QwikConnect

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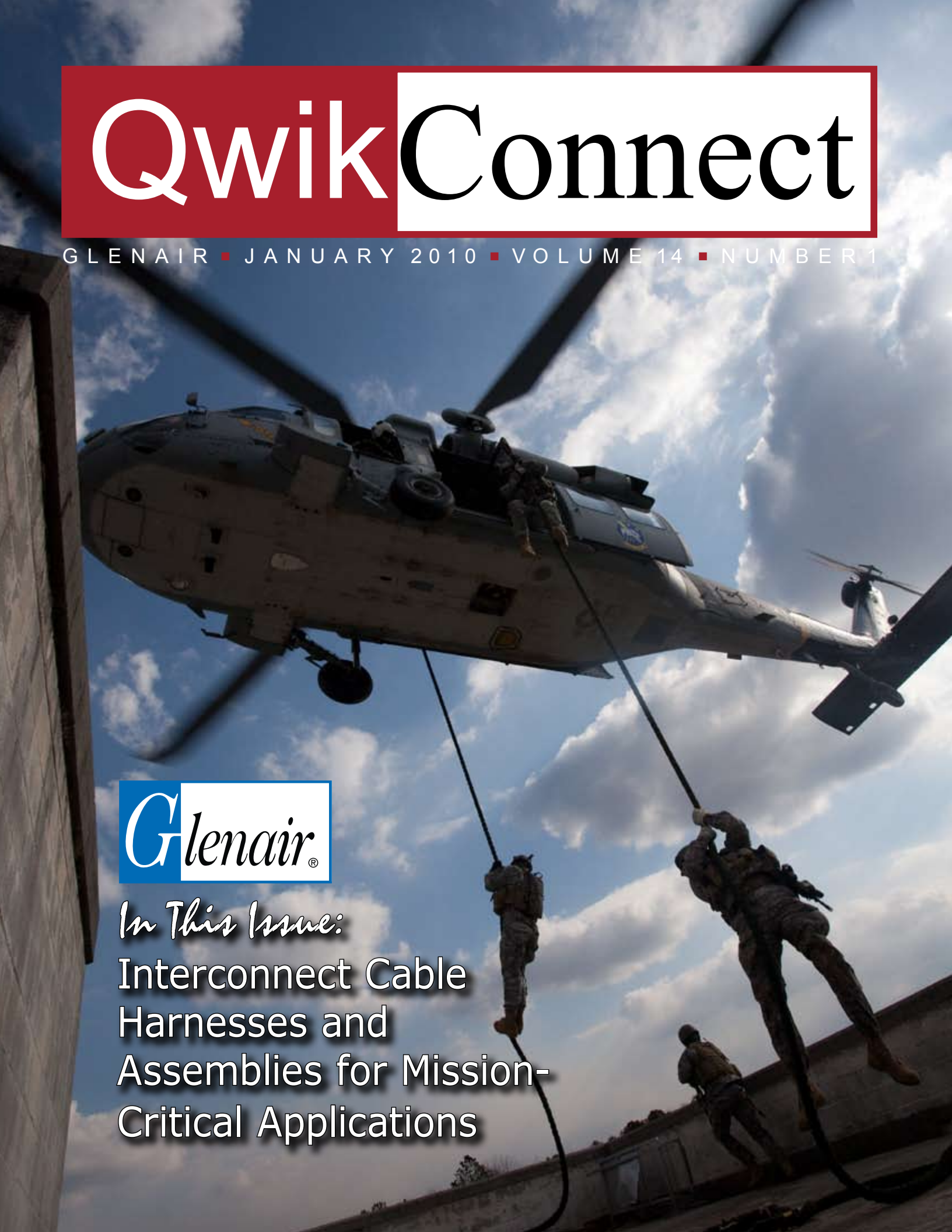
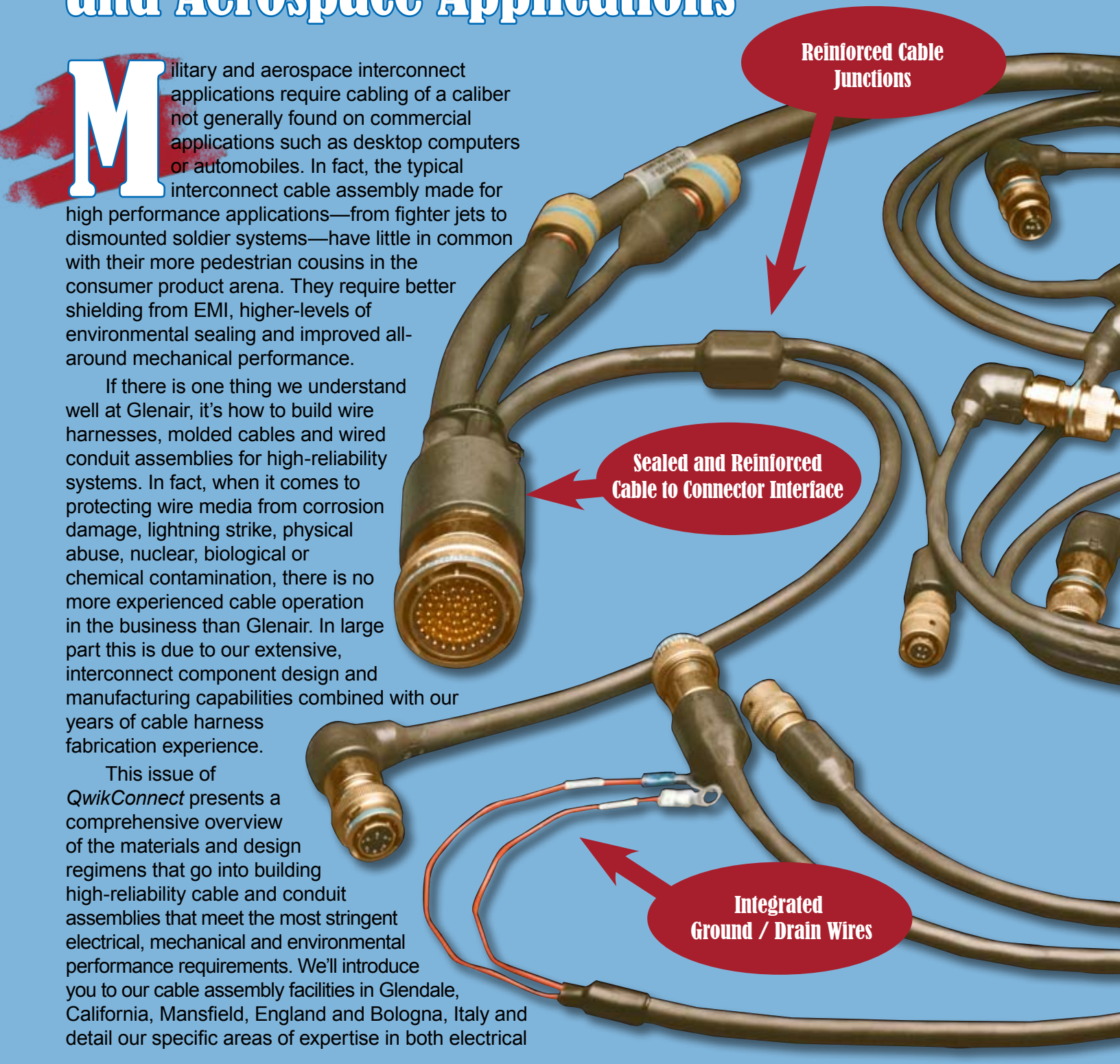


