QwikConnect

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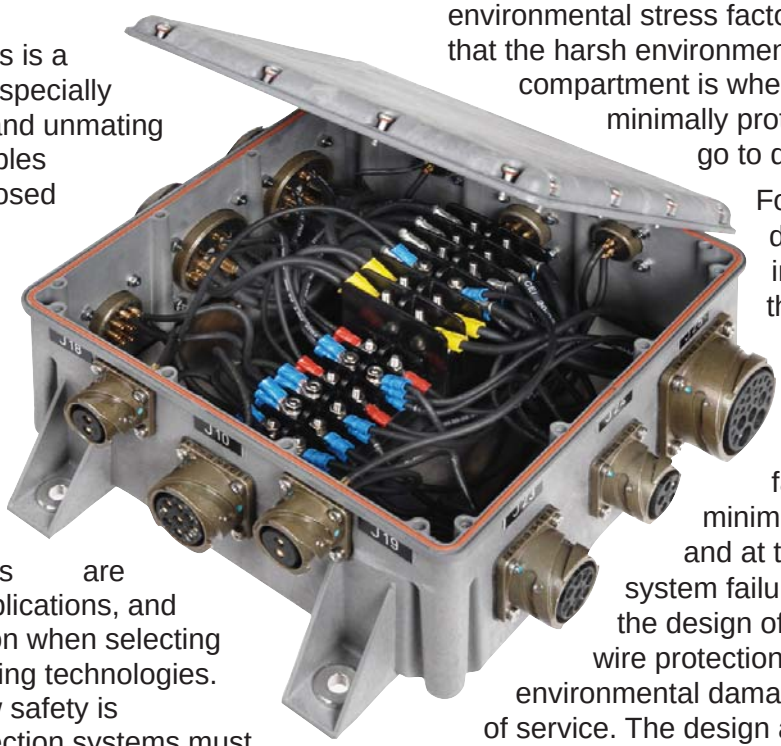
Take The "A" Train!

Glenair Has the Connectors, the Cables and the Expertise to Solve Even the Toughest Rail Industry Interconnect Challenges

Take the "A" Train:
Connectors, Cables and World-Class Interconnect Expertise Arriving Now on Track 5015!

At their most basic level, rail system interconnect design challenges are similar to other transport modes. Reducing weight is a critical issue, especially for high-speed and Maglev rail systems. Shielding electromagnetic interference is important, especially in sensitive electronic systems such as engine monitoring and diagnostic sensors. Basic mechanical protection of cables, conductors and contacts is a standard requirement especially when frequent mating and unmating is required, or when cables are routed through exposed intercar or undercar locations. To ensure rapid and accurate car linking and cabin reconfigurations, interconnects must be easy to couple and keyed to avoid mis-mating. Vibration, shock and connector decoupling problems are also common in rail applications, and require focused attention when selecting shell materials and mating technologies. As passenger and crew safety is paramount—interconnection systems must not compound flammability, smoke or toxicity risks.



But make no mistake: the overriding challenge is environmental. Rail and transportation systems represent one of the most challenging environments for the long-term survivability and reliability of interconnect cables and assemblies. From high-speed rail transportation systems to heavy railway freight lines, the standard daily fare of the rail industry is one harsh environmental challenge after another.

Electrical and signal interconnections in rail car linkages, for example, are subject to significant environmental abuse. Undercar cables, exposed to splashing, mud, diesel exhaust and high heat, require extremely robust environmental protection. Locomotives are brutal testing grounds for cable systems which are subjected to hot oils, solvents, and fuel spills, not to mention high heat and other environmental stress factors. In fact, it's fair to say that the harsh environment of a locomotive engine compartment is where poorly designed or minimally protected interconnect cables go to die.

For this reason, the art of designing rail industry interconnect cables that provide long-life and value depends on a comprehensive understanding of the environmental stress factors that can, at a minimum, diminish performance, and at their worst lead to complete system failure. Glenair is expert in the design of cable, box and conduit wire protection systems that prevent environmental damage and ensure longevity of service. The design and manufacture of environmentally sealed connectors, backshells and other components that keep interconnect systems free of corrosion has been our bread-and-butter business for over 50 years.

This issue of *QwikConnect* presents an overview of the Glenair interconnect technologies that are specifically geared for use in rail systems. From the composite interconnect junction box pictured above, to our comprehensive family of harsh environment power and signal connectors, Glenair is perfectly positioned to address every rail industry interconnect

Connectors and cables see tough, environmental duty in rail applications. Poorly sealed products, or those made from inappropriate materials, can lead directly to system failures.

challenge. In fact, we've built interconnect cables, junction boxes and conduit assemblies for virtually every rail industry sub-system including:

- Automatic Train Control (ATC) Systems
- High Temperature Engine Controls and Sensors
- Speed Sensors
- Diagnostics
- Braking Systems
- Antiskid Systems
- Traction Motors
- Converters
- Couplers
- Pantographs
- Electronic Monitoring and Diagnostic Systems
- Intracar/Intercar/Undercar Cabling Systems
- Radar and Rail Navigation Systems
- Radio Communications Systems
- Data Systems
- Rail Car Lighting and Security Systems
- Climate Control for Passengers and Freight
- Battery Chargers
- Door Control Systems
- Equipment and System Bonding Systems
- Cabin Video, Phone, and Internet Systems
- Way-Side Signaling
- Track Controls
- Trackside Safety Systems

Down By the Station: The Explosive Growth of the Rail Industry

Urban and inter-urban rail transportation is growing rapidly as cities seek to ease traffic congestion, reduce highway wear and tear, and curb air pollution. Freight shipping by rail has grown twice as fast as trucking since 2002. For example, about 42% of all US freight, some 5 billion ton miles per day, now moves by train. Fuel efficiencies and other cost factors are driving this growth. Diesel fuel was formerly so cheap that point-to-point trucking had a huge advantage over rail in freight movement. But in the past ten years, diesel prices have risen by over 400%. According to the Association of American Railroads, rail fuel efficiency has improved 72% since 1980 when a gallon of diesel moved a ton of freight an average of 235 miles by rail. By 2001, that figure increased to 406 miles per gallon. Another measure of fuel efficiency, revenue ton-miles per gallon (RTMG), or fuel consumption associated with loaded miles, shows Class 1 rail RTMG is four-and-one-half times better than truck RTMG.

In addition to fuel economy, rail transportation's air quality and pollution emission credentials are superior to trucking. The US Environmental Protection Agency (EPA) estimates that a typical truck emits roughly three times the particulates per ton-mile than a locomotive. The EPA also notes that railroads account for less than 5% of total transportation particulates, even though railroads

Urban and inter-urban rail transportation continues to grow at a steady rate on a worldwide basis.

account for almost half of the nation's freight ton-miles. Of course rail will never entirely replace point-to-point trucking. But it is clear that rail will continue to play an increasingly important role in freight movement.

