 parts in 3 days using standard tooling

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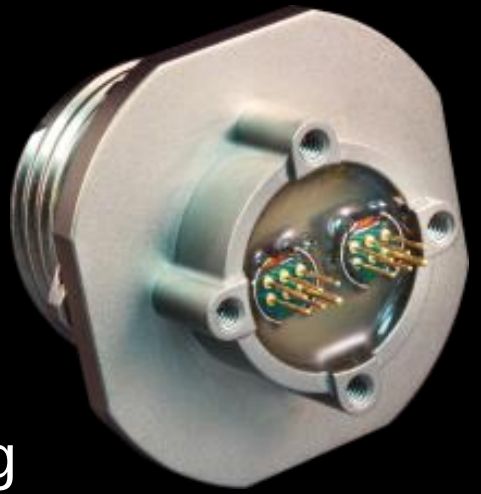
Key to CODE RED Performance

Unlike static epoxy potting, CODE RED sealing encapsulant is a dynamic adhesive material

- Expansion and contraction is matched to metal connector materials
- Virtually immune to thermal aging
- Order of magnitude stronger and more durable than conventional hard epoxy potting



CODE RED Features and Benefits

- Hermetic Seal > 1X10-7
- Light weight, corrosion resistant materials
- Low-resistance copper alloy contacts
- Extreme temperature tolerance
- Meets NASA outgassing
- Turnkey, drop-in replacement for glass-seal hermetics
- Can be used in various product families and shell geometries