Glenair®

In This Issue:

Interconnect Cable Harnesses and Assemblies for Mission-Critical Applications

Superior Cable Assemblies for Military and Aerospace Applications

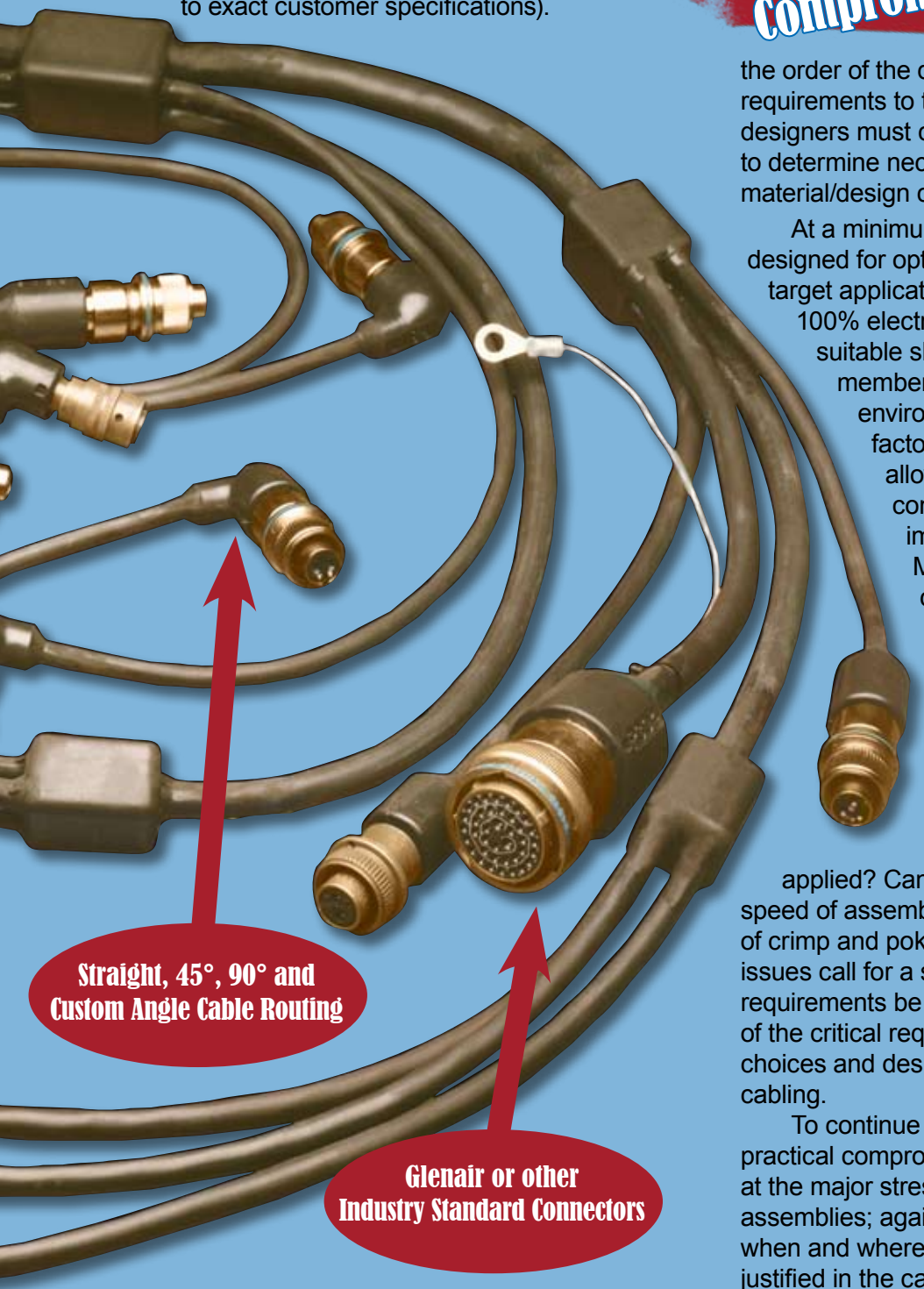


Military and aerospace interconnect applications require cabling of a caliber not generally found on commercial applications such as desktop computers or automobiles. In fact, the typical interconnect cable assembly made for high performance applications—from fighter jets to dismounted soldier systems—have little in common with their more pedestrian cousins in the consumer product arena. They require better shielding from EMI, higher-levels of environmental sealing and improved all-around mechanical performance.

If there is one thing we understand well at Glenair, it's how to build wire harnesses, molded cables and wired conduit assemblies for high-reliability systems. In fact, when it comes to protecting wire media from corrosion damage, lightning strike, physical abuse, nuclear, biological or chemical contamination, there is no more experienced cable operation in the business than Glenair. In large part this is due to our extensive, interconnect component design and manufacturing capabilities combined with our years of cable harness fabrication experience.

This issue of *QwikConnect* presents a comprehensive overview of the materials and design regimens that go into building high-reliability cable and conduit assemblies that meet the most stringent electrical, mechanical and environmental performance requirements. We'll introduce you to our cable assembly facilities in Glendale, California, Mansfield, England and Bologna, Italy and detail our specific areas of expertise in both electrical

and fiber optic cable systems. Along the way we'll be discussing both our Glenair ASAP Cable Assemblies (Fast turnaround, point-to-point cables available as standard catalog offerings) as well as examples of the many Customer Bespoke Interconnect Assemblies (longer lead-time cable and conduit assemblies made to exact customer specifications).



The Ideal Cable Assembly and the Spirit of Compromise

At Glenair, we understand that not every application calls for the type of ultra-high-performance interconnect assemblies that we commonly build, and that "compromise" is the order of the day when matching cost and use requirements to the cable design. Interconnect cable designers must carefully examine their requirements to determine necessary trade-offs between cost and material/design choices.

At a minimum, all interconnect cables must be designed for optimal form, fit and function within the target application environment; be fabricated for 100% electrical continuity; and be equipped with suitable shielding, jacketing and strength members to withstand anticipated electrical, environmental and mechanical stress factors. But these minimum requirements allow for considerable latitude when it comes to material selections that impact cost and long-term durability. Many applications require materials capable of withstanding hundreds—or even thousands—of mating cycles. Others do not.

Can the wiring media be exposed to its environment, or must it be encapsulated and sealed? Is the application controlled by military specifications or can commercial standards be applied? Can terminations be soldered, or is the speed of assembly, performance and maintainability of crimp and poke terminations required? Do EMI issues call for a shielded assembly, or can these requirements be safely ignored? These are just a few of the critical requirements that can dictate material choices and design compromises in interconnect cabling.

To continue this discussion on the ideal versus practical compromises, let's take a categorical look at the major stress factors affecting interconnect assemblies; again in the context of understanding when and where any deviation from the "ideal" is justified in the cable design.

THE COMPROMISE

- Mate and forget vs. repetitive mating
- Exposed environmental vs. enclosed mounting
- Commercial vs. military
- High power vs. signal (or combined)
- Crimp vs. solder
- Shielded vs. unshielded

The above picture depicts where this need for compromise often leads. Note the use of inexpensive expando braid for mechanical protection, secured in place with plastic ties. Note as well the absence of environmental sealing, EMI shielding or accommodation for high heat or other environmental stress factors.