The ongoing growth of the intermodal form of freight shipping has contributed to the recent success in rail freight. In an intermodal transportation network trains and trucks are connected in a seamless system which combines the efficiency of rail with the convenience and flexibility of trucks. Also called "Piggy-back" or "containerized" shipping, intermodal shipping rates are typically 15% to 20% below trucking for comparable freight movements. Initially, intermodal freight hauling consisted of the piggybacking of highway trailers on flatcars (TOFC), which the Southern Pacific Railroad pioneered in 1953. By 1958 the practice had been adopted by 42 railroads. By the beginning of the 1980's, U.S. railroads were recording more than two million piggyback carloadings a year. According to the Association of American Railroads (AAR), rail intermodal traffic tripled in the United States between 1980 and 2002, from 3.1 million trailers and containers to 9.3 million. In Europe, stricter railway height restrictions (smaller loading gauge and structure gauge) and overhead electrification prohibit containers from being stacked two high, and containers are hauled one high—either on standard flatcars or other railroad cars.

Intermodal shipping combines the efficiency of trains with the flexibility of trucks.

Next Generation Rail Transport

The latest generation of passenger trains are as sophisticated as commercial jets. New locomotive control panels are as jam-packed with system controllers, sensors, gauges, and equipment as any modern airplane cockpit. The power and signal linkages within and between cars on modern commuter trains constitute one of the more complex interconnect cabling systems in existence. The interconnect cables used to service exterior and interior lighting systems, passenger and freight climate controls, and passenger services such as video, phone and Internet, rival in complexity those found in the most sophisticated wide-body passenger plane.

Glenair has been selected by the leading manufacturers of today's most modern metro and commuter rail systems to supply our complete range of ruggedized connectors, conduit wire protection systems, earth bond connectors and other rail industry interconnect solutions for a broad range of rail projects and programs.

Working On the Railroad: Glenair Commital Connectors and Cables Are Ready to Roll!

On new rail applications as well as retrofits of existing rolling stock, manufacturers face contractual penalties for railway system "down-time." Cost-conscious designers are therefore motivated to choose interconnects and interconnect cabling that deliver reliable performance. For this reason, high-reliability suppliers like Glenair—whose products take into account the total cost-of-ownership over the full life of the system—are increasingly sought out for design assistance and fabrication.

In addition to our work designing interconnect products for new rail applications, Glenair has a long track-record of solving problems in existing systems undergoing periodic mid-life overhauls. During the overhaul process designers sometimes take the opportunity to enhance functionality and improve performance in both locomotives and rail cars. Often these design improvements require changes in power and signal interconnect cables and hardware. When retrofitting existing locomotives, switches, gages, indicators and sensors must fit into existing control panel real estate. Consequently, overhaul designers sometimes require reduced interconnect package size or better solutions for the routing and attachment of cable harnesses. Glenair is well positioned to assist in this work as we are the only manufacturer in the business that both produces the individual interconnect components, and supplies complete wiring and cabling services as well.

Glenair is first and foremost a component manufacturer. We supply the rail industry with connectors and backshells such as our ITS Series (VG95234 qualified) and MIL-C-5015 type power and signal products. We also manufacture EMI/RFI composite junction boxes, earth bonds, high-performance fiber optic connectors and cables, and a host of other discrete interconnect components designed specifically for use in rail applications. In 2005 Glenair further cemented its position as a top-tier rail industry interconnect provider with its acquisition of Commital S.p.A..

Commital, from its base in Bologna, Italy, has supplied the rail industry with a broad range of high reliability interconnect products for over thirty-years. Well known throughout Europe, Commital's commitment to customer service, quality and product availability are a perfect complement to Glenair's standard business approach which emphasizes high-availability and customer service. But rail customers often require assistance not only with the connectors themselves, but with integration of the components into well-designed conduit and cable assemblies. This is an area of particular expertise at Glenair, where our background in the production of interconnect cable harnesses, junction box systems, and conduit wire protection assemblies enables us to perform a vital role in the complete design and implementation of complex interconnect systems. The following pages present an overview of the many individual connector products manufactured by Glenair's Commital division for direct application in rail interconnect systems, and/or for integration into factory assembled harnesses and assembies.

State-of-the-Art Connector Manufacturing in Italy

Before joining the Glenair family, Commital had a thirty-year history as one of the top providers of ruggedized power and signal connectors for military, industrial, entertainment, telecom and rail applications. Headquartered in Bologna, Italy, Glenair Commital is certified to UNI EN ISO 9001, NATO AQAP110, and various VG product qualifications.

In over 60,000 square feet of production space, a highly skilled and educated workforce runs a modern robotic factory with automated parts picking and assembly.

Commital conducts its own qualification testing including salt spray, humidity cycling, vibration and shock, thermal shock, dielectric values, insulation resistance, and current ratings. “Green” plating facilities employing environmentally sensitive processes round out the manufacturing operation.

The main product line manufactured and assembled in Bologna is power and signal connectors qualified to the VG 95234 specification. These MIL-C-5015 type connectors are designed with reverse bayonet couplings and are intended for use in rail, transportation and military vehicle applications.

North American Assembly

Commital’s volume production capabilities allow Glenair to perform final assembly operations both in Bologna and in North America. Final assembly of Series ITS and other connector families in North America are completed in Glenair’s main factory in Glendale and also by our value-added distributor, Avnet.

The Glenair ITS connector series features over 200 power and signal insert arrangements. Based on the MIL-C-5015 standard, ITS features an improved reverse bayonet coupling technology in place of the standard threads used in MIL-C-5015. The 3-point bayonet mechanism reduces coupling time and provides easier mating, especially when the connector is in an awkward position. Positive

Glenair's Commital Connector Division produces a wide range of reverse-bayonet style connectors ideally suited for rail applications (Series ITS shown).

locking of the three stainless steel pins provides reliable resistance to vibration and shock, and prevents connector de-coupling in even the most rugged applications such as locomotives, mass transit cars and military vehicles. Bayonet pins are protected from damage by their placement inside the plug coupling nut, and the receptacle's exposed ramps are easy to clean in harsh environments. Extremely durable, the reverse bayonet coupling is rated to 2,000 matings.

Commital ITS-RG Connectors are designed for easy handling in harsh rail yard environments.

