DEEP DIVE:
Glenair Subsea Interconnect Technologies
ROVs: The Workhorse of Subsea Science and Exploration

Small unmanned submersibles called “marine remotely operated vehicles” or ROVs are deployed throughout the oil & gas industry—and in other industries such as scientific research, fisheries and aquaculture, oceanography, underwater archaeology, ocean exploration, and military/defense—to perform inspection, repair, and maintenance functions in water too deep or too dangerous for divers. ROVs service sea floor drilling and processing operations with capabilities as diverse as trenching and drill support. The various classes of ROVs are distinguished by their size, maneuverability, methods of propulsion. Regardless of class, all ROVs are cable connected (tethered) to their support platform. In addition, ROVs share two key characteristics: a subsea-to-topside visual feed (typically an HD/SD TV which provides real-time or slow-scan viewing) and the ability to rise or submerge subsea. Autonomous underwater vehicles (AUVs) are a far different class of submersible, and do not employ a support tether.

ROV classes

- Observation
- Observation with payload
- Work class
- Bottom crawling

Typical work-class ROV systems provide power levels ranging from 100 to 200 horsepower, and even as high as 330 HP. Trenching vehicles are equipped with 1500 HP electrical power for impressive thrust in either vertical or horizontal directions. In the past, ROVs have operated at 120V, but due to growing power requirements the industry is now adopting 270 and 240 VDC full wave rectification of 120/208 three phase AC for manned submersibles. Small inspection-class ROVs continue to operate in the 100–130 VAC range.

During operation ROVs are linked to a host ship by a neutrally buoyant tether or, when working in rough conditions or in deeper water, a load-carrying umbilical cable is used along with a tether management system (TMS). The TMS is either a garage-like device which contains the ROV during lowering through the splash zone or, in the case of larger work-class ROVs, a separate assembly which sits on top of the ROV. The purpose of the TMS is to lengthen and shorten the tether as needed so that the cable drag effect of underwater currents is minimized. The umbilical is an armored cable that contains a group of electrical conductors and fiber optics that carry electric power, video, and data signals between the operator and the TMS. Some umbilical tethers are equipped with pneumatics to power work-class ROV equipment. Where used, the TMS then relays the signals and power for the ROV down the tether cable to power sonars, magnetometers, still cameras, manipulators, water samplers, cutting arms, or scientific instruments that measure water clarity, temperature, density, sound velocity, and light penetration.
Interconnect Technology for ROVs

ROVs are the backbone of all deepwater offshore operations. From installing assets and bringing wells online, to the complex business of decommissioning end-of-life fields. ROV equipment sets are pressure resistant, making it possible for the submersible to function and operate in harsh and remote depths up to 10,000 feet. In the demanding deep-water operations environment, electrical engineers specifying interconnect technology must consider extremes in temperature, pressure, and corrosion when choosing appropriate cables and connector sets to bring power and data to equipment and tools. Connectors must be evaluated for mating durability and wire-to-connector termination durability by considering working conditions including cathodic delamination, corrosion due to dissimilar metals, and mechanical stress due to cable routing and wave action.

Pressure resistant connectors are required on all ROVs for electrical and optical circuits interconnecting payload components and/or for umbilical connectivity topside. 10k psi is the standard for ROV connectors. Connectors typically employ front-end sealing technology that allows for wet underwater mating (not currently supplied by Glenair) and/or open-face exposure of connector halves to subsea pressures (a major Glenair strength—see our revolutionary SeaKing connector series later in this special edition of QwikConnect).

Back-end sealing technology protects the termination zone for both cable and contact, and is often a weak point in connector and cable sealing. Glenair brings over 60 years of mission-critical sealing expertise to our subsea interconnect designs, including deep materials science fluency in elastomers such as polyurethane and neoprene. Various other techniques and materials are available for front-end and back-end-to-cable sealing in subsea interconnects including:

Connector Sealing Technologies

- Glass-to-Metal
- Welding/Brazing
- Metal-to-Metal Seals
- Rubber-molded connectors
- Needle valves
- Tapered threads
- Potting/Adhesives/Sealants
- Dual O-rings

O-rings are the unsung hero of sealing, and when properly applied can yield reliable, high pressure sealing results. O-rings are small, cheap, suitable for high-mating cycle applications, easy to inspect, easily serviced and, as mentioned, extremely effective when proper attention is applied to engineering best-practices. These practices focus on gland design (or the relative advantages and disadvantages of axial face seals compared to radial piston or rod seals), as well as careful attention to metal-to-metal extrusion gaps, and O-ring groove widths.

Glenair SeaKing™ cutaway diagram showing replaceable Nitrile or Buna-N (NBR) O-ring seals that facilitate fast and trouble-free field replacement.
Next to mechanical design, the proper application of materials science has the greatest impact on high-pressure sealing. Metallic and non-metallic materials must be evaluated for temperature extremes, fluid compatibility, abrasion resistance, gas decompression, and conductivity. Shore hardness is a particularly critical material selection criterion in high-pressure sealing applications as it directly impacts material performance under pressure. Extrusion gaps in the designed-for clearance between metal sub-assemblies, for example, can be problematic for O-rings with Shore hardness ratings under 90. Many legacy subsea connector series were originally designed for shallower, lower pressure applications with shorter deployments. But today’s requirements for 10k psi high-pressure performance and deployments measured in weeks, not hours, call for both better mechanical design and harder 90 Shore-rated seals.

Many subsea applications utilize electrical and optical Pressure Balanced Oil Filled (PBOF) cables. PBOF cables use a compensating fluid-filled elastomeric tube as a conduit for the electrical and fiber optic lines. The elastomeric conduit allows the ocean pressure to transfer to the compensating fluid, equalizing the pressure differential.

PBOF technology has been widely utilized in ocean science exploration, drilling systems, production control systems, towed sonar arrays, and most importantly, for the interconnection of subsea floor structures and equipment. Special PBOF connectors are employed to enable the ROV to connect and disconnect flying lead PBOF cables for maintenance or equipment replacement.