Series 80 Mighty Mouse Cables with Various Forms of Mechanical and Environmental Protection

There's nothing wrong with this cable. In fact, we suspect it is appropriately designed for the application (we didn't build it). But clearly the engineer has embraced numerous compromises, or "trade-offs" from our "ideal," to get a cable assembly that meets the requirements of the application while managing costs.

Environmental and Mechanical Stress Factors that Impact Cable Design

Application environment and mechanics dictate the stress factors a cable or harness must endure. "Build to print" specifications often spell out cable assembly environmental and mechanical stress factors, desired materials and design.

Glenair's cable/harness engineering team can suggest design ideas, material types and fabrication processes that we know from experience best meet application needs. Below is a partial list of environmental conditions that Glenair cable and conduit interconnect assemblies can be purpose-built to withstand:

- **Fluid Immersion**
- **Chemical Resistance**
- **Abrasion**
- **Clamping**
- **Flame/outgassing**
- **Corrosion**
- **Impact/crush**
- **Shock and Vibration**
- **Temperature Cycling/Shock**
- **Altitude**
- **Fungus**
- **Pressure Extremes**
- **Pull Forces/Elongation**
- **Bend Radius**
- **Aging/UV Exposure**
- **Pull Strain on Conductors**

This list names the most common environmental and mechanical stress factors that impact cable design and material choices. Obviously the addition or

subtraction of such factors as fluid immersion, resistance to extreme temperatures, repetitive flex cycles and other such requirements would measurably impact cable harness material choices and other aspects of the cable's design.

User Ergonomics

Specific user requirements and ergonomic considerations contribute to material and design choices. The picture shows Glenair made cables with our Series 80 Mighty Mouse connectors on the Land Warrior Weapon System. Unique packaging, routing and user ergonomics must be considered as part of the design process. Attention to such factors as connector mating and unmating forces or the ability to manipulate connectors while wearing gloves distinguish well-conceived cables from the many poor designs found in tactical military and other mission-critical applications.

Electrical Performance Requirements

Electrical specifications dictate material and design decisions for wires, cables, connectors, shielding, and grounding. In specialty cable assemblies, such as coaxial or fiber optic, other considerations such as impedance or optical mode come into play. We will discuss wire and cable later, but it's important to note that these electrical requirements impact many material, design, fabrication and test decisions. For example, the percentage coverage of braided shielding, tape or other grounding materials ties to the desired level of electromagnetic protection as measured in decibels at a particular frequency range. This information and other electrical specifications (such as amperage per conductor, overall current rating and so on) are also critical to cable and harness design.

The "Custom Cable Harness Designer's Guide" on the following page summarizes the main specifications that must be addressed for cable design work to proceed in a timely manner. The more answers you can deliver in your initial analysis the faster the design process can be completed, and the faster the final assembly can be produced.

Custom Cable Harness Designer's Guide

Originator: _____

Title of Assembly _____

Project/Program _____

Working Environment:

- ☐ Shipboard
- ☐ Airframe
- ☐ Avionics
- ☐ Secure Communications
- ☐ Ground Support/Soldier System
- ☐ Armored Vehicle
- ☐ Rail/Mass Transit
- ☐ Space
- ☐ Missile Defense
- ☐ Telecommunications
- ☐ Industrial
- ☐ Down Hole/Oil Patch
- ☐ Other

Basic Harness/Assembly Description:

- ☐ Open Wire Harness
- ☐ Repairable/Jacketed
- ☐ Overmolded (MIL-M-24041 Materials)
- ☐ Metal/Fabric Overbraided
- ☐ Flex Circuit
- ☐ Conduit

Basic Physical Description:

- ☐ Single-Ended ☐ Double-Ended
- ☐ Multi-Branch
- ☐ Overall Length_____
- ☐ Dimensional Tolerance ± _____ %

Electrical Wire Description:

- ☐ Number of Conductors_____
- ☐ Conductor Material/Finish_____
- ☐ Insulation Material_____
- ☐ Wire Gage(s)_____AWG
- ☐ Wire Voltage Rating_____
- ☐ Twisted Pair
- ☐ Shielded Twisted Pair
- ☐ Coaxial
- ☐ Hybrid Optical/Electrical
- ☐ Standard Multiple Conductor Cable
- ☐ Other

Optical Fiber Requirements:

- ☐ Number of F/O Lines_____
- ☐ Single-Mode
- ☐ Multi-Mode
- ☐ Acceptable Optical dB Loss
  - ☐ ≤ .5 dB
  - ☐ ≤ 1.0 dB

Environmental Requirements:

- ☐ Non-Environmental
- ☐ Moisture Resistant
- ☐ Full Water Immersion
- ☐ Chemical/NBC Resistant
- ☐ Advanced Corrosion Protection
- ☐ IP67

Cable to Connector Interface:

- ☐ Direct Wire / Potted
- ☐ Strain-Relief Backshell
- ☐ Environmental Backshell/Boot
- ☐ Shield Termination Backshell/Boot
- ☐ Overmold Termination Assembly
- ☐ Other

Overall EMI/RFI Shield Requirements:

- ☐ Single Shield, Standard Coverage
- ☐ Double Shield, Maximum Coverage
- ☐ Other

Protective Jacketing Material:

- ☐ General Purpose Polyurethane
- ☐ Low-Smoke, Zero Hal "BlueJacket"
- ☐ Chemically Resistant Viton
- ☐ High-Flexibility Neoprene
- ☐ Other

Style and Class of Connectors:

- ☐ MIL-STD Connector Series
- ☐ Industrial Power and Signal
- ☐ Fiber Optic
- ☐ Ultraminiature Circular
- ☐ Ultraminiature Rectangular
- ☐ Class of Mating Receptacle(s)_____

High-Speed Serial Data Applications:

- ☐ 10/100BASE-T
- ☐ 1000BASE-T
- ☐ USB 2.0
- ☐ IEEE 1394

Special Considerations:

- ☐ Space-Grade
- ☐ RoHS Compliant Materials
- ☐ EMI/EMP Filtering
- ☐ Extreme Temperature Tolerance
- ☐ UL94-VO Flammability
- ☐ UV Resistance
- ☐ Field Repairability
- ☐ Crush/Abrasion Resistance
- ☐ NASA-STD-8738 Crimping/ Soldering

Alternative Wire Protection Media:

- ☐ High Flexibility Convoluted Tubing
- ☐ EMI/EMP Metal-Core Conduit
- ☐ Molded Shrink Boots
- ☐ Junction Boxes and Cable Bays

Identification Method:

- ☐ Heat Shrink Band
- ☐ Nylon Band
- ☐ Hot Stamp
- ☐ Other

Electrical Tests:

- ☐ Hi-Pot ☐ VAC
- ☐ Insulation Resistance

Glenair®

Lightweight, Flexible, Crush-Resistant

WIRED CONDUIT ASSEMBLIES

Someone once said, "there is more than one way to skin a cat." Well, nothing could be more true when it comes to material selection for wire and cable protection. Glenair has worked with customers worldwide to design literally thousands of wire and circuit protection systems that leverage our unique array of high-performance conduit and convoluted tubing materials instead of standard cabling and jacketing. Depending on the requirements of the application, we often recommend lightweight PEEK tubing, helically wound with stainless steel wire for outstanding crush and pull resistance, and terminated with aluminum or composite fittings, hardened against all classes of environmental, mechanical or EMI damage. In other applications we might propose our metal-core conduit with its outstanding EMC performance and crush resistance.