Standard ITS inserts are made from neoprene, but high temperature silicon or solvent-resistant elastomer inserts can be specified. ITS series connectors can be ordered with a flame retardant compound that significantly reduces fire hazards, and meets smoke density and toxicity standards. The Glenair ITS-RG Series Connector is a unique, ruggedized rubber-coated version of the ITS Series designed for use in harsh environmental applications. Offering the same electrical performance as the standard ITS, the ITS-RG has better insulation from high current and voltage. The rubber covering also allows for easier gripping and handling in rail yards, prevents shell damage, eliminates fluid infiltrations and guarantees a Protection Index of IP67. The rubber coating conforms to the strictest safety norms regarding fire resistance, toxicity and smoke including ASTM C542, ASTM E662/83 and CEI 20.37/85.

IT and ITS Series backshells are available for every wire and connector protection requirement.

Extremely versatile, Glenair's ITS series connector has been specified in a wide range of rail applications including climate controls, brakes, converters, door-opening systems, pantographs, data and communication systems, couplers, speed sensors, diagnostics, antiskid devices, lighting, intervehicle coupling connections, and even toilets.

For threaded coupling connectors in rail, industrial and military applications, the Glenair IT series conforms to the MIL-C-5015 standard with insert arrangements from 1 to 150 contacts, and contact sizes from 20 awg to 4/0 awg. IT Series connectors intermate with other standard MIL-C-5015 connectors.

ITS and IT Series connectors come in plug and receptacle styles that include in-line receptacles with accessory threading, square flange styles with or without accessory threading, and jam nut designs with or without accessory threading. Glenair also offers a wide range of ITS and IT connector backshells and accessories, including protective covers for plugs and receptacles.

Field assembly requirements call for Glenair ITH Series connectors. Employing rigid inserts and crimp contacts, ITH is an easy to assemble and highly reliable MIL-C-5015 style connector. Contact insertion takes half the time compared to soft insert connectors—no contact lubricants or socket guide pins are required. Grommets have sealing membrane holes, so no sealing plugs are necessary. With reverse bayonet coupling, ITH series connectors conform to VG95234, international electrical standards, and European Economic Community compliance directives for electromagnetic compatibility. EMI shield termination accessories are available for overall and individual wire shields. Insert arrangements of 7 to 70 contacts are available with 8, 12, 16 awg contacts rated from 15 to 46 amps.

The rigid insert in ITH Series connectors provides for faster assembly than standard MIL-C-5015 type connectors.

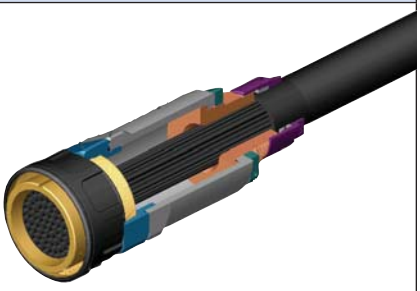
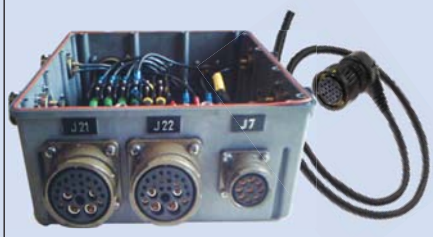
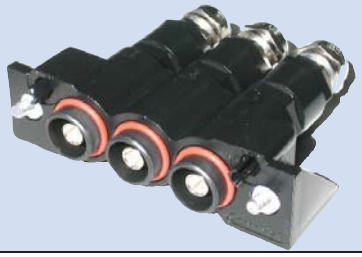
Often critical to rail interconnect systems, Glenair connectors and accessories can be ordered with flame retardant materials that control for flame to ASTM 162, smoke to ASTM 662, and toxicity to Bombardier SMP 800C. Contact styles include solder, crimp and PCB versions made of copper alloy with silver or gold plating. Coax, twinax, triax and thermocouple contacts are also available.

900 Series Circular Power Connectors are available with aluminum alloy shells up to size 48 in thread, bayonet or lever action coupling. Hinged dust covers protect unmated connectors in the harshest conditions. For superior handling, choose extended length coupling nuts with deep ribs. UL94-V0 plastic inserts and insulating parts make contact insertion a snap. Solder or crimp silver plated contacts up to 4/0 awg rated to 400 amps are available. "Finger-tipped" contacts prevent shorting and shock risk. Shielded contacts for coax, twinax, triax, quadrax are also available.

C1 Single Pole Connectors are ideal for intercar connections, pantographs and other high-power applications. Bayonet coupling system simplifies mating and multiple polarizations prevent mis-mating. The C1 handles working voltage to 3,000 volts DC at 1,000 amps and temperatures -40°C to 120°C with IP76 protection rating and fire resistance in accordance with NF F 16-102.

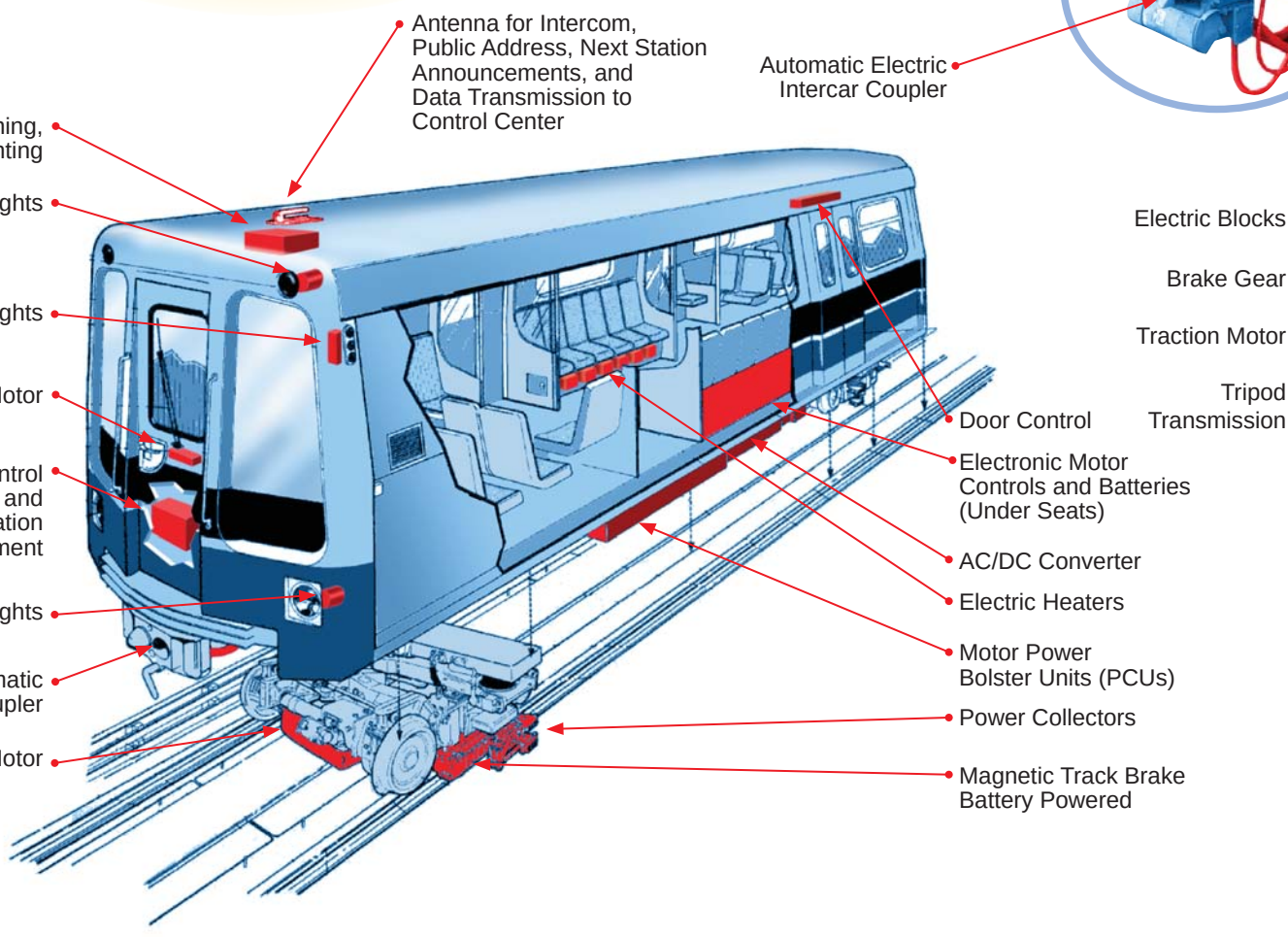
IRT Series Connectors employ unique coupling systems for the toughest railway applications, including blind mates for undercar, between cars and engine frames. Choose from screw and nut or latch coupling. Insert arrangements include power and signal contacts rated up to 3,000 volts AC and 350 amps. The IRT's temperature range is -55°C to 125°C with industry-standard fire resistance and IP67 protection.