Glenair has developed a superior PBOF technology design that allows for faster, easier assembly and ease-of-repair in the field, and the utilization of both straight and sweeping, non-constricting 45° and 90° elbows. These improvements and a host of others are now available in Glenair SeaKing high-pressure connectors and coming soon in our revolutionary SuperG55 series. The SubSea/Marine Team at Glenair invites you to enjoy the rest of this special edition of QwikConnect and to contact the factory for applications and design-in support.

O-rings with proper Shore hardness can prevent the extrusion problems shown in this diagram.

NOAA's Hercules ROV recovers a basalt recruitment block experiment from the sea floor.
**ROV Payloads**

The equipment that ROVs use to perform their underwater work is known as the “payload.” An ROV’s payload could include sonar, lights, video cameras, gyroscopes, navigation systems, thrusters, manipulators (robotic arms) and occasionally, still cameras and strobes. All of these devices require interconnection to power supplies, communication systems and controllers. Subsea equipment engineers must consider extremes in temperature, pressure, and corrosion when choosing subsea connectors. The ROV’s size and duty range can also influence connector choice. Glenair’s dedicated subsea engineers can work directly with ROV payload designers to select the best interconnect for the application.
Hydrostatic test lab

The Glenair marine/subsea technology team is unique in the industry having the ability to design, produce, validate, and test its complete range of subsea interconnect technologies using 100% in-house resources. Glenair’s hydrostatic lab is a dual-mode pressure test facility equipped with both large form-factor pressure vessels for testing complete cable assemblies, mated cable connectors, and even customer sub-assemblies. In addition, a small pressure vessel cell provides qualification and validation testing on discrete connector inserts and bulkhead connectors. Both the large pressure vessel and small pressure vessel systems can validate and test up to 16.5K psi, or 1 ½ times Glenair’s standard 10,000 psi subsea connector rating.

Welcome to the lab, my friends! Lemme show you around.

LARGE PRESSURE VESSELS: Built to accommodate complete cable assemblies, mated connectors, and customer-supplied sub-assemblies. Each unit contains a 12” diameter X 72” depth test chamber accommodating specimen weights up to 1500 lbs.

DISCRETE CONNECTOR TESTING: All Glenair subsea interconnects are subjected to 100% inspection and test.

1. Cable and subassembly staging

TECHNICAL STAFF: Knowledgable and trained subsea specialists perform both in-house product qualification testing, as well as customer subassemblies.
CONTROL ROOM: The modular consoles in the control room provide for up to 8 pressure circuits, operating in Manual mode or Automated. Each circuit is capable of a maximum of 16.5K psi. Monitors display: Automated Test Profiles, Data Acquisition, remote viewing of Test rooms and more. System is network connected for access to Profiles and distribution of test reports.

3. Hydrostatic test lab control room

4. Production connector staging

5. Small connector pressure test bunker

SeaKing™ and SuperG55™ QUALIFICATION TESTING: Both Glenair Series 70 SeaKing and SuperG55 rugged dry-mate subsea connectors have been tested and qualified to their 10K psi pressure rating—open-face and mated—in Glenair’s state-of-the-art hydrostatic test lab. Additional testing included mating cycles, salt spray, and electrical continuity.

| Glenair Hydrostatic Test Lab Technical Specifications and Pressure Test Standards |
|---------------------------------|---------------------------------|
| Pressure test profiles          | Automated or manual             |
| Maximum test pressure           | 16.5K psi                       |
| Data acquisition types          | Pressure, time, temperature, and electrical performance |
| Performance monitoring under pressure | I/R, continuity, insertion loss, and backreflection (optical) |
| Industry profiles               | All major oil & gas standards   |
| Custom profiles                 | Yes, including customer-supplied subassemblies |
| Capacity (large pressure vessels) | Working volume = 12” diameter x 72” depth; Test specimen weight up to 1500 lbs. |
High-pressure subsea
Ruggedized serial and high-speed electrical connectors
Glass-sealed high-pressure bulkhead feed-thrus
Fiber optic and optoelectronic solutions
Hazardous zone ATEX explosion-proof
Commercial Oil & Gas and defense industry solutions

Marine/Subsea Interconnect Solutions from Glenair

High-performance, mission-critical interconnect technologies with proven shipboard and subsea performance
Sneak peek: Marine Molded dry mate submersion-zone connectors

Sneak peek: SuperG55 dry-mate 10K PSI underwater electrical connectors

SeaKing 10K PSI high-density subsea connectors and cables

Ocean ex ATEx-qualified and approved explosive zone connectors

Glass-sealed high-pressure to 30K PSI hermetic bulkhead connector feed-thrus and HTHP

MIL-DTL-28876 qualified Navy fiber optic connectors, termini, and backshells

ITS-Ex ATEx-qualified and approved explosive zone connectors

Series 22 GeoMarine® 5K PSI transition-zone and subsea connectors and cables

Harsh environment opto-electronic (photonic) transceivers and media converters
SERIES 70

SeaKing™

10K PSI / 700 Bar / 7000m open-face or mated, dual O-ring equipped, high-density, high-voltage, fiber optic and hybrid electrical/optical subsea connectors

SeaKing is an innovative new connector series that eliminates a broad range of mechanical design weaknesses found in many of today’s high-pressure subsea connector families. From its double O-ring seals and retractable engaging nut, to its multi-keyed mating interface, the SeaKing represents a bold new approach to subsea power and signal connectivity.

Ideally suited for offshore oil & gas, military/defense, oceanographic research, and other harsh-environment subsea applications, the dry-mate connector series is built for optimal durability and reliability. Tested to 15,000 PSI (open face and mated), and equipped with integrated dual O-ring seals, marine bronze coupling nuts, corrosion-resistant stainless steel shells and high-pressure contact inserts with gold-plated signal contacts, special RF and fiber optic solutions, the Series 70 SeaKing is today’s most advanced high-density signal and standard-density power subsea connector available.