Whatever the protection requirement, from extreme temperatures to repetitive flex, Glenair offers a conduit- or convoluted tubing-based wire and circuit protection solution that can outlast and outperform even the most aggressively armored cable. And we do it with innovative and/or QPL'd materials that are manufactured and stocked in-house for the best availability in the industry. Best of all, our conduit and convoluted tubing assemblies can be supplied wired, terminated, tested and ready for immediate application. Our wired conduit material solutions include:

- Various configurations of high-temperature polymer plastic tubing systems (PFA, FEP, ETFE, PTFE, PVDF and PEEK), together with a host of fittings, transitions, adapters and other accessories used in routing and termination.
- Flexible metal-core conduit systems in brass, nickel-iron, and stainless steel; again with a whole host of appropriate shielding materials, fittings and accessories used to incorporate connectors, feed-thrus and other devices into the system.

Glenair Bespoke, Made-to-Orde

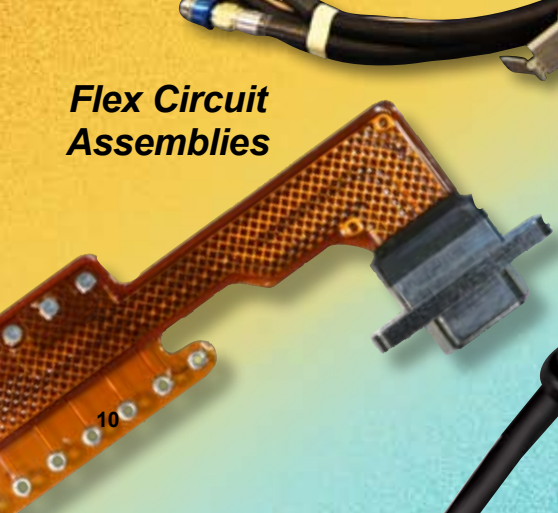
Nobody tackles the wide range of customer bespoke cable opportunities like Glenair. With cable assembly operations in Glendale, Mansfield and Bologna, Glenair is perfectly positioned to compete for even the most complex custom harness and assembly work. From ultra-miniature micro and nano connector harnesses to our signature overmolded and fiber optic assemblies, Glenair has become the go-to wire harness and assembly shop for demanding military and commercial cable assembly applications.

F/A-18 Radar Pantograph Assembly

F/A-18E/F APG-79 Radar Assembly

ASAP Fiber Optic Assemblies

Flex Circuit Assemblies



Glenair ASAP O

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Harsh Environment Geo-Marine Assembly

ASAP Micro Wire Harnesses

High-Speed ASAP Mighty Mouse Molded Cordsets

ASAP High Speed Cables

ASAP Wired Conduit Assemblies

Not to be outdone by the custom side of the business, Glenair's team of talented cable assembly designers and fabricators have developed a wide range of standard catalog solutions to common point-to-point cable requirements. For applications that can benefit from faster turnaround and the specification of highly-available catalog products, Glenair offers a complete line of "ASAP" cable assemblies with simple catalog-based ordering. Choose from EMI hardened Micro-D assemblies, point-to-point wired conduit assemblies, molded high-speed Mighty Mouse cables and even tactical fiber-optic solutions—all with the convenience and speed of straight-from-the-catalog ordering.

ff-the-Shelf Cable Assemblies

GLENAIR'S CABLE ASSEMBLY RODEO ROUNDUP

OPEN WIRE BUNDLE ASSEMBLIES

If tight spaces constrain wire routing, open wire cables are ideal. These unjacketed cables are usually less expensive than jacketed or overmolded harnesses, and are designed for use in enclosures, equipment housings, behind sealed bulkheads or in airframe applications where wire circuitry is effectively protected from outside elements by the aircraft body.

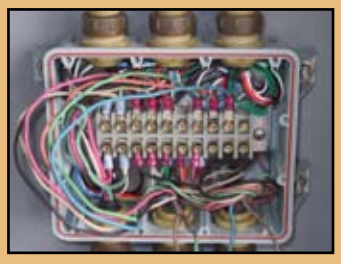
The pictures on these pages show some classic examples of unshielded open wire bundle assemblies used inside of cable junction boxes and other protected environments. This low-cost cable design is obviously also chosen for non-EMI hardened applications, or when EMI shielding is handled by the box or equipment enclosure.

Open wire bundle assemblies sometimes use Kapton tapes and films to organize wires and cables. Since there are many other cable management products of this type, the engineer's principle interest is typically to ensure appropriate steps are taken to protect the assembly from surface abrasion, assist in routing, and prevent damage from handling, corrosion, creep or other potential sources of trouble.

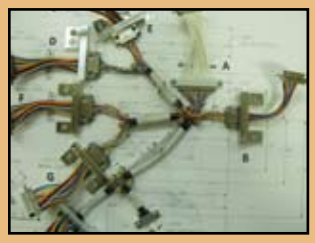
Open wire bundles and unjacketed cables are the most common type of assembly in noiseless applications with negligible crosstalk from adjacent wires. Many data transfer applications utilize open wire bundles with individual signal wires, tightly twisted pairs, or even twisted shielded pairs managed with tie-wraps.

OPEN WIRE BUNDLE CABLES USED IN INTERNAL BOX WIRING AND OTHER ENCLOSED SYSTEMS

- Low Cost Compared to Overmolded or Jacketed Solutions
- Field Repairable
- Non-Environmental
- Not Particularly Durable



LIGHTWEIGHT AND FLEXIBLE OPEN WIRE BUNDLE CABLE HARNESSES



- Appropriate where no Noise or Crosstalk or Adjacent Wires is Expected
- Prevalent for Data Transfer with Tightly Twisted Pairs
- Shielded Pairs Might be Inside of an Unshielded Cable Assembly
- Great for Awkward Routing Challenges

MANAGEMENT OF OPEN WIRE BUNDLES

- Wrap/Tapes
- Cable Ties
- Cable Clips
- Spiral Wrap
- Split Tubing
- Expando Braid

Open Wire Bundle Assemblies

For Non-Environmental Applications

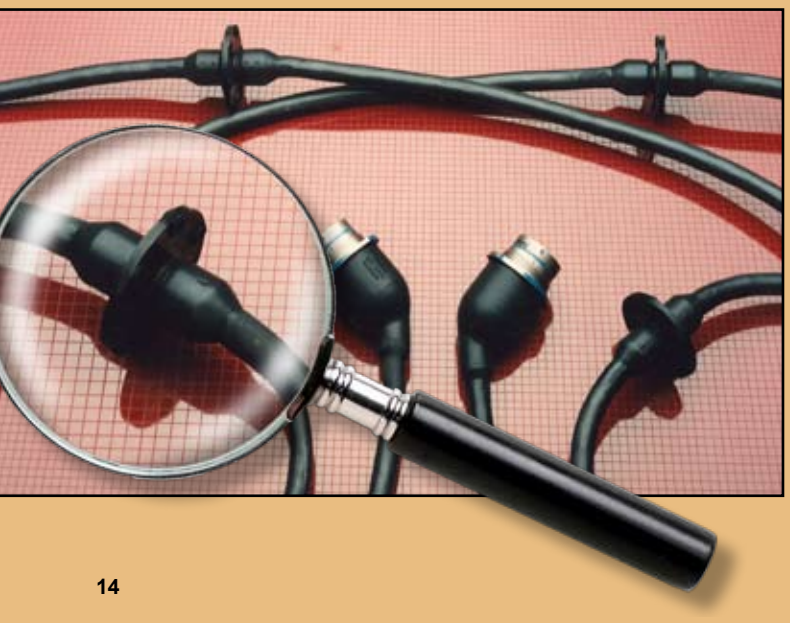
For interconnection of electronic elements within the protective confines of a box or equipment housing

For non-environmental applications with little or no requirement for mechanical reinforcement or overall EMI shielding

GLENAIR'S CABLE ASSEMBLY RODEO ROUNDUP

NON-CONNECTOR FEED-THROUGH ASSEMBLIES

Not all interconnect cabling needs to be connectorized. Feed-through cables, such as the designs shown here, are commonly specified when direct termination to a terminal rail or other circuit is possible, such as in systems that do not require periodic/convenient connection and disconnection of electronic devices.