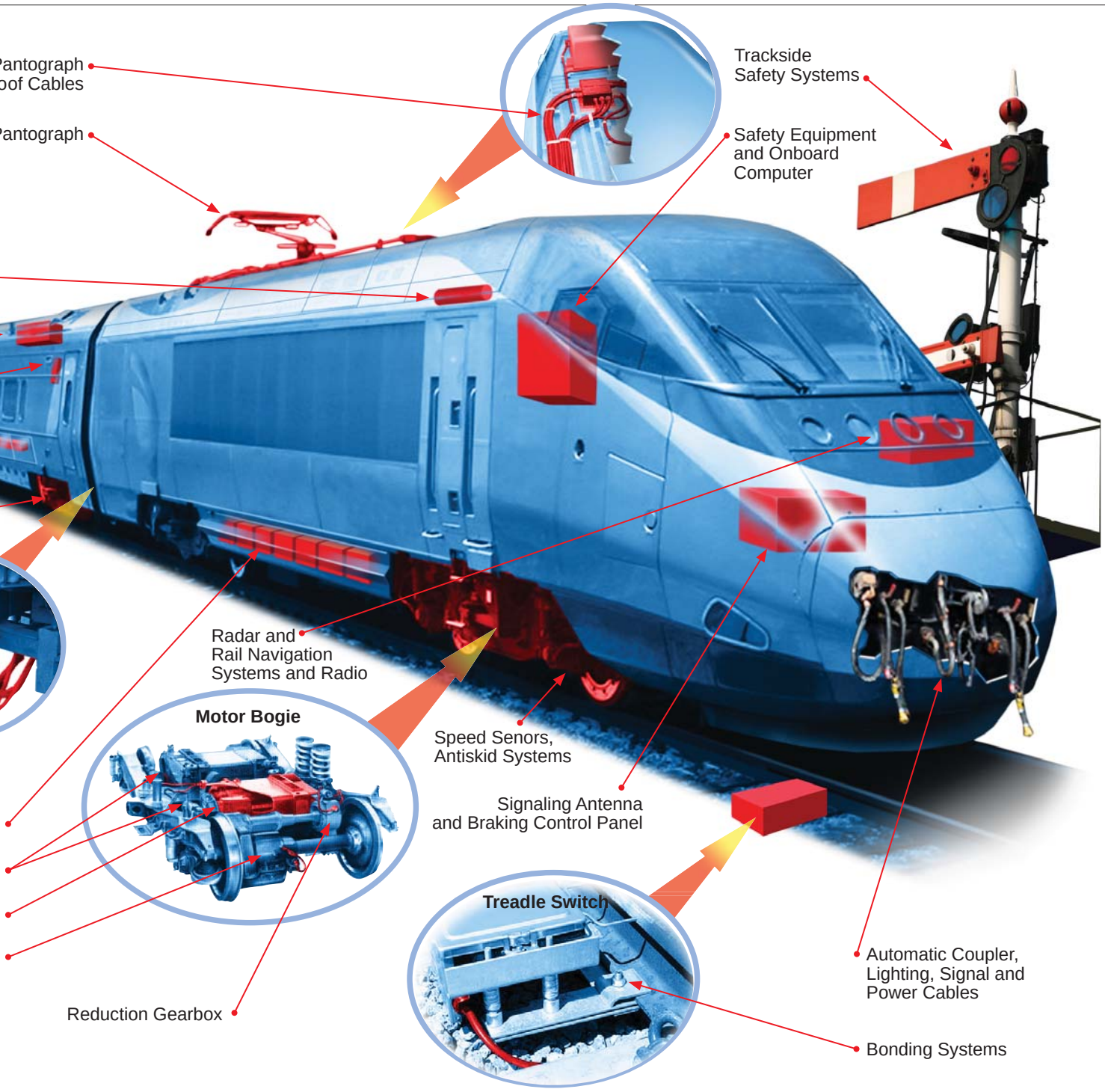
IRT Series High-Power connectors with double blocking lock system and IP67 environmental rating.