STANDARD CONFIGURATIONS

- High density, small form-factor connector
- Redundant dual O-ring seals ensure high-pressure performance
- Signal, power, RF Coax, and optical contact arrangements
- Five shell sizes with 4–109 contacts (#16, #20, and #22)
- Stainless steel construction with anti-galling marine bronze engaging nut
- Full-mate inspection ports
- Easy O-ring replacement
- Key and keyway polarization

Cable Connector Plug (CCP)  Bulkhead Connector Receptacle (BCR)  Flange Connector Receptacle (FCR)
**Sealing:** The Series 70 SeaKing is the best sealed subsea connector on the market. All critical interfaces, including bulkhead seals, glass-to-metal insert seals, mating interface bore seals, and face seals are fully redundant ensuring 10K PSI protection, even in the event of a single-seal failure.

**Mating:** SeaKing utilizes a modified UNC (coarse) mating interface with added clearance to reduce bio-fouling and facilitate rapid-advance mating. The marine bronze coupler on the plug is equipped with thread flats as well as knurling and is less susceptible to galling than standard steel engaging nuts. Polarized keys and keyways prevent both thread damage and mismating.

**Ease-of-Use:** Multiple PBOF backshell indexing points, indexable flange FCRs, full-mate inspection ports, retractable engaging nuts, and other features make SeaKing the most user-friendly subsea connector on the market.
SERIES 70 HIGH-PRESSURE 10K PSI / 700 BAR / 7000 M

SeaKing high-density subsea connectors and cable assemblies

Available connectors and cable assemblies

**SeaKing™ CONNECTOR SERIES OVERVIEW**

700-001

*SeaKing™ Cable Connector Plug (CCP), 10,000 psi rated (mated condition), subsea environment, solder termination*

700-006

*SeaKing™ Flange Connector Receptacle (FCR), 10,000 psi rated (open face and mated), subsea environment, solder termination, indexable flange*

700-007

*SeaKing™ Bulkhead Connector Receptacle (BCR), 10,000 psi rated (open face and mated), subsea environment, solder termination*

**TURNKEY OVERMOLDED AND REPAIRABLE CABLE ASSEMBLIES AND SPECIAL CONFIGURATIONS**

10K psi overmolded CCP assembly

10K psi overmolded 75 Ohm Coax hybrid assembly

Repairable wire mesh grip-equipped topside CCP cable

Cabled bulkhead connector receptacle (BCR) assembly

FCR assembly with flange mounting points and indexed flange

Special Oil & Gas industry NE 606 overmolded cable
REVOLUTIONARY PBOF SWIVEL HOSE ATTACHMENT ACCESSORIES

Hose barb fittings for PBOF cable assemblies are the perennial weak link in subsea oil & gas applications. Kinked and twisted hoses, leaky fittings, corroded hose clamps, and general poor performance characterize most existing solutions. The Glenair PBOF swivel hose attachment for SeaKing connectors solves these problems and more. Designed from the sea floor up to perform flawlessly and reliably, this revolutionary attachment puts an end to the long list of field maintenance problems associated with oil-filled cable applications.

- Straight, 45°, and 90° “full radius” angle and profile hose routing
- Hose angle adjustment feature eliminates risk of oil leakage
- Corrosion-resistant materials used throughout
- Threaded couplers with safety set-screws for fail-safe leak and decoupling protection—no special tools required for assembly
- Compact PBOF compression fitting with 340° hose swivel action
- Support for the broad range of hose diameters and wall thicknesses

The complete range of SeaKing PBOF hose compression fittings includes straight, 45°, and 90° full radius profile versions; with and without integrated oil fill ports

<table>
<thead>
<tr>
<th>SeaKing Performance Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pressure Rating</strong></td>
</tr>
<tr>
<td>Plug: 10,000 psi, mated condition</td>
</tr>
<tr>
<td>Receptacles: 10,000 psi mated and open face</td>
</tr>
<tr>
<td>per ISO 13628-6</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
</tr>
<tr>
<td>600 V typical</td>
</tr>
<tr>
<td>5 GOhm insulation resistance at 500 VDC</td>
</tr>
<tr>
<td>per MIL-STD-202, Method 301</td>
</tr>
<tr>
<td>per MIL-STD-202, Method 302</td>
</tr>
<tr>
<td><strong>Materials</strong></td>
</tr>
<tr>
<td>Salt Spray (corrosion)</td>
</tr>
<tr>
<td>Humidity (steady state)</td>
</tr>
<tr>
<td>Thermal Cycle</td>
</tr>
<tr>
<td>MIL-STD-202, Method 101</td>
</tr>
<tr>
<td>MIL-STD-202, Method 103</td>
</tr>
<tr>
<td>ISO 13628-6</td>
</tr>
<tr>
<td><strong>Shock</strong></td>
</tr>
<tr>
<td>30G Mechanical Shock</td>
</tr>
<tr>
<td>per ISO 13628-6</td>
</tr>
<tr>
<td><strong>Vibration</strong></td>
</tr>
<tr>
<td>5G Vibration</td>
</tr>
<tr>
<td>per ISO 13628-6</td>
</tr>
</tbody>
</table>

Threaded PBOF compression nut and connector coupling nut (with additional safety set screw) provide for fast and easy assembly and prevent leaks and assembly decoupling

Interlocking teeth on SeaKing plug connectors interface with corresponding teeth on the PBOF swivel hose attachment to facilitate easy indexing and routing of hose assemblies

Revolutionary swivel hose barb compression attachment eliminates twisting and damage in PBOF assemblies

Interlocking teeth

Elastomer Tubing

Optional Fill Port

Threaded couplings

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The SuperG55 family of dry-mate underwater connectors is a revolutionary new design of the popular industry-standard marine interconnect used in countless ROV, underwater camera, diver communications, lights, pan and tilts, and other subsea applications.

