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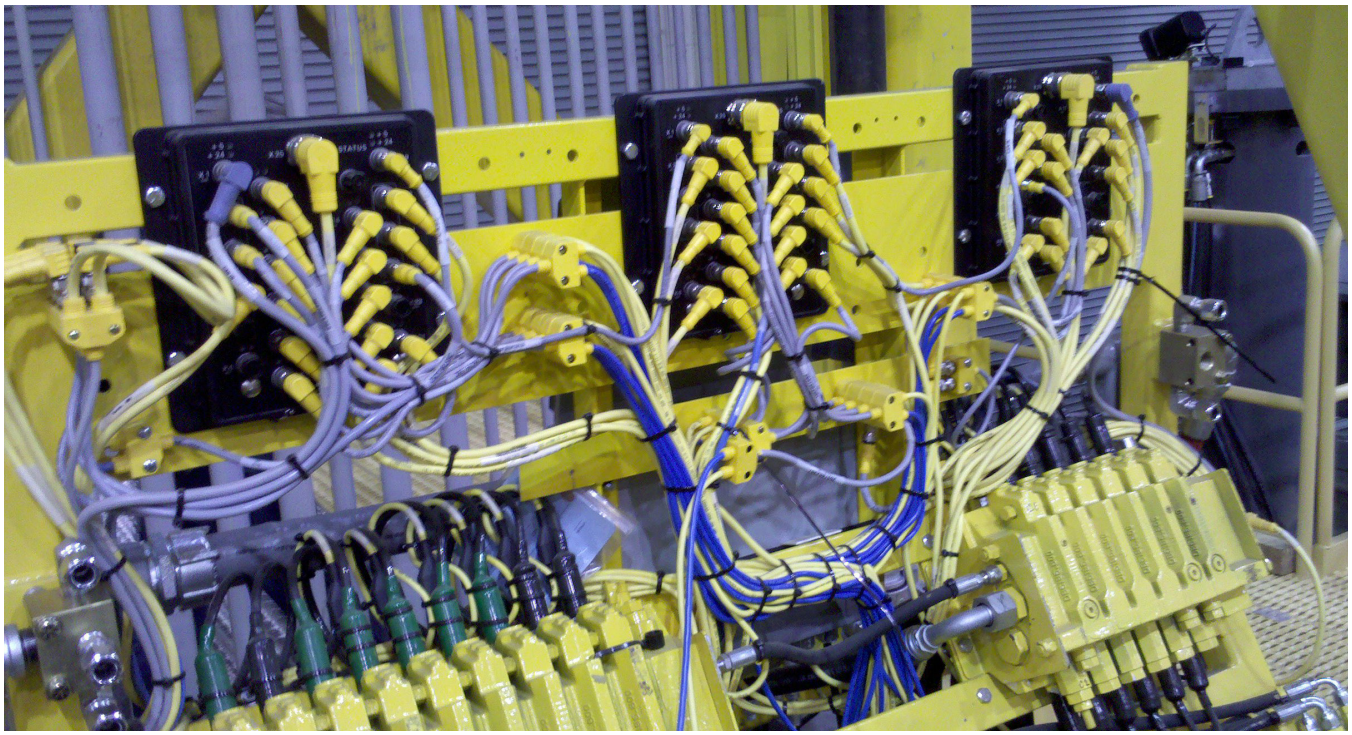
Quick Disconnect vs. Hard-Wiring: Selecting A Connectivity System For Your Industrial Application

White Paper - W1011



Today's fast-paced applications require progressive connectivity solutions to increase productivity and accommodate diverse performance requirements. A streamlined connectivity system can simplify wiring and expedite automated processes. Delivering flexible operation for various applications, connectivity systems provide enhanced communication capabilities and increased productivity. With such versatility, there are many types of systems available, including quick disconnect and conventional hard-wiring.

While traditional hard-wiring continues to be a proven practice that can minimize initial cable investments, it is often prone to failure from corroded contacts or mechanical loosening of the connections. Further, hard-wiring can be expensive and time consuming for operators due to the amount of equipment needed to maintain numerous applications and correct faulty wiring or faulty connections.

In place of hard-wiring procedures, wiring topologies utilizing quick-disconnects (QDs) have become standard practices in many industrial applications including factory and process automation, control and device interfacing and communication networks. In comparison to hard-wiring, QD cabling in offers numerous advantages, including installation and maintenance cost savings, improved ingress protection, added plug and play capabilities and improved reliability achieved through testing. This white paper will define hard-wiring and QD systems, while providing a detailed comparison to illustrate the benefits of QD wiring in industrial environments.

DEFINING CONNECTIVITY SYSTEMS

Hard-Wiring

Hard-wiring in industrial applications can be

summarized as any cable or individual conductor that is terminated by conventional field-applied means. These terminations include soldering and mechanical terminals including screw, clamp and spring designs. Less common terminating methods include insulation avoidance fastening (specialized clamp or pins capable of conductor contact while minimizing insulation stripping). Since cable cutting and dressing is typically applied during the installation, bulk cables are often utilized and are field cut to required lengths. In many hard-wired installations, conduit is utilized to house and secure the cables and/or conductors and significant labor is needed to install and feed the electrical media through the conduit. In breaching control cabinets or bulkheads, hard-wiring typically utilizes simple mechanical cable glands to secure cables and, in some cases, establish some level of ingress protection.