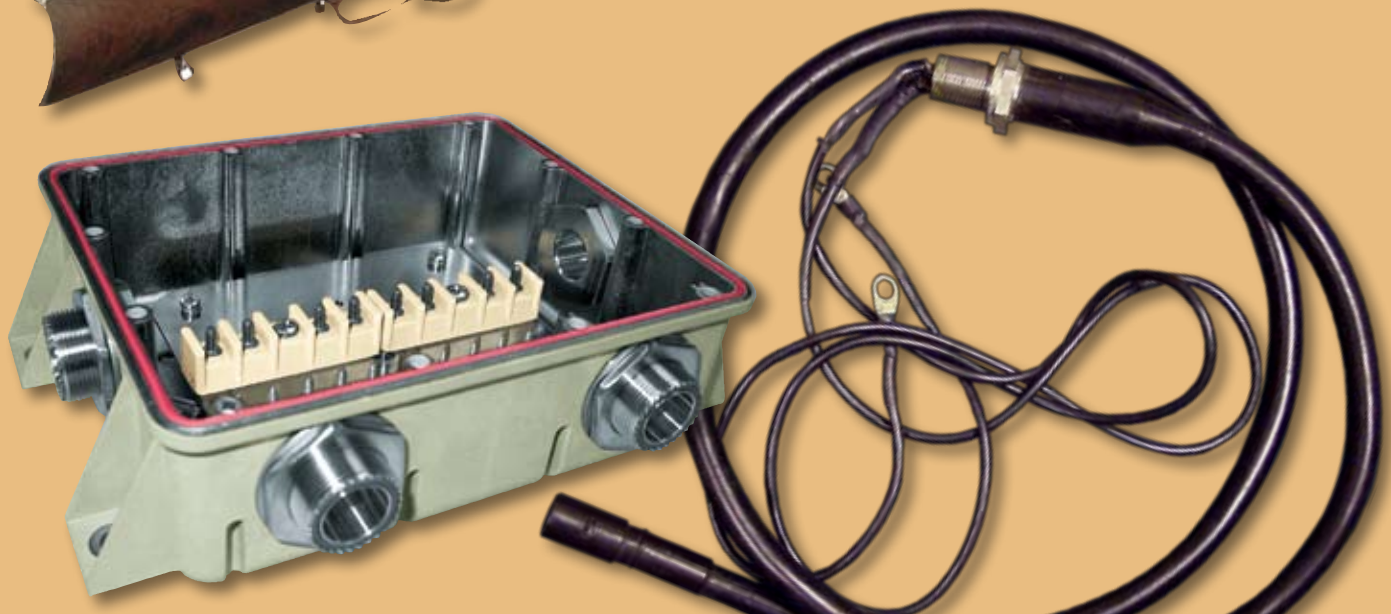


The manufacture of the interconnect hardware, backshells, feed-throughs, connectors, coupling technologies and so on that go into our high-reliability cable assemblies is under the direct supervision of Dave Glenn—now celebrating his 35th year with Glenair (see the Outlook column for QwikConnect's salute to Dave and Glenair's host of veteran interconnect industry employees).

Feed-through cabling can utilize elastomeric elements molded directly into the cable, such as the bulkhead fittings in F-16 fuel cell cable lower left, or backshell type components that provide the necessary sealing and EMI shield termination where the cable enters a box or passes through a bulkhead. In either event, Glenair can design and fabricate cable assemblies for feed-through type applications that do not use connectors at every point of attachment.

WIDE SELECTION OF FEED-THROUGH FITTINGS

Feed-through fittings, fabricated by Glenair from metal materials as well as lightweight composite thermoplastics play important roles in non-connectorized cable assemblies.



Feed-Through Cabling

For Non- or Partially-Connectorized Applications

GLENAIR'S CABLE ASSEMBLY RODEO ROUNDUP

"REPAIRABLE" JACKETED/SHIELDED CABLES

Backshell equipped jacketed and shielded cables provide excellent environmental sealing and EMI protection. Braided shielding, tape or other materials can be added to twisted pairs or multi-conductor cables for conducted EMI prevention.

Glenair can make virtually any cable to order with exact customer jacketing, shielding, and conductor specifications.

Jacketing can be directly extruded onto cables, or blown on, depending on the environmental conditions anticipated and cost considerations. A fully-sealed cable offers good tamper resistance. The standard, jacketed cable, equipped with appropriate accessories such as simple strain-relief clamps, is a relatively inexpensive and easy way to ensure mechanical, electrical and environmental reliability for interconnect cables used in exposed environments. The best environmental seal and mechanical protection is provided by jacketing that is extruded directly on to the cable. Jacketing can also be "blown on" by using compressed air to expand soft tubing, inserting the cable, and then allowing the tubing to collapse on to the cable for a sealing fit. A wide variety of materials can be used for jacketing, depending on the performance requirements of the application.

Heat shrink tubing is a fast and inexpensive way to encapsulate the entire length of a cable run, particularly for prototypes or short point-to-point cables. Another application for heat-shrink tubing, of course, is the encapsulation of just the cable-to-backshell-to-connector junction.

BACKSHELL EQUIPPED FOR EXTERNAL HARSH ENVIRONMENTS

- **Shields added to twisted pairs, or multi-conductor cables help prevent EMI (victim or source)**
- **Jacketing extruded, shrunk or blown on**
- **Types of jacketing based on environmental conditions such as immersion, chemical or caustic fluid exposure, corrosion potential, temperature or radiation exposure**
- **User installable backshells aid in ongoing maintenance and field repair.**

SHRINK BOOTS FOR ADDITIONAL SEALING AND STRAIN RELIEF

- **Boots provide strain relief for wiring exiting a backshell or connector.**
- **Enhances sealing of cables to backshells or connectors under environmental exposure.**
- **Aids in organizing wiring to specific routing angles.**
- **Used for cable breakouts where one cable branches out to 2, 3, or 4 separate cables.**
- **Aids in resealing field repaired cable or conduit connector assemblies.**

Glenair's cable operation is uniquely positioned to supply design and engineering advice on repairable, backshell-equipped cable assemblies given our status as the world's largest manufacturer of circular and rectangular backshells. Our backshell and shrink boot capabilities allows us to offer faster turnaround on assemblies that rely on these mil-standard and commercial equivalent connector accessories.

