

Reliable connections in motion:

Molded M12 cordsets for rolling stock

Solution Brief



From production risk to industrialized reliability

Train manufacturers, system integrators and maintenance companies are under constant pressure to deliver higher fleet reliability, shorter build and commissioning cycles and lower lifecycle cost—while operating in an environment where vibration, moisture, temperature changes and tight installation spaces are the norm. In this context, connectivity is not a small detail: A single weak connection can create intermittent faults, unexpected downtime and extensive troubleshooting.

Molded M12 connector cordsets offer a proven alternative to field-assembled connections by providing factory-tested, sealed and strain-relieved solutions that improve consistency and robustness across the vehicle. The result is faster installation, reduced rework and more reliable performance in service, helping rail OEMs and partners standardize connection quality and continuity and minimize maintenance interventions over the lifetime of the train.

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Current challenges

Reliability requirements in harsh environments

- Continuous vibration and shock
- Wide temperature range + condensation
- Exposure to water, dust, oils, brake dust, cleaning chemicals

Homologation and certification

- Meeting rail standards like EN50155, EN50121 and EN45545 (fire/smoke/toxicity), as well as other project-specific requirements
- Documentation and traceability required for approvals

Installation time and production repeatability

- High labor time for termination and routing
- Human error during manual connector assembly
- Need for standardized harnesses and consistent quality across build sites

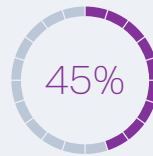
Weight and routing constraints

- Cable weight matters (especially high-speed trains)
- Difficult routes through articulated sections, bogies, doors, couplers

Digitalization in the Rolling Stock market



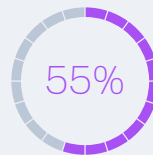
More than 100,000 passenger coaches in the European Union will need upgrades in the coming years.



More than 45% of total build effort on rolling stock on-board systems goes to cabling installation and testing.



Global passenger information system market is expanding at a CAGR* of 10-14%, with projections indicating it will reach \$50-75 billion by around 2030.



More than 55% of railway users expect free internet access on board when they are travelling.

Source: Belden research
*CAGR: compound annual growth rate

Belden combines century-long manufacturing expertise with railway-specific know-how to deliver reliable, scalable and repeatable on-board connectivity platforms.

Addressing key priorities

Labor time, quality checks and commissioning delays drive cost more than connectivity itself. Molded M12 cordsets reduce variability and rework, lowering overall program cost.

>>> Operators

- More resistant to vibration, moisture and cable movement
- Fewer intermittent failures (the hardest faults to find)
- Faster replacement in service (swap cable, restore operation quickly)

>>> OEMs

- Factory-tested, consistent assemblies across all builds
- Better production repeatability across plants and suppliers
- Reduces warranty risk, service claims and commissioning issues

>>> Installers

- Plug-and-play reduces on-site termination time
- No risk of incorrect pinout, poor assembly or missing sealing parts
- Less rework during commissioning and acceptance tests



Belden approach

- Use of **pre-assembled cordsets with molded M12 connectors**, replacing field-attachable solutions
- **Customized cable lengths per OEM and application**, fully adapted to the train architecture and installation needs
- Molded connector technology ensuring **long-term reliability under vibration and harsh railway conditions**
- **100% unitary continuity testing**, performed by Belden through exhaustive, standardized quality processes
- Elimination of assembly, testing and rework activities on the OEM production line
- Project-oriented supply model capable of managing high reference complexity and phased deliveries
- Optional **M12 Push-Pull interface** for faster connection and disconnection

Value delivered to the customer

- Guaranteed continuity and connection quality across all customized variants
- Elimination of connection-related defects and late-stage rework
- Reduced dependency on manual processes and skilled labor
- Faster, more predictable manufacturing and commissioning
- Lower total cost of ownership through improved reliability, repeatability and lifecycle performance

Sealed overmold

- IP67, IP69K rated
- Water- and dust-proof

Vibration-resistant

- Secure strain relief
- Shock and vibration protection



Custom lengths based
on customer designs

Reliable performance

- Factory-tested
- Long service lifecycle

Rail industry-compliant

- EN50155, IEC61373, EN45545
- Chemical-resistant & LSZH

Positive outcomes

“This approach delivers exceptional benefits, including an installation time reduction of up to 80%.”



Improved performance and mean time between failures (MTBF)



Faster troubleshooting or/and reduced mean time to repair (MTTR)



Nearly 50% reduction in installation costs



Lower total cost of ownership



Why Belden is different

Structural differentiation

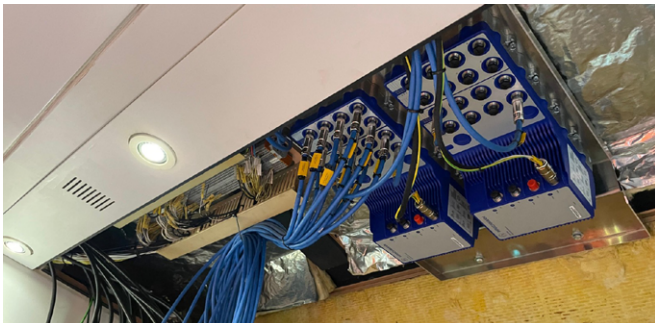
In working with Belden, you gain extensive structural knowledge to help ensure your application is a success.