Quick Disconnect

QD wiring utilizes cables terminated with preassembled or molded connectors that are used together with mating connectors and receptacles. In most applications, cables are ordered in predetermined lengths and service loops are used to take-up any slack in surplus lengths. Receptacles are often used in conjunction with a mating cordset to breach control cabinets and distribution bulkheads. To maximize the benefits of QD cables, relatively small remote I/O devices such as junction boxes and splitters are utilized to minimize labor installations (sometimes a junction box can completely replace a control box or bulkhead) and offer a "plug and play" topology that can often be readily modified or expanded to meet future demands of end-users.

QD VS. HARD-WIRING

Installation/Commissioning

One of the biggest advantages of QD is seen during installation and commissioning. Installation time required for a single cable with molded connectors is significantly less than hard-wiring the same device—in fact it is three to five times less. It is much quicker to thread a connector onto a mating connector and dress the cable when compared to bending conduit, cutting it to fit, installing it, pulling wires and finally making connections to terminals. Many devices, such as sensors, valves and solenoids, can be sourced pre-wired with a connector to eliminate connection time during installation of the device, resulting in even greater time savings.

The time savings during installation is realized in faster startup and commissioning of machines and facilities, which results in labor savings up to thousands of dollars depending on the size of the job. Millwrights can especially appreciate the ease of equipment "burn-in" when QD components are readily commissioned and decommissioned in debugging wiring and network topologies.

Maintenance Savings

Cost savings will also be realized in maintenance—daily or situational. In larger factory operations, machine and plant downtime can cost up to hundreds of thousands of dollars per hour. With QD, the removal and replacement of a failed or damaged device can be done very quickly to minimize downtime. Alternatively, it takes significantly more time to replace the same device if it is hard wired with conduit. QD also reduces normal maintenance times for the same reason. In factory operations, signal, control and power QD wiring can enable modular topologies that ease the expansion and contraction of production lines.

Ingress Protection (IP)

Reduction in installation time and maintenance cost are not the only benefits that a QD connector assembly provides. Most QD systems have cable sealing to the connector body and around the circumference of the connector body. This sealing is designed to prevent the ingress of liquids and debris. Also, the connection area itself (typically a threaded, snap or bayonet design) incorporates some type of sealing to prevent ingress into the electrical connection point between male and female junctions. Since very high IP values are associated with rugged factory-molded and potted connector styles, the ability to achieve sufficient IP with a hard-wired solution is difficult, if not impossible, since mechanical means—and in some instances adhesives—lack the sealing qualities of factory applied connector moldings and potted enclosures.

Plug and Play Capabilities

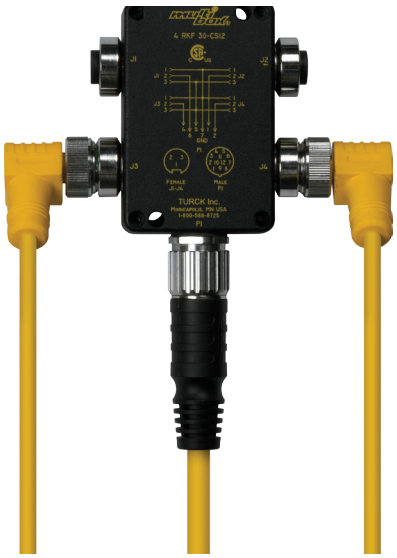
The advantages of a QD system are most evident in wiring schemes utilizing networking and/or wiring consolidation components. These include, but are not excluded to, junction boxes and splitter cables. With junction boxes deployed as remote I/O points, wiring capabilities are enhanced significantly in that devices can be deployed and removed seamlessly without any cable dressing. Further, there are no excess cables, since junction boxes utilize a trunk cable to consolidate individual device cables into one large, high-density cable. All of these attributes are often housed in a compact, fully sealed solution. The splitter or splitter cable acts as a mini junction box - I/O capabilities that utilizes a trunk cable—and typically offers more density than a junction box but somewhat less wiring capabilities.

Another benefit to plug and play capability is diagnosis. Many QD cables, splitters and the majority of junction box designs can be fitted with LED lights. LED lighting in these components can monitor both signal and power functions of a device, control box or PLC in typical applications. In complex wiring schemes, this monitoring function is critical to rapid wiring integrity diagnosis and fault identification.

Other Tangibles

Reliability of pre-molded or potted connectors is achieved through factory testing. Each piece is tested electrically to ensure a user will receive a product that works correctly when installed. Eliminating wiring mistakes results in a quicker startup and avoids costly troubleshooting, rewiring and potential replacement of damaged items due to faulty wiring. A subsequent, small detriment to using molded QD is the lost re-configuration one can do with a hard-wired topology or an assembled style connector that can be dismantled and rewired.

Some machines have limited space on them through which conduit or cables need to be routed, or the machines need to meet certain weight limitations. The cable on connector assemblies is smaller in diameter and more flexible than conduit, making installation much easier in these situations. Also, there is significantly less weight in connector assemblies. In some instances, OEM's have also utilized connectors to enhance the sheer appearance of a machines' wiring and conceal the raw cable designs and any conductor (and potentially live wire) exposure.



INDUSTRIAL TRENDS

The immergence of industrial wiring protocols combined with stringent cabling shielding demands have significantly increased the use of QD topologies in recent years. With the expansion of many wiring protocols specifying STP (Shielded Twisted Pair) conductor-based cabling (such as DeviceNet™, PROFIBUS® and Ethernet), QD cable systems are essential in meeting the demands of these protocols. Hard-wiring a system with these protocols is extremely difficult since the binding of the twisted pairs can be easily compromised in field terminations. Special pre-molded and potted connectors are specifically designed to meet the electrical specifications of these protocols and are means of noise termination via the cable shielding media and the connector pin(s) or coupling components.