GLENAIR BACKSHELLS FOR "REPAIRABLE" JACKETED AND SHIELDED CABLES

High Performance Jacket Materials

MATERIAL PROPERTY	EPDM (Ethylene Propylene EPM)	HYPALON (Chlorosulfonated Polyethylene)	NEOPRENE (Polychloroprene)	VITON (Fluorine/ Hydrocarbon)
Temperature Range	-60°F to +300°F (-51°C to +149°C)	-60°F to +300°F (-51°C to +149°C)	-60°F to +250°F (-51°C to +121°C)	-40°F to +392°F (-40°C to +200°C)
Specific Gravity	1.26	1.18	1.25	1.80
Weight: Lbs./Cubic Inch	.045	.043	.045	.055
Abrasion Resistance	Excellent	Excellent	Excellent	Excellent
Wear Resistance	Good	Good	Good	Good
Flame Resistance	Good	Good	Good	Good
Sunlight Resistance	Good	Excellent	Excellent	Excellent
Chemical Resistance:				
Aliphatic Hydrocarbons	Good	Good	Good	Excellent
Aromatic Hydrocarbons	Good	Fair	Fair	Excellent
Ketones, Etc.	Good	Poor	Poor	Poor
Oil & Gasoline	Good	Good	Good	Excellent

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GLENAIR'S CABLE ASSEMBLY RODEO ROUNDUP

OVERBRAIDED CABLE ASSEMBLIES

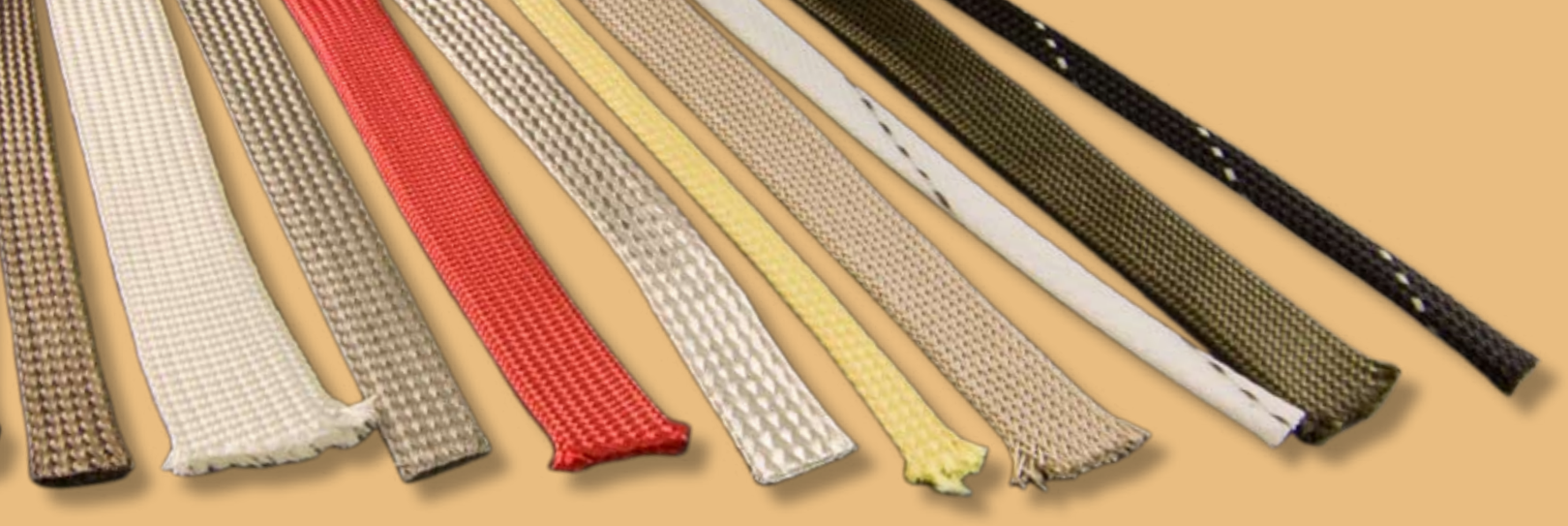
Let's move on now to cable assemblies that use textile or metal braid material as their principle wire protection material.

Metal and textile braid serves many important functions. In addition to EMI shielding and enhanced pull strength, these materials can provide protection from chemical, abrasion and heat damage. Textile braid allows drainage to keep infiltrations from affecting connector performance. Textile braid products are organized according to material types with performance attributes such as high-temperature resistance, weight reduction, and overall strength being the most important factors that affect the relative cost and performance of the products.

The material can be overbraided at the factory to a cable or wired conduit assembly or supplied in a bulk tubular format for installation by the customer. Glenair supplies a unique braided material, called AmberStrand® that combines the conductive EMI shielding properties of metal braid with the weight reducing attributes of high-strength composite thermoplastic.

Many textile materials are relatively inexpensive polymer products, such as the E-CTFE material (trade name Halar). Others, such as AmberStrand® are composite thermoplastics with advanced levels of mechanical and electrical performance as well as enhanced

Glenair's in-house braiding operation is truly impressive with the largest capacity of braiding equipment West of the Mississippi. Over 50 total braiders, ranging from 16 to 96 carriers, provide the capacity to produce and stock virtually unlimited quantities of textile and metal braid material.



Metal braiding materials used at Glenair include bare copper; copper weld; copper plated with tin, nickel or silver; bronze; stainless steel; nickel plated stainless steel; and copper covered steel.

temperature tolerance and weight reduction. All the textile braid solutions provide good to excellent abrasion protection. Most, with the exception of nylon, provide good to excellent chemical resistance. Kevlar is by far the strongest material. Tubular textile braids, in materials such as polyethylene and Halar, are very flexible and reduce cable abrasion. During installation, the braid is expanded to accommodate entry of unsealed cable before collapsing for a snug fit.

For higher-performance applications, advanced, non-metal braid material is available in PEEK, Teflon, Kevlar, Dacron, Nomex, FEP, Ryton and polyimide. Again, when requirements demand maximized heat-resistance, weight reduction, strength or other parameters, it is appropriate to specify these higher-performance non-metal braids. Otherwise, for basic wire management and abrasion protection the standard material choices are sufficient.

Tubular metal braid affords excellent strength enhancement and EMI shielding of wire conductors. Conductive braid can be terminated to backshells and/or connectors for the purpose of grounding by soldering, banding or other mechanical means according to the assemblies' exact grounding specifications.

Shield sock versions, in which the braided material is factory-terminated to the cable-clamp accessory greatly simplifies subsequent assembly. Cable braid shields can be slipped over wiring or directly overbraided onto the cable assembly. Multiple braid layers further enhance tensile strength and EMI protection by reducing line-of-sight penetration.

Overbraiding specifications typically call for a 95% level of optical coverage of the protected cable. Doubling of braid layers provides some additional coverage, perhaps as much as 97 or 98%, by eliminating braid apertures.

GLENAIR'S CABLE ASSEMBLY RODEO ROUNDUP

OVERMOLDED CABLE ASSEMBLIES

Let's turn the discussion now to overmolded type cable assemblies. Overmolded terminations and transitions provide the ultimate environmental seal. The encapsulating material vulcanizes with the cable jacketing to form a total seal against liquid or dust incursions.

Mold tooling is highly specialized to accommodate the precise application. Integration of mounting brackets and other hardware enhances the utility of the assembly. Overmolding is extremely tamper resistant.