We're able to industrialize customized connectivity at scale for railway OEMs. We design and manufacture both Ethernet cables and M12 connectors, ensuring end-to-end control of the complete connection solution. End-to-end railway compliance is embedded in the solution, not added afterwards, saving you time. Belden is also able to manage high reference complexity with low quantities per delivery.

Belden's expertise is a significant benefit. We're focused on continuous innovation, including M12 Push-Pull, improving installation efficiency. Belden has a proven track record of more than 100 years of manufacturing expertise in cables and connectivity, ensuring process stability and long-term reliability.

Strategic differentiation

Belden's team of experts has extensive application knowledge in railway on-board networks, and can help you establish an integrated ecosystem combining connectivity, cabling and network architecture. Belden also brings advantages to OEMs, thanks to its global production model, quality and support model for local and global OEMs. Belden counts leading OEMs and operators among its trusted partners.



From prototype to production: A two-phase approach

Step 1 – Engineering and prototype phase: flexibility as a priority

In the early project phase, we support the customer with engineering expertise and maximum flexibility to accelerate design validation and prototyping.

What we provide:

- Engineering support for cable selection, connector choice and architecture
- Different cable samples for testing (mechanical, environmental, fire behavior)
- Field-attachable connectors to allow quick changes during design, flexible cable lengths and fast on-train modifications during prototype builds
- Support during installation, testing and troubleshooting of the prototype

Step 2 – Series production phase: ensuring reliability and efficiency

Once the prototype and architecture are approved, we move to a standardized and industrialized solution for series production.

What we provide:

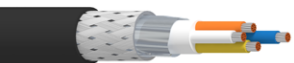
- Factory-assembled cordsets with molded connectors
- Defined variants (connector A/connector B/ cable type/custom lengths)
- Consistent quality and repeatability across all trains through factory testing procedures, such as continuity and pinout verification, electrical performance testing, and visual and mechanical inspection
- Full documentation, traceability and part numbers for rail coaches' upgrade programs

Example of installation with field attachable connectors



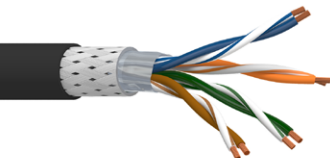
Design your own cordset

Cable options



BE43769

RailTuff™ Railway Approved Cat 5e, PROFINET, AWG 22(19), HiFlex, Premium Cross-linked LSZH Insulation and Jacket, Heavy Shielded, DIN 5510-2 level 1 to 4, EN 50155 Flame Resistance acc EN 45545-2, IEC 60332-1-2, EN 50305 & IEC 60332-3-25 cat D, EN 45545-2 (Class R15 and R16 HL3), Oil Resistance, ECE R118.03



BE43800

RailTuff™ 5E, 4 Pair AWG 26 Bare Copper - Stranded, Polyolefin (PO, PE, PP) insulation, SF/UTP - Overall Braid + Foil shielding, Cross linked e-beam LSZH / FRNC jacket, EN 45545-2 HL1-3



BE43802

RailTuff™ 7, 4 Pair AWG 24 Tinned Copper - Stranded, XLP/XLPO, XLPE insulation, S/FTP - Overall Braid + Foil shielding, Cross linked e-beam LSZH / FRNC jacket, EN 45545-2 HL1-3, ECE R118.03

Click [here](#) to see other options for industrial ethernet cables.

Connector options

Field attachable M12 D-Coded Crimp



Product Version		Product name
Straight	Male	RM12C-MSSV4D-CAT5
Angled	Male	RM12C-MASV4D-CAT5
Straight	Female	RM12C-FSSV4D-CAT5
Angled	Female	RM12C-FASV4D-CAT5

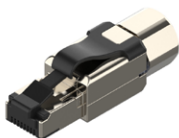


Field attachable M12 X-Coded Crimp



Product Version		Product name
Straight	Male	RM12C-MSSV8X-CAT6a

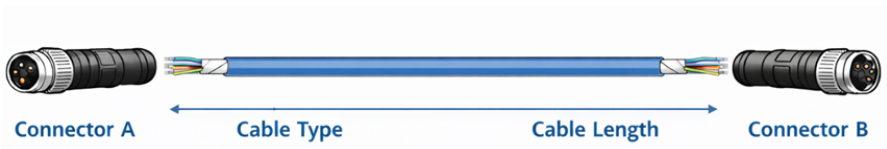
Field attachable RJ45 IDC data connector



Product Version			Product name
Cat5E	Straight	Male	RJ45I-MSSV8E-CAT5E
Cat5E	Angled		RJ45I-MASV8E-CAT5E
Cat6A	Straight		RJ45I-MSSV8E-CAT6A
Cat6A	Angled		RJ45I-MASV8E-CAT6A

Click [here](#) to see other options for connectors.

Customized M12 Molded Cordsets



Once the prototype and architecture are approved, we move to a standardized and industrialized solution for series production where customer selects connectors, length and type of cable, and Belden delivers the customized M12 molded cordsets individually tested. Belden can support customer labeling requirements to streamline installation on site.



Connect to what's possible.

Solution Brief



About Belden

Belden Inc. delivers complete connection solutions that unlock untold possibilities for our customers, their customers and the world. We advance ideas and technologies that enable a safer, smarter and more prosperous future. Throughout our 120+ year history we have evolved as a company, but our purpose remains – making connections. By connecting people, information and ideas, we make it possible. We are headquartered in St. Louis USA, and have manufacturing capabilities in North America, Europe, Asia and Africa.

Contact us to learn more about our
molded connector cordsets:

belden.com/contact-us

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