Customer Requirement	Glenair Rail Interconnect Solution
Complex intercar jumper cables between carriages on the French TGV rail system experienced severe twisting, vibration and shock. Twinax cable conductors were subject to breakage due to poor quality of the existing cable strain relief.	• Glenair-designed conical backshell inserts allow free movement of wires during severe movements in service. • Assembly passed the 1 million cycle test requirement with no electrical failure or visible damage to conductor and wire insulation. 
The interconnect cabling serving ATM Milan's signaling network was susceptible to damage caused by floods, shocks, extreme temperature changes and rodent infestation.	 • Glenair designed an armored electrical harness using a low fire hazard neoprene cable jacket and flame retardant polyurethane material. • Overmolded cable design seals all transition points to feed-thrus and connectors. • Waterproof composite junction boxes and sealed connectors ensure robust environmental performance.
Intercar jumper cables on the Great North Eastern Railway (GNER) are subject to extreme corrosion damage.	• Glenair solution included ruggedized connectors made from aluminum bronze material to arrest corrosion. 
Undercar "bogie" power connectors suffered from poor performance and reliability due to contact corrosion.	 • Glenair designed single and multi-pole bogie connectors purpose built for harsh environment rail applications. • O-ring equipped connectors provide IP67 protection rating when connectors are fully mated.
Trackside system grounding on signalling and other wayside systems specified by Bombardier, Alstom, CAF, ATM and Ansaldobreda require the ability to drain extremely high currents in the event of an electrical short circuit.	• Glenair GroundControl Earth Bonding System provides a superior permanent electrical connection between the cable lug rail and structure. • Lightweight handheld tool affords easy installation of earth bonds in a variety of materials and sizes. • System is Network Rail approved for current side leads. 
New ASTM standards require the use of electrical components which ensure passenger and crew safety from flame, smoke and toxicity.	 • Glenair Commital division produces power and signal connectors and accessories with Flame Retardant protective coatings. ➡ *Flame to ASTM 162* ➡ *Smoke to ASTM 662* ➡ *Toxicity to Bombardier SMP 800C* • The connectors are integrated in conduit wire protection assemblies built from low-smoke, zero-halogen materials.

Sophisticated Cables for Sophisticated Trains

Modern passenger trains are more sophisticated than ever, and the interconnect cables used to service locomotive control panels, exterior and interior lighting systems, passenger and freight climate control, and passenger devices such as video, phone and Internet, now rival in complexity those found in the most sophisticated passenger jet.





A World of Rail Industry Interconnect Solutions

Glenair supplies a comprehensive line of high-reliability interconnect solutions for the rail industry: from MIL-C-5015 type reverse bayonet power and signal connectors, to corrosion-proof junction boxes, overmolded cable assemblies, conduit wire protection products and more. We are the go-to manufacturer of purpose designed interconnect cabling for the most challenging rail interconnect applications.

Glenair US Rail and Transit Projects

Recent, Current and Future

State	Location	Type of Projects
Alabama	Birmingham	Light Rail
Arizona	Phoenix, Tucson	Light Rail
Arkansas	Fayetteville, Little Rock	Heavy Rail, Light Rail
California	Los Angeles, Orange County, Richmond, Sacramento, San Diego, San Francisco, San Jose, Santa Clara, Visalia-Tulare	Heavy Rail, High Speed Rail, Light Rail
Colorado	Denver, Fort Collins	Light Rail
District of Columbia	Washington	High Speed Rail, Light Rail
Florida	Bradenton, Fort Lauderdale, Miami, Orlando, Tampa	High Speed Rail, Light Rail
Georgia	Atlanta	Light Rail
Hawaii	Honolulu	Light Rail
Idaho	Boise	Light Rail
Illinois	Chicago	Light Rail, Metros
Indiana	Indianapolis, Michigan City	Light Rail
Iowa	Ames, Des Moines	Light Rail
Kansas	Kansas City	Light Rail
Kentucky	Louisville	Light Rail
Louisiana	Baton Rouge, New Orleans	Light Rail
Maryland	Baltimore	Light Rail
Massachusetts	Boston, Lowell	Light Rail
Michigan	Detroit, Lansing	Light Rail
Minnesota	Minneapolis-St. Paul	Light Rail
Missouri	St. Louis	Light Rail
Montana	Missoula	Light Rail, Metros
Nebraska	Omaha	Light Rail
Nevada	Las Vegas	Light Rail
New Jersey	Bayonne, Hoboken, Hudson-Bergen, Jersey City, Newark	Light Rail
New Mexico	Albuquerque	Light Rail
New York	Buffalo, Jamaica, New York City, Rochester, Staten Island	Heavy Rail, Light Rail, Metros
North Carolina	Charlotte, Raleigh-Durham, Winston-Salem	Light Rail
Ohio	Cincinnati, Cleveland, Columbus, Dayton, Lorain, Toledo	Light Rail
Oregon	Portland, Salem	Light Rail
Pennsylvania	Harrisburg, Lancaster, Lehigh Valley, Philadelphia, Pittsburgh	Light Rail
Rhode Island	Providence	Light Rail
South Carolina	Charleston, Myrtle Beach	Light Rail
Tennessee	Knoxville, Memphis, Nashville	Light Rail
Texas	Austin, Corpus Christi, Dallas, El Paso, Fort Worth, Houston, San Antonio	Light Rail
Utah	Ogden, Salt Lake City	Light Rail
Virginia	Arlington, Charlottesville, Norfolk, Roanoke	Light Rail
Washington	Seattle, Spokane, Tacoma	Light Rail
West Virginia	Charleston, Huntington	Light Rail

Glenair International Rail and Transit Projects

Recent, Current and Future

Country	Location	Type of Projects
Argentina	Buenos Aires	High Speed Rail, Metros
Australia	Alice Springs, Brisbane, Dampier, Sydney	Heavy Rail, High Speed Rail, Light Rail
Belgium	Brussels	High Speed Rail, Metros
Brazil	Mato Grosso, Sao Paulo	Heavy Rail, Light Rail, Metros
Canada	Montreal, Toronto, Vancouver, Windsor	Heavy Rail, Light Rail
Canary Islands	Tenerife	Light Rail
Chile	Santiago	Metros
China	Bejing, Chengdu, Guangzhou, Hong Kong, Kowloon, Shanghai	Heavy Rail, High Speed Rail, Metros
Denmark	Copenhagen	Metros
Dominican Republic	Santo Domingo	Metros
Finland	Helsinki	High Speed Rail, Metros
France	Angers, Caen, Grenoble, Lille, Lyon, Marsille, Montpellier, Nantes, Orleans, Paris, Perpigan, Rennes, Strasbourg, Toulose, Valenciennes, Villers-les-Pots	High Speed Rail, Light Rail, Metros
Germany	Berlin, Bremen, Cologne, Dortmund, Frankfurt, Karlsruhe, Nurnberg, Potsdam, Stuttgart	High Speed Rail, Light Rail, Metros
Greece	Athens, Thessaloniki	Light Rail, Metros
Guatemala	Guatemala City	Heavy Rail
Hungary	Budapest	Metros
India	Delhi, Mumbai	Heavy Rail, Metros
Israel	Jerusalem, Tel Aviv	Light Rail
Italy	Rome, Turin, Milan, Florence	High Speed Rail, Light Rail, Metros, Infrastructure
Japan	Honshu	High Speed Rail
Malaysia	Kuala Lumpur	High Speed Rail, Light Rail
Netherlands	Amsterdam, Rotterdam	Heavy Rail, High Speed Rail, Light Rail, Metros
New Zealand	Auckland	Light Rail
Norway	Oslo	Heavy Rail
Philippines	Manila	Light Rail
Portugal	Lisbon, Porto	High Speed Rail, Light Rail
Puerto Rico	San Juan	High Speed Rail, Light Rail
Republic of Ireland	Dublin	Light Rail, Metros
Romania	Bucharest	Metros
Russia	Moscow	Metros
Singapore	Singapore	Light Rail, Metros
South Africa	Dorasan, Gautrain	Heavy Rail, Light Rail
South Korea	Mokpo, Seoul	High Speed Rail
Spain	Alicante, Barcelona, Madrid, Mallorca	Heavy Rail, High Speed Rail, Light Rail, Metros
Sweden	Nyland	Heavy Rail
Switzerland	Bahn, Zurich	Heavy Rail, High Speed Rail, Light Rail
Taiwan	Kaoishung, Taipei	High Speed Rail, Metros
Thailand	Bangkok	Light Rail
Turkey	Ankara, Istambul	High Speed Rail, Light Rail, Metros
United Arab Emirates	Dubai	Metros
United Kingdom	Croydon, London, Manchester, Midland, Newcastle, Nottingham, Sheffiled, Willesden	Heavy Rail, High Speed Rail, Light Rail, Metros