Available in 3 shell sizes, the SuperG55 is manufactured from 316L Stainless Steel with insert molded contact assemblies designed for pressure-sealed applications up to 10K psi mated and unmated. Intermateable and intermountable with other “55” series connectors, the Glenair solution introduces a long list of product innovations designed to improve performance and durability. Our PBOF versions, for example, utilize easy-to-assemble threaded fittings which deliver both superior sealing performance while reducing installation time. Other innovations include full-mate inspection windows, improved solder cup contact design, improved potting and sealing, and more. Cable plugs and receptacles are available in attachable (user-terminatable) versions or factory overmolded single-ended whips.

To improve assembly speed and electrical performance, the SuperG55 CCP is equipped with extended-length solder cups and an auxiliary potting cap for post-soldering wire-to-contact sealing.

To facilitate 360° indexing of the bulkhead keyway, SuperG55 FCR designs are now equipped with removable, spoked-body and indexable flange—a proven innovation borrowed from Glenair Series 70 SeaKing.

10,000 psi mated/unmated (approx. 22,500ft/7,000m)
Recessed plug socket contacts for safety
Intermateable and intermountable with other “55” series connectors
3 shell sizes — 15, 20 and 24, with 3 to 21 contacts
PBOF versions available
600 VDC, 5 to 18 Amps (dependent on conductor and cable size and make-up)
Retractable, anti-galling coupling nuts prevent mismating and improve durability
**SuperG55**

Tested and qualified for intermateability with popular “55” type interconnects

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**SuperG55 FLANGE CONNECTOR RECEPTACLE (FCR)**

- **Jig plate (insulator)**
- **O ring**
- **Wires**
- **Pin contact With solder buckets**
- **4 Hole flange shell**

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**UNIVERSAL CCP SUPERG55 FOR EITHER MOLDED OR PRESSURE-BALANCED OIL-FILLED CABLE CONFIGURATIONS**

- **Hose**
- **Oil-filled shell**
- **Female contact with hood and solder buckets**
- **Extended shell**
- **3 full-mate viewing ports**
- **Female contact**
- **Polyurethane or Neoprene Coated**
- **O-ring seal**
- **Locking ring and grub screw**
- **O-ring seal**
- **Filling cap and seal**

**SuperG55 Performance Specifications**

<table>
<thead>
<tr>
<th>Performance Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mating Cycles</td>
<td>500</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-20°C to +90°C</td>
</tr>
<tr>
<td>Voltage Rating</td>
<td>600 VDC / 440 VAC</td>
</tr>
<tr>
<td>Current (max.)</td>
<td>5 to 18 Amps (dependent on contact and cable conductor sizes)</td>
</tr>
</tbody>
</table>

**SuperG55 Material/Finish**

<table>
<thead>
<tr>
<th>Material/Finish</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shells</td>
<td>316L Stainless Steel/Passivated</td>
</tr>
<tr>
<td>Insulator</td>
<td>PEEK</td>
</tr>
<tr>
<td>Insert</td>
<td>Neoprene</td>
</tr>
<tr>
<td>Contacts</td>
<td>Copper alloy, gold plated</td>
</tr>
<tr>
<td>O-rings</td>
<td>Nitrile</td>
</tr>
<tr>
<td>Overmold and Cable</td>
<td>Polyurethane or Neoprene</td>
</tr>
</tbody>
</table>

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**NON-STANDARD MATERIALS:** Other material options are available as part of our non-catalog offerings including Anodized aluminium, Titanium, and Aluminium Bronze. Glenair is also able to supply SuperG55 interconnects in composite thermoplastic (PEEK) to meet application requirements for reduced cathodic corrosion as well as weight reduction without affecting connector performance.

**HIGH-SPEED ETHERNET:** The SuperG55 Ethernet option is available in the 1508, 2013 and 2021 contact configurations and provides both high speed (Up to 1GB) and power (600Volts) in a full subsea environment (10,000PSI). Gigabit speed data transfer up to a distance of 75mtrrs.

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**AVAILABLE CONTACT ARRANGEMENTS**

- **1503**
  - 3 #12

- **1508**
  - 8 #16

- **2008**
  - 8 #12

- **2013**
  - 13 #16

- **2021**
  - 21 #16
  - 12 #12

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Songs of the Sea
Fill in the randomly numbered blanks to solve this sea song puzzle

1. ___th___ C______
2. __________’s _α_______
3. ___k_______r
4. ___ W_________ __ _
   __________d __________d
5. (________’ ___) ___
   ______ o _____ y
6. W______ ______s/
   ______ gg_
7. ______ o_t___ ______
8. ________b
   __________α_______m___
9. O______ ___n
10. ___l______b_________
11. ______ t___ _α
12. A__________
13. ___k_______
   ______r
14. _____ y___e
   ____s_____r
15. _α___ ___, _α_____
16. ___e__i__w___
17. ___o__ o___
18. e______________
19. _h_ r__________i_
20. _ ____m_____ S___

Solution posted November 15th
www.glenair.com/qwikconnect

Bridge:
   E C#m7  A
It’s far,
B7   E   C#m7
beyond a star,
   A
It’s near,
B7 E C#m7 Gdim
D7 beyond the moon;
G   Em Am7
I know
D7   G   Em
beyond a doubt
Am7  D7
My heart
G Gdim Edim G7
will lead me there soon.
Bridge:

E   C#m7  A
It's far,
B7            E         C#m7  Gdim
beyond a star,
A
It's near,
B7               E     C#m7  Gdim
D7 beyond the moon;
G    Em  Am7
I know
D7         G    Em
beyond a doubt
Am7  D7
My heart
G        Gdim   Edim   G7
will lead me there soon.
SERIES 802

AquaMouse

Ultraminiature high-pressure

Originally developed for petroleum pipeline inspection equipment, Series 802 connectors are available in ten sizes from 1 to 130 contacts and equipped with Viton® O-rings to withstand exposure to corrosive chemicals and high temperature environments. These connectors feature high density crimp Mighty Mouse inserts, 316 stainless steel or marine bronze shells and a piston O-ring for hydrostatic sealing. Series 802 insulated wire, panel mount receptacles can be ordered as square flange, in–line or jam–nut versions. Choose integral shield termination platform or accessory thread for use with a variety of strain relief options. Crimp style gold–plated crimp contacts accept #12–30 wire. Connectors are backfilled with epoxy potting compound. Hermetic glass–sealed connectors come with solder cup contacts (non-removable) or PC tails. 100% tested to meet 1 x 10⁻⁷ cc/sec helium leakage. Open face pressure rating 3500 PSI.