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CODE RED

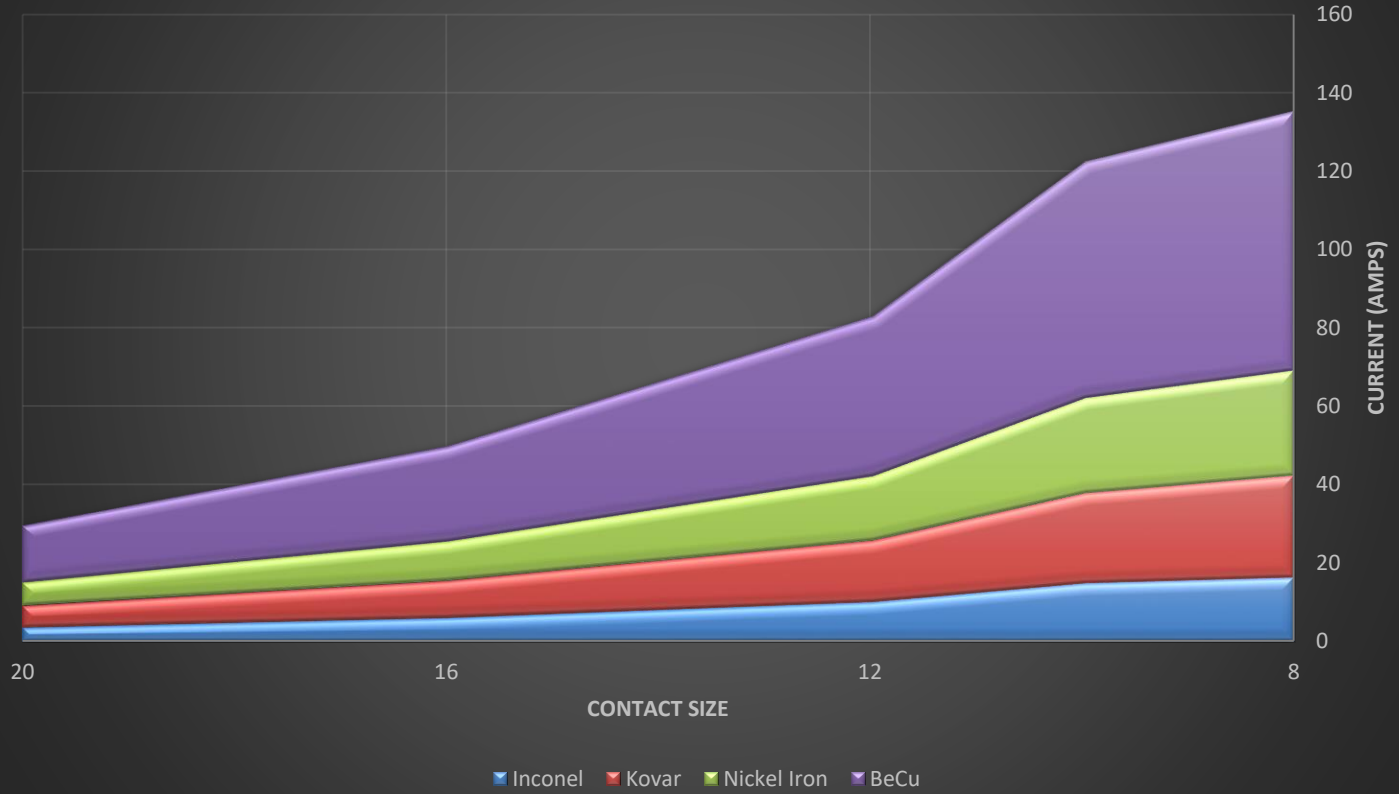
CODE RED Weight Savings: MIL-DTL-38999

Shell Size -Config.	Glass Sealed	CODE RED	Weight Δ	% Weight Reduction
	Weight (grams)			
9-35	28.4	13.6	14.8	52%
11-98	35.2	18.6	16.6	47%
13-35	48.2	25.6	22.6	47%
15-97	56.2	32.6	23.6	42%
19-32	81.4	49.2	32.2	40%
21-11	91.4	62.6	28.8	32%
23-21	95.8	69.0	26.8	28%
25-08	153.7*	88.2	65.5	43%

Material	Specific Gravity	Density (lb/in^3)	% Heavier than Composite	% Heavier than Aluminum
Composite	1.27-1.51	0.055	-	-
Aluminum	2.55-2.80	0.098	44%	-
Stainless Steel	7.70-7.73	0.284	81%	65%

CODE RED

Current Carrying Capacity (single pin geometry @20ºC)



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Standard Materials

Component	Material	Finish
CODE RED	Dynamic Glenair Encapsulant Sealing	N.A.
Contacts	Beryllium copper alloy per ASTM B197 or equivalent	50 microinches gold per ASTM B488 Type 3, Code C, Class 1.27 over 50-100 microinches nickel plate per SAE-AMS-QQ-N-290 Class 2
Retaining Ring	300 Series Stainless Steel	Passivated per AMS 2700, method 1, type 2, class 3
Insulator	Epiall 1908 or E484	N.A.
Wire Grommet and Interfacial Seals	Blended fluorosilicone/silicone elastomer 30% silicone per ZZ-R-765, 70% fluorosilicone per MIL-R-25988	N.A.
Shell and Jam Nut	Aluminum alloy 6061-T6 per ASTM B221	Electroless nickel per ASTM B733

CODE RED Testing and Validation

- DWV and IR
- Contact retention
- Insert retention
- Hermetic seal at 30 psi
- IR at temperature
- DWV at altitude
- Random vibration at temperature*

CODE RED Testing and Validation

Connectors utilizing Code Red potting have gone through grueling qualification testing to validate the technology including:

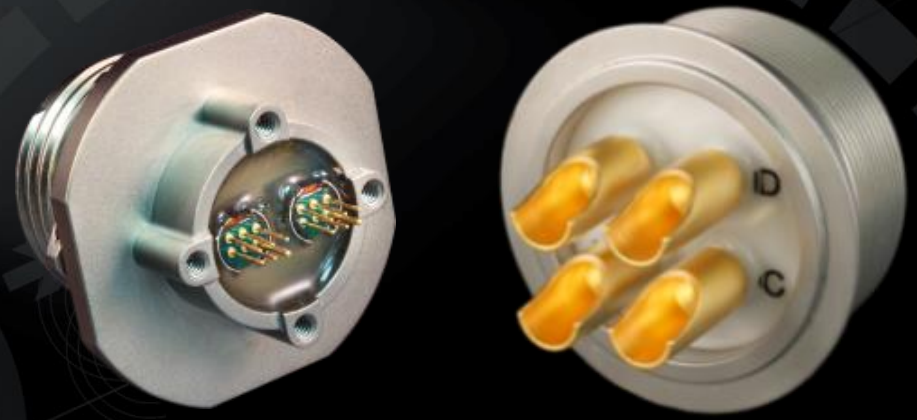
- 100 cycles of thermal shock
- 1000 hours of thermal aging
- Extreme temperature exposure to +200°C

CODE RED

Material and process summary

- CODE RED is a proprietary encapsulant sealing and application process that delivers hermetic performance on par with glass-sealed solutions
- CODE RED is not old school epoxy potting. CODE RED Sealing solves all the aging, embrittlement, temperature cycling and leak problems inherent to hard epoxy solutions
- CODE RED Hermetics =
  - Dynamic hermetic encapsulant with a coefficient of expansion matched to copper contact and aluminum shell materials
  - Proprietary (internal) connector shell package architecture
  - Proven, quality-controlled application process performed in Glenair's CODE RED Center of Excellence

The widest range of mission-critical interconnect technologies in the world



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