An Introduction to Industrial Ethernet Connection Systems

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Unlike traditional office settings, Ethernet has spread into environments where protection from noise, solids, liquids and even gases is of concern. Manufacturing equipment and automated test environments are just some of the more common areas where standard RJ45 based connectors do not offer protection from these sources of contamination. Conditions in these environments warrant the use of industrial grade connectors and connection systems. The primary evolution involves encasing or shrouding the standard RJ45 in either a plastic or metal housing, depending on the application and required durability.

It is common to measure a connection system's resistance to the aforementioned contaminants by what is known as the IP (ingress protection) rating, as defined by the International Electro-technical Commission (IEC 60529). Typically, connectors which carry can IP-67 rating are capable of provided adequate protection in even the harshest environments. Without outlining the specifics between various grades, the use and meaning behind IP-67 grade connection systems is as follows. The first digit represents the resistance against solids. In this case "6", which happens to be the highest classification, and means the connector is dust tight or impervious to solids. The second digit represents resistance to liquids. A rating of "7" means the connection system can be submersed in one meter of water for up to one hour before leaking, and also resist moderate pressure water spray. This level of ingress protection can be provided by many of today's industrial grade plastic housings. However, there are applications in which a metal solution is desired, especially if resistance to fire and even explosions is of concern. These normally consist of die-cast Zinc or nickel plated alloy housings, which also inherently provide complete protection from EMI.

Oil and gas exploration is one such area where network connections are not only subjected to liquids and gas, but also ultraviolet light, extreme temperatures, mud and very severe handling. All of these influences can increase the likelihood of network failures. Only the highest grade industrial strength connection systems will offer the protection required to maintain a working and reliable network connection in such an environment. For example, in a top-drive control application, it is imperative that control and data signal transmission be maintained.

This heavy and powerful piece of equipment is responsible for supplying the rotational force, or torque to facilitate the drilling of a well. It is also able to traverse vertically and is hydraulically actuated. Speed control, elevation and line pressure are important parameters to monitor to ensure adequate safety on the drilling platform. In addition, keeping the rig from becoming inoperable is second only to safety. The only time a rig should be inoperable is during a scheduled shut-down, such as when repositioning for a new well. Start-up and shut-down may account for just a few percent

of operating time, but it is during this time that many incidents can occur. One such incident involves the disconnection and subsequent reconnecting of data signal and control cables. Most electrical related issues can be attributed to poor electrical contact. As if the abusive handing from rig operators is not enough to consider during this time, the connectors may be left free and become encrusted with mud, or even rolled on by heavy equipment while left dangling on the ground below. Protective caps are offered with many connectors so as to protect unused or temporarily disconnected ports from contamination. A ¼ turn bayonet style locking feature is used to facilitate quick connections, while providing high tensile strength support, which keep plugs from being pulled out of their receptacles. There is another industrial grade connection type connector, which was not enhanced or modified to bring Ethernet connectivity into harsh settings, as was the case with the traditional RJ-45. This connector type is known as a M-12 connector, and it has already been quite a popular choice for connecting devices used in industrial automation and control applications.

From inception, the design concept of the M-12 was to address the need for data acquisition and control functions in harsh environments. The strengthening and sealing the RJ45 connector may provide a connection system comparable to that of an M-12 in terms of its IP rating, but the M-12 is inherently more robust and more compact than most RJ45 based systems. The attractiveness of the RJ45 based system is the lower upfront integration cost of some of the plastic based solutions, as well as using open protocols such as TCP/IP. This begins to phase out, once you consider metal based options, and it is arguable which offers superior performance. The M-12 was not necessarily designed with high speed data transfer in mind. However, much like the evolution of RJ45 based industrial connectors addressed the need for mechanical robustness and ingress protection; M12 connectors have been evolving to accommodate high speed networks, and two pair connectors can support data rates up to 100Mbs. Designs are currently underway to enhance the transmission performance of the M12, but don't expect to see them replacing the tradition RJ45 style (8P8C) connector in the office. Doing so would be analogous to burning premium fuel in an engine designed to burn regular. This is a needless expense, as there is no net performance gain.

As is the case with most decision making, some of it will come down to pride of ownership, and certain beliefs which are formed based on others advice or experiences. Cost is always going to play a factor, and some of the metalized connection systems are on the high-end of that spectrum. Therefore, their use is best justified in applications like the one cited earlier in this discussion. Tradeoffs have to be analyzed and connectors chosen which offer the attributes necessary to ensure repeatable operation over the network's, or at least the connector's lifespan.