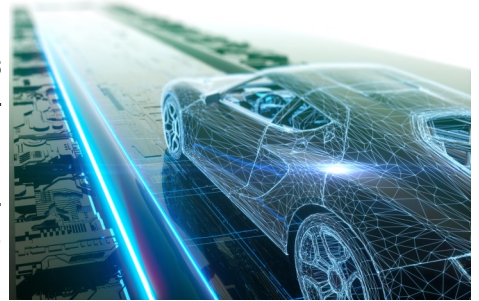


## EXRAD<sup>®</sup> Automotive Ethernet Twisted Pairs

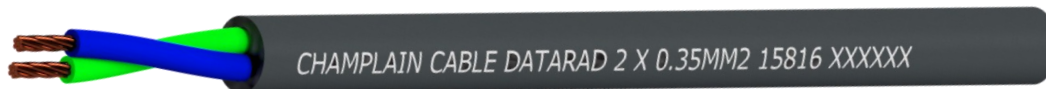
**Automotive Ethernet is poised to be the “Next Big Thing” in vehicle technology.** It enables all kinds of data-driven systems to be integrated into a vehicle. From vehicle diagnostics to self-driving platforms and whole lot in-between.

The physical layer of these systems is connected with twisted-pair wires which carry the signal throughout the vehicle. To meet the rigors of an automobile or commercial vehicle, these pairs need to be designed to provide not only robust data performance, but also robust physical performance



Currently, the data and physical requirements are defined by multiple entities: IEEE 802.3 committee, OPEN Alliance committee, SAE J-3117, and ISO 19652-12. (ISO is currently in draft form) The main requirements can be summarized as follows:

<b>Data rates:</b>	100BASE-T1 and 1000BASE-T1
<b>Max Node Length:</b>	15m for 100BASE-T1 and 15m/10m for 1000BASE-T1
<b>Conductor sizes:</b>	0.13mm <sup>2</sup> , 0.22mm <sup>2</sup> , 0.35mm <sup>2</sup> and 0.50mm <sup>2</sup>
<b>Constructions:</b>	Single twisted pair, jacketed or unjacketed options
<b>Temperature Ratings:</b>	100°C, 125°C, 150°C
<b>Electrical Performance:</b>	Must pass after ISO-6722-1 short and long-term heat-age at rated temperature; at low temperature; and also in a humidity chamber.



**Although these cables may look simplistic and generic, the devil is in the details.** The conductors are small and stranded, the insulation walls are very thin, there are considerable environmental requirements (high-temp, low-temp, humidity), and the data requirements (particularly 1000 BASE T1) push the limits of standard processing techniques. The difference between acceptable performance and borderline failure can be determined by very minute inconsistencies in manufacture.

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**Even with those challenges, there are many benefits to these Automotive Ethernet cables.** Three of the most compelling involve weight, space and cost savings, all of which are critical considerations for vehicle wiring. Automotive Ethernet twisted pairs are small and light compared with other cable options (LVDS, Coaxial), and the system uses less overall wire length which contributes to weight reduction.

Additionally, Automotive Ethernet systems are intended to carry low-voltage power to the devices to which they are connected, which eliminates the need for additional power wiring and saves additional space, weight and cost.

Automotive Ethernet cables also allow for water tight sealing / connectorization, which is necessary in many areas of the vehicle. These systems are also compatible with PC and Apple based architecture, allowing for user interoperability.

**But achieving these benefits means careful design considerations must take place.**

First, meeting the electrical requirements after heat age is a critical parameter since insulation materials tend to degrade over time, which is accelerated in the presence of heat. So appropriate insulation materials must be used. The only acceptable materials are Polypropylene (PP), Polyethylene (PE) and Fluoropolymers (such as FEP). Of those materials, PP has a temperature limit of only 105°C, so meeting heat-age requirements is a challenge. And while FEP is thermally and dielectrically robust, it is also a very costly material. Irradiated PE is a good option because it is low cost and can meet the performance requirements across a wide range of environmental conditions.



Second, an unjacketed pair, (which is preferred for space, weight and cost reasons), is also susceptible to conductor separation when bent and manipulated, which causes a rise in data error rates. So a twisted pair should be optimized to reduce that occurrence.

Third, for jacketed pairs there is also the issue of connector sealing, which is difficult without the round profile that a jacket provides. Additionally, a jacket protects the pair from physical damage during assembly and throughout the life of the vehicle.

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**A well-suited cable design and supplier would incorporate the following:**

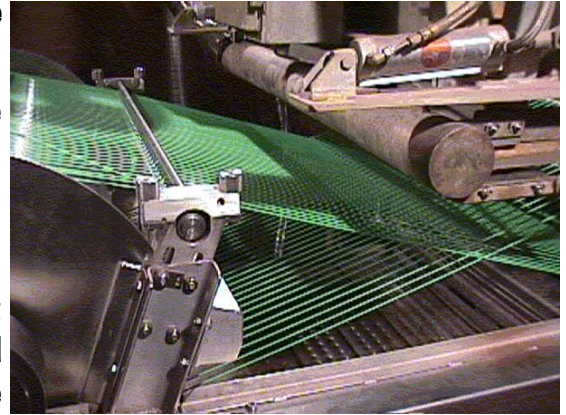
**Materials technology:** To ensure the best materials are used to optimize performance and cost.

**Engineering expertise:** To ensure great cable design and also processing know-how.

**Irradiation cross-linking:** Irradiation is a technology that improves many wire insulation materials in many ways, and Champlain uses this technology to optimize our Automotive Ethernet cable pairs. You can read more about Irradiation in our white paper here: [Irradiation Cross-Linking of Polymers](#)

**Pair twisting expertise:** Champlain invented TWISTR<sup>™</sup> technology to improve the performance of the many twisted pair cables we produce. You can read more about it in our white paper here: [TWISTR<sup>™</sup>-Technology](#)

**Appropriate Equipment:** As stated above, very minute inconsistencies in manufacture can affect pair performance. State-of-the art extrusion, twisting, and testing equipment, plus a robust quality system all work together to produce consistent products.



Lead wire in a typical “figure-8” configuration under an irradiation beam.

Champlain Cable has been making Ethernet cables for nearly 30 years. We’ve been first-to-market with many leading-edge Ethernet and other data-communication products. We currently support multiple global Automotive and Commercial Vehicle OEM’s and Tiers with OPEN and other Ethernet cables, and look forward to supporting the Automotive Ethernet market far in to the future.

**You can review specifications and learn more about our ingenuity at [www.champcable.com](http://www.champcable.com)**