08:40

Glossary of Rail Terms

Train Number	Destination
Approach Warning System	A railroad signaling system that provides a signal as a train approaches an area of track, such as a roadway crossing.
Automatic Coupler	Allows rail carriages to be attached to each other by pushing the two carriages together.
Automatic Train Control (ATC)	An automated safety system for railways using cab signaling instead of track-side signals, and smooth deceleration in lieu of rigid stops in older technology.
Automatic Train Protection (ATP)	UK term. An automated system preventing collisions through a driver's failure to observe a signal or speed restriction.
Bogie (UK) Truck (US)	The undercarriage assembly incorporating the wheels, suspension, brakes and, in powered units, the traction motors.
Cab Signaling	A method where signals are displayed to the train driver in his cab, usually from a trackside induction system.
Car (US)	A railway carrying vehicle ("freight car" or "passenger car"). In the UK, the term denotes an electric multiple unit vehicle.
Carriage (UK)	Railway or underground passenger carrying vehicle.
Class 1 Railroad	A freight railway company that meets certain minimum size criteria.
Coach (Carriage)	A passenger carrying railway vehicle.
Commuter Rail (regional rail, suburban rail)	Electric or diesel propelled railway for urban passenger train service for local travel between a central city and adjacent suburbs.
Converter	Electronic system converting alternating current to direct current. Also used for converting AC traction supplies required for DC traction motors.
Diesel Multiple Unit (DMU)	Diesel-powered self-propelling passenger rail vehicles able to operate in multiple with other such sets.
Electric Multiple Unit (EMU)	Electrically powered self-propelling passenger rail vehicles able to operate in multiple with other such sets.
Elevated Railway (“the el”)	A railway typically built on supports over city streets.
Greenfield	Outdoor conduit used by railroad.
Heavy Rail (metro, subway, rapid transit, rapid rail)	Electric railway with capacity for heavy traffic volume running on dedicated track. Characterized by high speed and rapid acceleration passenger rail cars operating singly or in multi-car trains on fixed rails.
Interface	An electronic device that converts one type of signal to another.
Inverter	Electronic power device mounted on trains to provide alternating current from direct current.
Jumpers	Multi-core cables for electrical connections between railway vehicles. Presumably they allowed the electricity to "jump" between coaches. Also slang for people who “jump” in front of moving trains to commit suicide.
Junction	A point at which two lines or separate routes diverge from each other.
Light Rail (streetcar, tramway, trolley)	Lightweight passenger rail cars operating singly (or in short, usually two-car, trains) on fixed rails in right-of-way not separated from other traffic. Typically driven electrically with power drawn from an overhead electric line via a trolley or pantograph.

Glossary of Rail Terms

Arrivals 08:40

Train Number	Destination
Loss of Shunt	Failure of a shunt train detection system due to poor electrical contact between the wheel and the rail (see Shunt).
Maglev	Train using electromagnetic levitation, guidance and propulsion to hover above the guideway. This frictionless rail systems can travel at speeds approaching 300 miles per hour.
Mode	A system for carrying transit passengers described by specific right-of-way, technology and operational features. The most common rail modes are commuter rail, heavy rail and light rail.
Multiple Unit (UK) MU(US)	A self-propelled rail vehicle that can be joined with others and controlled from a single driving station. May also be termed “railcars.”
Pantograph	Arms that collect current from overhead lines on electric trains or trams.
Personal Rapid Transit	An automated electric guideway transit or people mover on an exclusive right of way. Often used at airports and hospital campuses.
Retarders	Braking system pneumatically actuated on inside of rail, forcing a brake pad against the inside of the wheel flange, "pinching" the flange between the brake pad and the rail.
Rolling Stock	A railroad vehicle that is not a locomotive; a railroad car.
Shunt	A track signaling system that uses the rail car wheels and axle to complete an electrical circuit between one rail and the other. The completion of this circuit is used as a signal that the train is present. The signal may be used to activate crossing arms or other train signals.
Sleeper	European term: a rail tie.
Subway (UK)	A tunnel passing underneath the railway tracks to allow passengers to cross from one platform to another.
Subway (US)	A railroad that runs underground, generally in a large city. Subways are traffic considered "heavy rail" because they operate on their own dedicated track.
Third Rail	An electrified rail that runs along the tracks giving power to trains. Used mostly in subways and rapid transit systems.
Tie	Rail tie, also called "sleeper" in Europe.
Track Signal	A signaling system that uses the rail for transmitting signals. These signals may be used to warn of an approaching train and lower crossing arms for instance, or also to warn the engineer of a train on the track ahead.
Traction Motor	A type of electric motor used to power the driving wheels of a vehicle such as a railroad locomotive, electrical multi-unit train (such as a subway or light rail vehicle train), or a tram.
Train Approach System	Train-detection system that warns of a train approaching a highway crossing, for instance, by sending a signal to activate the crossing warning arms.
Wayside	Trackside. The term presumably has its origin from the term “right-of-way.”
Yard	A location where rolling stock is switched to and from trains and freight is loaded or unloaded.