AQUAMOUSE CONNECTOR CONFIGURATIONS AND CLASSES

- 3500 psi pressure rated
- High-temperature and corrosive chemical-resistant Viton® or Nitrile O-rings
- Ultraminiature #23 contacts
- Size #20, #20HD, #16, #12, #8 signal, power, fiber optic and shielded contacts
- Discrete connectors and turnkey cable assemblies

![Photo: Subsea production systems by jasonwoodhead23](Image)
Marine Molded Underwater Interconnect Assemblies

Glenair Marine Molded series connectors are used in remotely operated vehicles, underwater lighting systems, underwater video monitoring systems and other subsea applications. Available in both rubber molded cable and inline versions, as well as glass-filled epoxy bulkhead versions, the Marine Molded series is a reliable and cost-effective interconnect technology for high-pressure subsea applications up to 10K psi mated condition. Available in a wide range of high-pressure insert molded contact arrangements, with size #16 to size #0 contacts, and from two to eight circuits.

- 10,000 psi (mated) pressure rating
- 7.5 Amps to 200 Amps
- Two to eight contacts
- Catalog and custom cable options
- Chemically resistant

Neoprene Jacket
Neoprene Body
Gold-Plated Pins
Gold-Plated Socket Contacts

Female Cable Assembly

Neoprene Body
Gold-Plated O-Ring

Male Cable Assembly

Neoprene Body
Neoprene Jacket

Male Bulkhead Connector

Glass-Filled Epoxy Body
O-Ring
Stainless Steel Nut and Washer
Solder Cup Pins
Gold-Plated Pins
**SERIES GLA20**

**Marine Molded**

**Underwater Interconnect Assemblies**

Specifications, contact arrangements and accessories

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**Specifications**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacts</td>
<td>Copper Alloy, Gold-Plated</td>
</tr>
<tr>
<td>O-Rings</td>
<td>Nitrile</td>
</tr>
<tr>
<td>Nut, Washer</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Cable</td>
<td>Neoprene insulation, Stranded Copper Conductor</td>
</tr>
<tr>
<td>Bulkhead Connector Body</td>
<td>Glass-Filled Epoxy</td>
</tr>
<tr>
<td>Voltage Rating</td>
<td>600 VDC</td>
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<tr>
<td>Current Rating</td>
<td>See Contact Arrangements</td>
</tr>
<tr>
<td>Temperature Rating</td>
<td>-55°C to +105°C</td>
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</tbody>
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**Contact Arrangements and Current Rating**

<table>
<thead>
<tr>
<th>2 contacts</th>
<th>3 contacts</th>
<th>4 contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 #10 Contact</td>
<td>1 #10 Contact</td>
<td>1 #10 Contact</td>
</tr>
<tr>
<td>1 #12 Contact</td>
<td>2 #12 Contact</td>
<td>3 #12 Contacts</td>
</tr>
<tr>
<td>10 Amps</td>
<td>10 Amps</td>
<td>7.5 Amps</td>
</tr>
<tr>
<td>G2</td>
<td>G3</td>
<td>G4</td>
</tr>
</tbody>
</table>

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**5 contacts**

<table>
<thead>
<tr>
<th>6 contacts</th>
<th>8 contacts</th>
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</thead>
<tbody>
<tr>
<td>1 #10 Contact</td>
<td>1 #10 Contact</td>
</tr>
<tr>
<td>4 #16 Contacts</td>
<td>7 #16 Contacts</td>
</tr>
<tr>
<td>7.5 Amps</td>
<td>6 Amps</td>
</tr>
<tr>
<td>K5</td>
<td>K8</td>
</tr>
</tbody>
</table>

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**ACCESSORIES**

**Locking Sleeves**

Locking Sleeves enable a mated pair of cable assemblies to be locked together, preventing accidental unmating. Material: Delrin.

**O-Rings**

Replacement O-Rings for bulkhead connectors. Material: Nitrile

---

<table>
<thead>
<tr>
<th>Cable Part No.</th>
<th>Type</th>
<th>Sleeve Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GL20G*P</td>
<td>Male</td>
<td>GL20G401</td>
</tr>
<tr>
<td>GL20K*P</td>
<td>Male</td>
<td>GL20K403</td>
</tr>
<tr>
<td>GL20G*S</td>
<td>Female</td>
<td>GL20G402</td>
</tr>
<tr>
<td>GL20K*S</td>
<td>Female</td>
<td>GL20K404</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Cable Part No.</th>
<th>O-Ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>GL30G</td>
<td>2-213</td>
</tr>
<tr>
<td>GL30K</td>
<td>2-217</td>
</tr>
</tbody>
</table>
HIGH-RELIABILITY

Glass-sealed Hermetic Connectors

Resolve gas, moisture and particle ingress problems with advanced-performance glass-sealed hermetic connectors

VITREOUS GLASS TECHNOLOGY ADVANTAGES

- Superior pressure resistance to 32,000+ PSI
- Hundreds of designs, including long-length bulkhead feed-thrus and penetrators
- Higher resistance to extreme operating temperatures to 260°+ C
- Superior mechanical strength
- No material breakdown or aging over time
- Helium leak rate <1X10^-7 cc/sec to 1X10^-10