Overmolding is ideal for applications that place cable assemblies in harsh chemicals, such as jet fuel. Jacketing and mold materials can be specified from a range of options (including IAW MIL-M-24041) to afford maximum protection for even the most complex multi branched assembly.

Overmolded cable assemblies are by far the best solution for systems that require maximum levels of environmental and mechanical protection.

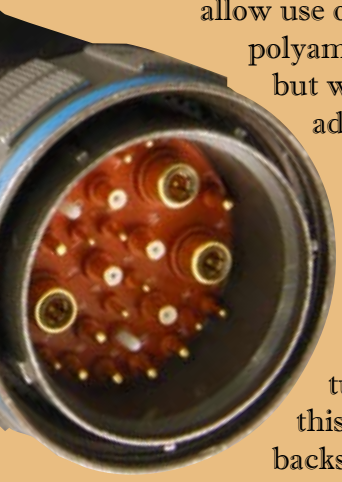
The connector and cable juncture of this aerospace assembly is protected and sealed with ruggedized injection overmolding. Note the conical cross-section of the overmold provides outstanding strain-relief and eliminates stress risers. In this assembly, a shield termination backshell provides and a bonding point for the molding material and a termination platform for the EMI shielding. The overmolding material, in this case polyurethane, provides outstanding environmental and physical protection of circuits at the critical wire-to-contact juncture.

At the innermost layer of a typical overmolded cable construction, wound insulated wires are taped with Mylar, double overbraided with 36 gage tin-plated copper wire, taped again, and finally covered with a thin-walled elastomeric jacketing. Overmold materials are carefully selected to vulcanize with the elastomer jacketing.

State-of-the art equipment and production systems add speed and reliability to the overmolding process. In this photo, a skilled technician is prepping a Series 80 Mighty Mouse cable for overmolding.

Traditional overmold tooling requires manual injection of heated, liquefied plastic material into the closed, heated tool. The material is pumped in until the cavity is completely filled. Heat is continuously applied to tooling for a prescribed period. The tool is dismantled, the overmold workpiece removed and flash, if any, is carefully trimmed away.

Automated overmold machines reduce cycle time significantly, enhance reliability and allow use of even more materials such as polyamide which is less expensive but with performance that is adequate for many applications. Large quantity overmolded cable assemblies that principally utilize standard connector and accessory products can be quoted and delivered with extremely rapid turnarounds using equipment of this type. Often, a special banding backshell is used in the overmolding process for easy shield termination and attachment of the molding material. There are a wide number of potential choices in this area, including backshells that accommodate multiple shield terminations.



Sealed, overmolded cables are ideal for aerospace applications, such as F-18 and V-22, where space is so limited that the only cable routing option available is through the fuel cell. Viton jacket and connector overmold materials allow harnesses to perform in this caustic environment without risk of damage for the life of the aircraft. Glenair has built tens of thousands of interconnect cables for extreme environmental applications of this type.

Overmolded cable assemblies are extremely durable. Pre-potting of the connector termination provides additional resistance to damage.

Hybrid fiber optic and electrical cable assemblies are ideally suited for final encapsulation of the cable to connector junction with Viton® to protect the assembly from both mechanical stress as well as caustic chemical damage.

OVERMOLDING ADVANTAGES

- **Waterproof sealing**
- **Robust mechanical protection**
- **Protection of terminations**
- **Chemical resistance**
- **No induced cold flow stress**
- **Electrical isolation and insulation**
- **Reduced wear damage**
- **Flexible routing/cable entry**
- **Superior sealing performance compared to standard shrink boots**
- **Tamper proof**

GLENAIR'S CABLE ASSEMBLY RODEO ROUNDUP

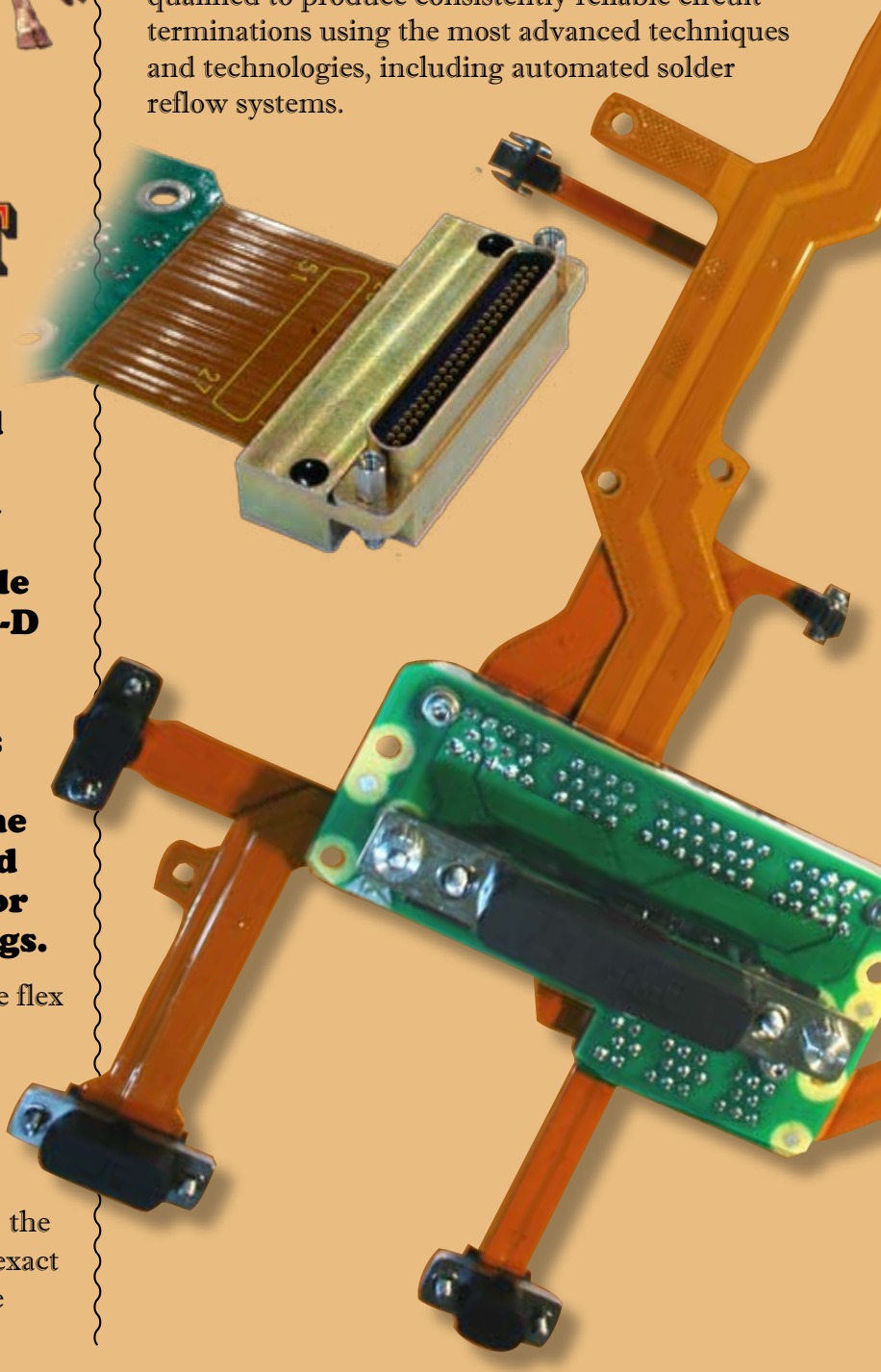
MICRO/NANO FLEX CIRCUIT ASSEMBLIES

Unsurpassed experience and expertise in Micro/Nano flex circuit production is a fair description of Glenair's UK cable facility. Our Mansfield cable shop has been integrating Micro-D and Nanominiature connectors into flex circuitry for over 30 years. Our technical capabilities include design and layout of turnkey assemblies as well as the production of custom-configured micro and nano interconnects for maximum size and weight savings.