Pendolino: A New Angle on Rail Transport

First developed and manufactured by Fiat, but taken over by Alstom in 2002, Pendolino is an Italian tilting train system used throughout Europe and in China. The tilt technology is contained in the bogie (swivel truck). When going into curves, sensors on the leading car determine the carriage box tilt (up to 8˚) needed to compensate for the lateral acceleration. This information is passed along to navigational devices in the following railway cars, which then use hydraulic cylinders to tilt the carriage box accordingly. In an S-curve, this sensitive system even allows the front of the train to tilt to one side, while the rear cars are still swerving to the other. Tilting a massive train at high speed causes significant centrifugal and centripetal forces under the cars. Traditional interconnects failed under the stress. Glenair was brought in to develop flexible, durable, high-reliability cabling and interconnects that would stand up to the stresses, heat, and other harsh conditions found on Pendolino train systems.

Pendolino (from the Italian Pendolo) is an Italian family of tilting trains manufactured by Fiat Ferroviaria

Like Hercule Poirot, Glenair Solves Another One on the Orient Express

Glenair application engineers, every bit the intellectual match for retired Belgian detective Hercule Poirot, were asked to solve not a crime, but a serious problem involving an emergency braking system upgrade on the Orient Express. A complicated interplay of hydraulics, pneumatics and mechanics, the braking system solution had to fit within very limited space, and the train is, of course, a much-revered and valuable historical artifact. The case was solved with Glenair Commital ITS reverse bayonet connector cables and flange mount receptacles. Plugs with cable clamp backshells mated to receptacles mounted on existing metal junction boxes along with a specially-designed, corrosion-free and EMI/RFI-protected Glenair Composite Junction Box, factory wired to an internal termination block.

No More Downbound Trains: Glenair Solves Rail System Refurbishment Challenges

High speed trains throughout the United Kingdom were experiencing electrical failures in engine governor harnesses. Harnesses in these twenty-year-old (and more) rail cars encountered constant high temperatures, vibration and engine oil contamination. The original design for a hard wired cable assembly required complete re-wiring and significant locomotive downtime if a section failed. Glenair proposed a braided and jacketed, high performance, high temperature conduit system with fluid-tight fittings and much simpler installation. Now, the affected section can be replaced immediately, cutting train downtime to a minimum.

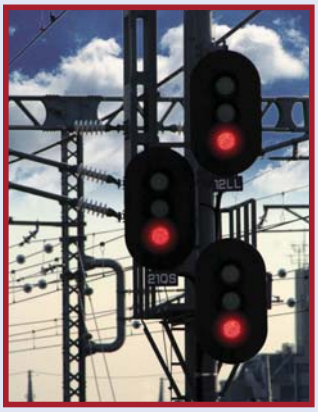
Conduit harnesses on some U.K. locomotive oil reservoirs included multiple fittings and sharp bends to fit properly on the equipment. With constant vibration and high temperatures, the conduit failed

allowing fluid ingress, subsequent electrical failures and lengthy downtime for repairs. Glenair proposed a much simpler hard wire harness incorporating overmolded Series 80 “Mighty Mouse” Connectors. Sealed against fluid infiltration, the cable harnesses are significantly more durable and far easier to mount.

Riding the Rails: Glenair Tackles Trackside Interconnect Problems

Not only are Glenair Cost Saver Composite Thermoplastic Junction Boxes great for undercar applications where up-splash and rail bed debris subject interconnect systems to significant hazards, they’re also terrific for trackside applications. The Milan Metro required signaling boxes that would protect interconnect media from weather and sun exposure. Signaling boxes, like most trackside applications, are critical to railway safety. They call for no fail solutions with maximum durability.

Glenair application engineers also designed a ruggedized interconnect cable solution for Milan Metro incorporating a high-performance electrical harness using a low fire hazard neoprene cable jacket and a flame retarded polyurethane material overmolded and sealed at all transition points, from Glenair feed-throughs to Glenair Series ITS connectors.



In a related rail application, Glenair designed a customized LED technology lighting system (employing Glenair Micro-D connectors) to simulate exactly the electrical performance of standard light bulbs. This development allowed use of signaling equipment already installed on site with the upgraded reliability and low power-usage of LED’s. The technology was packaged in IP67-rated waterproof Composite Junction Boxes that meet MIL-S-901D and MIL-STD-167 standards for shock and vibration, along with EMI/RFI/HIRF and lightning strike performance specifications.

Glenair is On Track with A Broad Range of EMI and Environmental Backshells

Glenair Series ITS MIL-C-5015 type (VG95234 Qualified) connectors for rail and other applications can be ordered with a wide variety of standard backshell styles for strain-relief, environmental protection and EMI reduction in multiple angles and profiles. In addition, Glenair is producing new “best-of-breed” backshell and accessory products for these Glenair MIL-C-5015 type reverse bayonet and threaded connectors that take full advantage of our innovative design, shielding and termination technologies.

Count on Glenair to develop labor-saving backshell solutions that address weight reduction needs, environmental requirements and overall package size. We have developed the industry’s simplest shield termination systems. Using conical, crimp, lockring and lampbase-thread ring technology combined with self-locking rotatable couplings and integrated shield socks in standard to ultra low profiles, Glenair has a solution for every interconnect challenge.

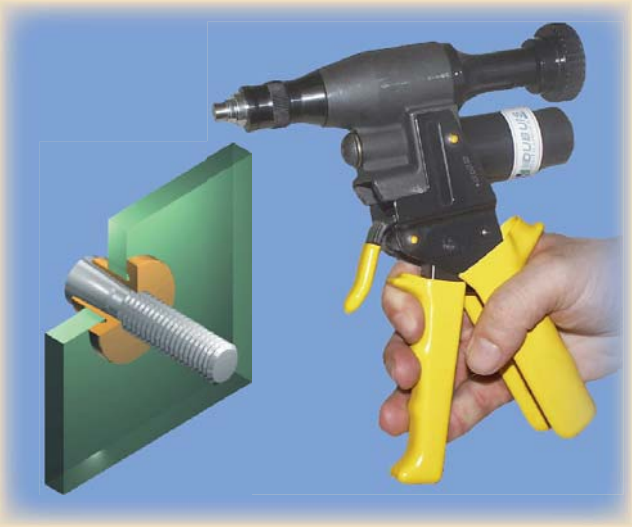
Special strain-relief backshell invented by Glenair for use on the French TGV rail system. This backshell design resolved complex intercar vibration and shock prolems which resulted in destructive cable damage.

GroundControl: The Glenair Earth Bond System for Rail Applications

For trackside equipment, Glenair's GroundControl Earth Bonding System is the quickest and easiest way to install and maintain high current grounding connections. Suitable for use with steel, stainless steel, and aluminum, Earth Bonds accommodate plate thicknesses of .059 inches (1.5 mm) and above. Bonds can be installed from one side into blind holes and uneven surfaces for a permanent low resistance electrical connection without welding, contact surface preparation or impacting. Earth Bonds can be removed and replaced in case of damage. One-person operation and limited tooling requirements makes GroundControl the most cost effective grounding system on the market.