CIRCULAR GLASS-SEALED HERMETIC CONNECTORS AVAILABLE WITH ACCELERATED LEAD TIMES

- MIL-DTL-26482
- MIL-DTL-83723
- MIL-DTL-38999 (QPL)
- MIL-DTL-5015
- Series 80 Mighty Mouse
MIL-DTL-38999 AND OTHER
Glass-Sealed Hermetic Connectors

GEOPHYSICAL AND OFFSHORE CONFIGURATIONS

- GeoMarine® double-start hermetic connector
- Hermetic power connector
- Single-way tool joint hermetic connector
- Hermetic probe connector
- Hermetic bulkhead penetrator

HIGH-SPEED/SHIELDED DESIGNS

- Triax hermetic
- Hybrid coax/signal hermetic
- Quadrax hermetic
- MT ribbon fiber optic hermetic
- Hybrid coax/signal hermetic

RECTANGULAR PACKAGES

- MIL-DTL-24308 QPL hermetic
- Series 79 Micro-Crimp hermetic
- MIL-DTL-83513 type micro-D hermetics
- Sealed panel-mount micro-D hermetic
- Well-Master™ 260° high-temperature Micro-D

MIL-DTL-38999 QPL PIN AND SOCKET HERMETICS

- Series I Scoop-proof 3 Point Bayonet Coupling
- Series II Low-profile 3 Point Bayonet Coupling
- Series III Scoop-proof Triple Start, Self-Locking
- Series IV Scoop-proof Breech Lock

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SERIES 22
Geo-Marine®

High-pressure harsh-environment connectors and overmolded cables for towed array and other high-pressure/submersible applications

Designed for use in oceanographic, geophysical and other severe industrial environments, Glenair Series 22 Geo-Marine® Connectors and Cables are the ultimate harsh-environment power and signal connector solution. Built to withstand hydrostatic pressures up to 5,000 PSI and exposure to extreme temperatures and corrosives, the Series 22 Geo-Marine® is ideally suited for applications such as US Navy towed array sonar systems, military land vehicles, submersibles and ROV’s, offshore-oil drilling equipment, seabed exploration, pipeline inspection systems, well monitoring equipment, and digital seismic streamers.

Geo-Marine® plugs are equipped with arctic coupling nuts—made from marine-grade naval bronze—with easy-to-grip castellated knurling and a powerful ratcheted anti-decoupling mechanism which guarantees reliable mating and demating performance in even the harshest environments. Supplied as discrete connectors—or more typically in build-to-print overmolded cable assemblies.

- 5000 psi pressure rated
- Marine Grade 316 stainless steel machined shells and Naval Bronze coupling rings
- High-pressure environmental and hermetically sealed receptacles for field applications
- Power and signal contact arrangements from 2 to 128 contacts
- Anti-vibration ratcheted coupling nuts with castellated knurling
- Available Viton® overmolded cable assemblies
SERIES 22
Geo-Marine® Connectors
High-pressure environmental and hermetic connectors

Range of Offerings
Series 22 Geo-Marine® connectors are supplied with either fused-glass ("H" hermetic class) or high grade thermoplastic ("E" environmental class) insulators. Both classes of connectors are supplied with rugged, corrosion-resistant materials. Low-profile and scoop-proof cable plugs and receptacles, as well as bulkhead feed-thrus are available. Specially-designed cable sealing backshells as well as EMI/RFI shield termination backshells and environmentally-sealed protective covers complete the range of discrete product offerings. 35 insert arrangements (contact sizes #12, #16, #20 and #22) are tooled and fully available.

WIDE RANGE OF PLUG CONFIGURATIONS WITH ANTI-GALLING ARCTIC COUPLING NUTS

- Cable plug with accessory threads
- Cable plug with overmold adapter
- Panel-mounted plug
- Factory overmolded plug

HIGH-PRESSURE ENVIRONMENTAL AND HERMETIC RECEPTACLE CONFIGURATIONS

- Jam Nut
- In-Line
- Square Flange
- Solder-Mount
- Bulkhead Feed-Through

RUGGEDIZED STAINLESS STEEL BACKSHELLS AND OTHER CONNECTOR ACCESSORIES

- Environmental strain relief backshell
- Overmolding adapter
- Right-angle strain relief backshell
- Environmentally sealed protective covers
Designed for safe operation in petrochemical refineries, oil & gas drilling platforms, and other explosion zone applications, the Glenair ITS-Ex series connector is optimized for life-of-system durability and reliability. Qualified by the globally-recognized IEC and IECEx standards bodies, the connector series is suitable for use in application areas where flammable gases and vapors are present as a normal condition of operation (group IIC) and with temperature classes T6 and T5, zones 1 and 2; and for applications where potentially flammable dust is present as a normal condition of operation (group IIIC) and with temperature classes T80°C and T95°C in zone 21 and 22.

Series ITS-Ex is designed for easy and repeatable termination of armored and unarmored cables built to IEEE 45, IEC, BS, DIN, and JIC standards. A full range of power and signal contacts, from size #16 to size #0 in over 40 insert arrangements are available to address all common voltage, wire size and connector service class ratings.