Our turnkey Micro-D and Nanominiature flex circuit assemblies are produced to exacting specifications. Customer-supplied designs are reviewed and revised to insure the most advantageous utilization of EMI shielding, polarization, strain-relief and connector packaging technologies. At Glenair, the final design solution is optimized to meet the exact mechanical and electronic requirements of the application environment.

Glenair's full spectrum flex circuit capability extends to all types and classes of connectors, but we excel in miniaturized printed circuit board systems that utilize our own high-reliability Micro-D and Nanominiature connectors. For printed circuit board applications, we supply both through-hole and surface mount designs in every angle and mounting style for integration into single-sided, double-sided and multilayered flex circuitry.

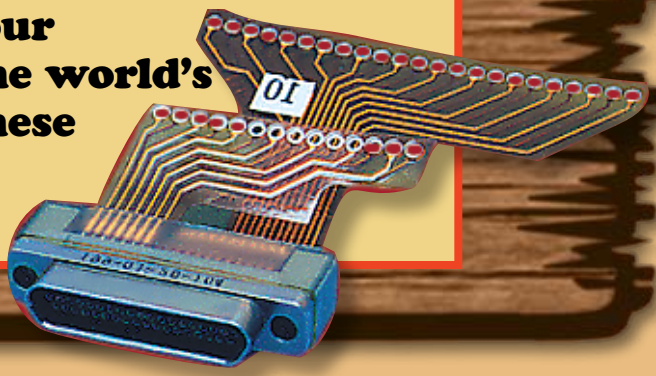
Glenair's experienced workforce is trained and qualified to produce consistently reliable circuit terminations using the most advanced techniques and technologies, including automated solder reflow systems.

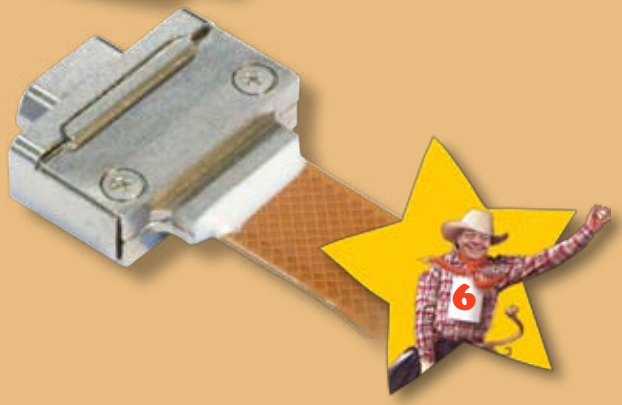


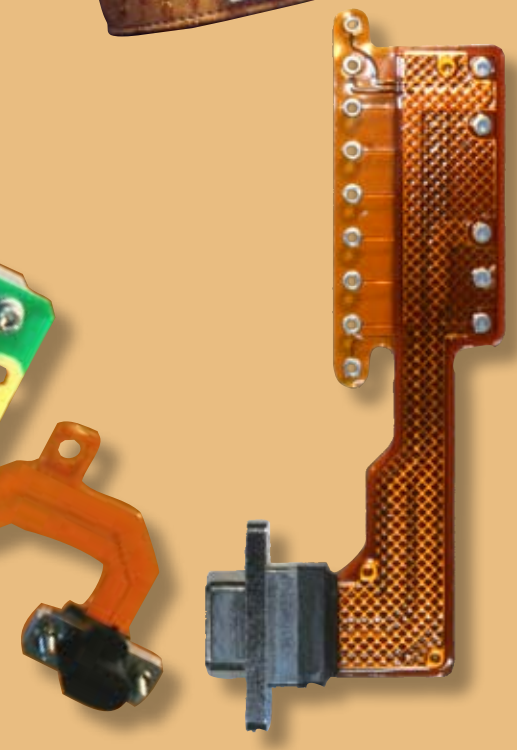
Micro and Nano Flex Circuit Assemblies

Superior materials and design expertise help make Glenair UK the world's premier high-reliability flex circuitry assembly facility

Glenair's unique status as a qualified manufacturer of MIL-DTL-83513 Micro-D and MIL-DTL-32139 Nano Connectors enables our cable shop to offer the world's fastest delivery on these high reliability flex assemblies.







Some select examples of customer bespoke flex circuit assemblies. Note the use of both standard as well as highly-customized micro and nano connectors. Glenair is unique in our industry as we manufacture the connector component parts and stock the most common part numbers for fast quoting and delivery.

Outlook

Outstanding in His Field

I'd like talk a little about Glenair "staff retention." Simply put, folks here tend to stick around a long time, and this quarter we will celebrate some truly significant anniversaries, including Ron Platz in our sales department—current tenure champ—with 50 years of service; Engineer Pat Oakes and Human Resources Director Orlando Bernal, both with 30 years; On the production team, Orlando Rivas, Jeronimo Rosales, Manuel Munoz and Shu Hsuan Hu are each reaching 30 years, while Joann Sprankle, James Nguyen, and Javier Romero are hitting 25 years of service. These folks have all made significant contributions to Glenair's success, and I want to thank them publicly for their many years of loyalty and hard work: Well Done!

But I'd also like to single out one individual for special recognition. The production side of our business is largely invisible to our customers, yet it's key to our commitment to be "First with the Most." In a constellation of bright lights, David Glenn is truly a Super Star. Celebrating 35 years with Glenair this January, Dave manages factory production—a veritable solar system of activities that must be held in perfect balance to keep our universe from flying apart. The many planets and moons orbiting Dave include blanking, machining, die casting, plastic injection molding, in-process inspection, plating, assembly, stock picking, ID marking, packing, final inspection and shipping.

It would be challenging enough if all Dave had to do was just make sure each of these functions was accomplished for regular production orders—but he's also faced with dozens of "hot" or expedited jobs competing for resources and favorable position in the queue on a daily basis. It's the kind of pressure that forms diamonds. And that's our Dave—a "diamond" who never fails to be pleasant and positive while calmly managing a frenzy of production activity. Dave inspires his team do their best because they *always* see him cheerfully working hard and consistently delivering the goods.

I was rummaging through Dave's personnel file for interesting historical artifacts, and I found a doozy. His first performance review on August 1, 1975, just seven months after he was hired as "Shipping and Receiving Clerk," noted his "high merit" for which he received a 4% raise (from $2.75 to $2.85 per hour!). Three-and-a-half decades later, Dave continues to earn the highest possible marks and we all take great pride in having him as our colleague.

It's become trite for business leaders to extol their employees as their "greatest asset," sometimes mere months before implementing massive layoffs to buoy the share price underlying their executive stock options. Despite the potential for cynicism, let me state it clearly: At Glenair we truly cherish every member of our team, especially the long-tenured folks who have made so many important contributions to Glenair's success. And there is no better exemplar than Dave Glenn. Congratulations, Dave, on 35 years of fun and accomplishment. Here's to many more!

QwikConnect

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