The GroundControl Earth Bond consists of two precision non-corroding machined components: a stainless steel conical dowel and an electro-tin plated copper bush.

Choose from hydraulic setting tools for 1/4", 3/8", M6 or M10 Earth Bonds. Tools feature one hand operation and ram retract mechanism actuated by a release trigger. Each tool is supplied with plastic carrying case.



The Ground Control system is approved for use by Bombardier, Alstom, CAF, ATM and Ansaldobreda.

Easy Installation of GroundControl Earth Bonds

1. Drill a hole in the mounting plate to a pre-determined diameter depending on the plate material, plate thickness and stud size selected.
2. Screw the bond into the nose of the hydraulic setting tool.
3. Insert the bond into the hole so that the flange is flush with the plate.
4. Pump the handle of the tool until an audible click is heard and release the tool from the stud.
5. Attach termination and tighten to required torque value.
6. Connection is complete!

Performance Specifications: Glenair GroundControl Earth Bond

Part Number	80958 - M6	80959 - M10	80960- M6	80961-M10
Electrical Performance: Aluminium Plate				
Electrical resistance measured at a point between the terminal lug (copper tin plated) and the aluminium plate	60 micro ohms T = 2mm	50 micro ohms T = 2mm	60 micro ohms T = 4mm	20 micro ohms T = 4mm
Withstand short circuit test - 3 passes of high intensity current with no degradation of the connection	10 Ka	20 Ka	10 Ka	20 Ka
Corrosion Test: 500 hours	90 micro ohms T=2mm	50 micro ohms T=4mm		
Mechanical Performance: Aluminium Plate				
Tensile force applied to the dowel or threaded stud to remove earth bond from the plate	250 daN T = 2mm	200 daN T = 2mm	300 daN T = 4mm	500 daN T= 4mm
Bending moment (IEC60068-2-21). Force applied at a point 5 mm from the end of the thread	34 daN T = 1.5 mm	100 daN T = 2mm	200 daN T = 4mm	300 daN T = 4mm
Pressure Seal: Pressure applied to both sides of bond for 2 hours with no leak between bush and plate	6 Bar	6 Bar	6 Bar	6 Bar
Electrical Performance: Steel & Stainless Steel Plate				
Electrical resistance measured at a point between the terminal lug (copper tin plated) and the steel plate	25 micro ohms T = 2mm	20 micro ohms T = 2mm	25 micro ohms T = 4mm	20 micro ohms T = 4mm
Electrical resistance measured at a point between the terminal lug (copper tin plated) and the stainless steel plate	120 micro ohms T = 2mm	70 micro ohms T = 2mm	75 micro ohms T = 4mm	60 micro ohms T = 4mm
Withstand short circuit test-3 passes of high intensity current with no degradation of the connection.	10 Ka	15 Ka	10 Ka	20 Ka
Corrosion test: 500 hours: 2 mm steel plate	30 micro ohms	25 micro ohms	–	–
On 2 mm stainless steel plate	150 micro ohms	90 micro ohms	–	–
Mechanical Performance: Steel + Stainless Steel Plate				
Tensile force applied to the dowel or threaded stud to remove earth bond from the plate	400 daN T=2mm	500 daN T = 2mm	500 daN T = 4mm	800 daN T = 4mm
Bending moment (IEC60068-2-21). Force applied at a point 5 mm from the end of the thread	100 daN T = 1.5 mm	190 daN T = 2mm	200 daN T = 4mm	330 daN T = 4mm
Pressure seal: Pressure applied to both sides of bond for 2 hours with no leak between bond and plate	6 Bar	6 Bar	6 Bar	6 Bar

Test	Specification	Test level	Comments
Tensile/Compression	IEC60068-2-21	Test to point of failure	Destructive
Torsion	IEC60068-2-21	Test to point of failure	Destructive
Bending Moment	IEC60068-2-21	Test to point of failure	Destructive
Withstand Short Circuit		M6 -3 x 5 Ka, M10-3x10Ka	Destructive
Electrical Continuity	IEC60512-2b	Measure results	Initial & after test
Pressure Seal	IEC6006802017 Test Qa	20 PSI	Record results
Vibration	IEC60068-2-6	10-500 Hz @ 0.75 mm/4 gn	Sinusoidal
Shock	IEC60068-2-27	300g,3 ms, half sine	
Rapid Change of Temperature	IEC60068-14	Temperature range -25C + 70C	16 cycles
Endurance	IEC60068-2-52		10 cycles
Salt Mist	IEC60068-2-52		500 hours continuous - Marine environment solution

Outlook

"Price is What You Pay, Value is What You Get"

Warren Buffett had it right: There is a difference between the cost of a product or investment, and the value you realize from its purchase over time. As we are fond of pointing out, Glenair is a value-rich supplier of interconnect components and assemblies. This "value" takes many forms: innovative new connectors, extensive inventories of critical part numbers, "No Gap" product lines, no dollar or quantity minimums, abundant factory capacity, and so on. Most regular readers of *QwikConnect* are familiar with these aspects of our business, and I don't intend to spend another of my *Outlook* columns writing about this familiar topic. Instead I want to highlight a different form of "value" that we bring to the marketplace: *The Human Value.*

As this edition of *QwikConnect* makes clear, Glenair is serious about providing the best possible service to every interconnect market we serve—from rail to sea, air and space. And we know the most important ingredient in our recipe for overserving these markets is the people that make up our worldwide organization. Furthermore, we understand how important it is to continue to grow our organization with individuals who can add new talents, ideas and experiences to the mix.

Now it has long been our philosophy to build staffing and production capacity in anticipation of our customers' needs, rather than as a reaction to them. In the restaurant business, it makes sense to have an extra table or two ready and waiting for that unexpected rush of business. Similarly at Glenair, we work hard to grow our staff and facilities to handle the next wave of demand, not just the current load.

Several industry veterans and other significant new hires have come on board recently at Glenair. Among them, a long-term rail industry interconnect marketing professional working out of our Connecticut office, an expert in wire protection product design and marketing, and a top-notch backshell and accessories design engineer. We've also added some key support staff in our fiber optics, filter connector, market development, and quality assurance groups. It's impossible to overestimate the "human value" that this new wave of people—combined with our existing staff—bring to our business.

Our model of overserving the customer with abundant technical support—the kind that can only be delivered by real human beings who are committed to the mission—is alive and well at Glenair. Frankly, we are convinced we field the best technical support and customer service team in the industry. To quote Mr. Buffett again, "It takes 20 years to build a reputation and five minutes to ruin it..." We are confident our reputation, now over 50 years in the making, is in good hands—both old and new.

Chris Toomey

President
Glenair, Inc.

QwikConnect

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