Special Ex design attributes of the series include an integral labyrinth flame path cooling zone, 2-part epoxy potting well, fixed in-line receptacles for attachment of cables to cable management brackets and trays, set screw (grub screw) secured protective safety covers, and durable life-of-system Ex marking labels.
SERIES ITS-EX
IECEx/ATEEx Qualified
Explosive Zone Connectors

RANGE OF APPLICATIONS
- Automotive refuelling or petrol stations
- Oil & gas extraction
- Oil refineries
- Gas pipelines and distribution
- Chemical processing plants
- Aircraft refuelling and hangars
- Transportation
- Pharmaceuticals
- Food processing
- Metal surface grinding
- Sugar refineries
- Grain handling and storage
- Coal mining

ATEX Marking

Ex db IIC T6, T5 Gb
Ex tb IIIC T80°C, T95°C Db IP68
-40°C ≤ Tamb ≤ +40°C (T6, T80°C) or +55°C (T5, T95°C)

IECEx Marking

Ex db IIC T6, T5 Gb
Ex tb IIC T80°C, T95°C Db IP68
-40°C ≤ Tamb ≤ +40°C (T6, T80°C) or +55°C (T5, T95°C)
QPL AND COMMERCIAL

MIL-PRF-28876
Fiber optic connection system

Qualified MIL-PRF-28876 fiber optic connectors and MIL-PRF-29504 termini—Navy approved, in stock, and ready for immediate shipment

- Connectors qualified to the complete requirements of MIL-PRF-28876 including plugs, wall-mount receptacles, jam-nut mount receptacles and in-line receptacles
- Multiple shell sizes and insert arrangements, including 2, 4, 6, 8, 18 and 31 channel layouts
- Backshells in straight, 45° and 90° configurations
- Corrosion-resistant and environmentally sealed
- Qualified MIL-PRF-29504/14 and /15 pin and socket termini and /3 dummy terminus
- Connectors, backshells and protective covers available for immediate, same-day shipment

M28876/7 plug with backshell
M28876/11 jam nut receptacle
M28876/2 receptacle with backshell
QPL AND COMMERCIAL
MIL-PRF-28876
Fiber optic connection system

<table>
<thead>
<tr>
<th>Connector/Backshell Types</th>
<th>Connector Type</th>
<th>Backshell Type</th>
<th>MIL-Spec</th>
<th>Commercial Type Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall Mount Receptacle</td>
<td>None</td>
<td>M28876/1</td>
<td>03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Straight</td>
<td>M28876/2</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45°</td>
<td>M28876/3</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90°</td>
<td>M28876/4</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>In-Line Receptacle</td>
<td>Straight</td>
<td>M28876/5</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Plug</td>
<td>None</td>
<td>M28876/6</td>
<td>06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Straight</td>
<td>M28876/7</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45°</td>
<td>M28876/8</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90°</td>
<td>M28876/9</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Jam Nut Receptacle</td>
<td>None</td>
<td>M28876/11</td>
<td>04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Straight</td>
<td>M28876/12</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45°</td>
<td>M28876/13</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90°</td>
<td>M28876/14</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>

Qualified QPL-29504 pin and socket termini

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Performance Requirements/Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Insertion Loss, Multimode</td>
<td>-0.3 dB Typical (62.5/125)</td>
</tr>
<tr>
<td>Optical Insertion Loss, Singlemode</td>
<td>-0.3 dB Typical (9/125)</td>
</tr>
<tr>
<td>Optical Back Reflection, Singlemode</td>
<td>Better than -40 dB - PC Polish - Better than -50 dB - Enhanced PC Polish</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-28°C to +65°C (MIL-Spec Epoxy and Cable) -55°C to +125°C (alternative Epoxy and Cable)</td>
</tr>
<tr>
<td>Temperature (Thermal) Shock</td>
<td>-40°C to +70°C, 5 Cycles</td>
</tr>
<tr>
<td>Temperature Cycling</td>
<td>-28°C to +65°C, 5 Cycles</td>
</tr>
<tr>
<td>Temperature/Humidity Cycling</td>
<td>-10°C to +65°C, 10 Cycles, 240 hours, 98% RH</td>
</tr>
<tr>
<td>Temperature Life Aging</td>
<td>+110°C, 240 hours, Dry Air</td>
</tr>
<tr>
<td>Mating Durability</td>
<td>500 cycles</td>
</tr>
<tr>
<td>Vibration - Sinusoidal</td>
<td>10 g Peak, 5-500 Hz sin./ 10.2 g RMS, 50-2000 Hz random</td>
</tr>
<tr>
<td>Impact</td>
<td>8 Drops from 8 feet</td>
</tr>
<tr>
<td>Crush Resistance</td>
<td>281 lbs, 7 Cycles</td>
</tr>
<tr>
<td>Cable Pull Out Force - Termini</td>
<td>Termini: 22 lbs min for 1 minute Connector: 162 lbs min for 10 minutes</td>
</tr>
<tr>
<td>Fluid Immersion</td>
<td>Turbine Fuel, Isopropl Alcohol, Hydraulic Fluid, Lubricating Oil, Coolant, Tap- and seawater, 24 hrs</td>
</tr>
<tr>
<td>Water Pressure</td>
<td>32 feet for 48 hours at +10°C to +35°C</td>
</tr>
<tr>
<td>Mechanical Shock (High Impact)</td>
<td>MIL-S-901, Grade A, Type B, Class I</td>
</tr>
<tr>
<td>Corrosion Resistance (Salt Spray)</td>
<td>500 hours</td>
</tr>
<tr>
<td>Sand and Dust</td>
<td>12 hours</td>
</tr>
<tr>
<td>Flammability</td>
<td>0.75 inch flame for 10 sec. mated, 1.50 inch flame for 60 sec. unmated</td>
</tr>
</tbody>
</table>

Qualified Fiber Optic Termini

<table>
<thead>
<tr>
<th>Type</th>
<th>Military Part Number</th>
<th>A Dia (Microns)</th>
<th>Typical Fiber Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin Termini</td>
<td>M29504/14-4131C</td>
<td>126.0</td>
<td>Multi Mode</td>
</tr>
<tr>
<td></td>
<td>M29504/14-4132C</td>
<td>127.0</td>
<td>Multi Mode</td>
</tr>
<tr>
<td></td>
<td>M29504/14-4135C</td>
<td>142.0</td>
<td>Multi Mode</td>
</tr>
<tr>
<td>Socket Termini</td>
<td>M29504/15-4171C</td>
<td>126.0</td>
<td>Multi Mode</td>
</tr>
<tr>
<td></td>
<td>M29504/15-4172C</td>
<td>127.0</td>
<td>Multi Mode</td>
</tr>
<tr>
<td></td>
<td>M29504/15-4175C</td>
<td>142.0</td>
<td>Multi Mode</td>
</tr>
<tr>
<td>Dummy Terminus</td>
<td>M29504/3-4038</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Crimp sleeve is supplied with terminus assembly and may be ordered separately (see Table II). For terminus less crimp sleeve, omit C from end of part number. Consult factory for additional sizes.

Terminated and tested MIL-PRF-28876 fiber optic cable assembly

**Insert Arrangements**

<table>
<thead>
<tr>
<th>Pin Insert Face</th>
<th>Socket Insert Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size A or Size 11 Ins. Desig. 1</td>
<td>2 channels.</td>
</tr>
<tr>
<td>Size B or Size 13 Ins. Desig. 1</td>
<td>4 channels.</td>
</tr>
<tr>
<td>Size C or Size 15 Ins. Desig. 2</td>
<td>6 channels.</td>
</tr>
<tr>
<td>Size F or Size 23 Ins. Desig.</td>
<td>18 channels.</td>
</tr>
<tr>
<td>Size F or Size 23 Ins. Desig.</td>
<td>31 channels.</td>
</tr>
</tbody>
</table>
HARSH-ENVIRONMENT

Fiber Optic Interconnect Solutions

Unlock the huge bandwidth of fiber optic connectors, cables, and ruggedized transceiver technologies

Glenair harsh-environment fiber optic connectors and board-level transceiver technologies are designed for harsh land, air, sea, and space environments and will operate reliably over very wide temperature ranges and high shock and vibration conditions. These proven technologies have been optimized to minimize size, weight and power and offer electrical-to-fiber conversion for Ethernet, video, signal aggregation and high-speed digital signals. Glenair also offers integration of electronics or opto-electronics into rugged connector packages and cable assemblies per specific customer requirements. We offer rapid response in-house electrical/PCB design, and mechanical connector/backshell engineering from our vertically integrated factory.

GLENAIR FIBER OPTICS

- Reduced size, weight, and power consumption
- Total EMI immunity, network security, increased transmission distance and ultra-high bandwidth
- High shock and vibration to support mission critical applications
- Wide operating temperature range: -40°C to +85°C and beyond
- Qualified, proven opto-electronic and fiber optic interconnect technologies for both commercial oil & gas and naval/defense applications.

Small form-factor transceiver
Signal aggregation media converter
7-port Ethernet switch
DVI video media converter
In-line fiber optic to copper media converter
Photonic contacts and connectors
FIBER OPTICS AND OPTO-ELECTRONICS
Harsh-Environment, Small Form-Factor Optical Interconnect Solutions
for Ethernet, video, and high-speed data

HARSH ENVIRONMENT FIBER OPTIC CONNECTORS AND OPTO-ELECTRONIC TRANSCEIVERS

- Opto-electronic transmitter and receiver contacts for Ethernet, video, and high-speed data
- High vibration and shock board-mount transmitters and receivers with Samtec surface-mount connectors
- High vibration and shock Bi-directional transceiver
- RF-over-fiber board-mount transceiver
- EMI shielded PCB transceiver showing Samtec surface-mount connector and Glenair GC F/O interconnects
- Harsh-environment opto-electronic connectors for Ethernet, video, and high-speed data
- MIL-PRF-28876 US Navy qualified fiber optic connectors and termini
- Eye-Beam® GMA Expanded-Beam IAW M83526
- Eye-Beam® GLT Expanded Beam Fiber Optic
Good Ideas

The founder of the Dayton Engineering Laboratories Company, the outfit that was to become Delco, was a man by the name of Charles Kettering. That's his picture there on the cover of Time magazine. Kettering was an American inventor, engineer, businessman, and the holder of 186 patents. In addition to his work at Delco, he was head of research at General Motors from 1920 to 1947. Kettering was renowned for the practicality of his inventions. As he said, “I didn't hang around much with…the executive fellows. I lived with the sales gang. They had some real notion of what people wanted.”

Early automobiles required a hand crank for starting. Occasionally, when the spark lever was not properly set, the hand crank kicked back, causing serious injury: a broken wrist, arm, or shoulder. On a winter night in 1908, the result was much worse. Byron Carter, founder of Cartercar, came across a stalled motorist on Belle Isle in the middle of the Detroit River. He gallantly offered to crank the car for the stranded driver. When she forgot to retard the spark, the crank kicked and broke Carter's jaw. Complications developed, and Carter later died of pneumonia. When Cadillac chief, Henry M. Leland, heard the news, he was distraught. Byron Carter was a friend and the car that kicked back was a Cadillac. “The Cadillac car will kill no more men if we can help it,” he told his staff.

He called Charles Kettering. The engineers at Delco worked around the clock to solve the problem. Leland approved their revolutionary electric starter and generator for his 1912 model and placed an order for 12,000 units. The same basic technology is still used today in modern automobiles.

Good ideas can come from any number of places. The end-user of a technology is invaluable when it comes to what does or doesn't work. Sales and marketing types in the field are classic sources for this “voice of the customer” feedback. Knowledgeable engineers are equally valuable sources of good ideas—especially when it comes to clever ways to solve a problem. Often, a good idea can come from someone outside a system or industry, as folks “inside a bubble” can tend to be influenced by ingrained taboos and traditions.

I have noticed here at Glenair that many of our best ideas originate with team members who are just plain not afraid to suggest a new way to tackle an old problem—regardless of what role they play in the organization. I absolutely cherish this behavior (what some folks call “acting like an owner”). Linus Pauling said “the best way to have a good idea is to have lots of ideas.” That sounds about right to me.

Chris Toomey