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Listed vs. AWM:
What to Know When Selecting Your Cable Solution

White Paper - W1008

With connectivity and networks providing the cornerstones for today's industrial, process automation and manufacturing plants, selecting the proper cables is more important than ever. Many industrial applications are subject to harsh environmental conditions and have demanding performance requirements for their machines and equipment, including cabling.

Cables recognized by UL as Appliance Wiring Material (AWM) are prevalent in factory and process applications. While these are a popular cable solution, rules governing cable use are becoming more stringent and are being strictly enforced. Environmental challenges in some applications may prove to be too extreme for cables that are only AWM recognized. UL Listed Instrumentation Tray Cables (ITC) and Power Limited Tray Cables (PLTC) have been developed to provide cabling that meets stringent durability and performance standards to provide users with continued high-quality functionality in harsh industrial conditions.

When selecting the proper cabling for industrial applications, it is important for users to consider performance strengths and limitations associated with each cable solution in order to select cabling that meet an application's exact needs. This white paper will address the differences between AWM recognized cable and UL listed cable, describing the testing requirements listed cables must satisfy and highlighting the benefits associated with ITC and PLTC cables, such as durability, reliability and longevity.

APPLIANCE WIRING MATERIAL CABLES (AWM)

UL AWM recognized cables must meet certain performance standards. These standards are much less severe than those required for listed cables. Cables that only meet the AWM specifications may not have the necessary durability to function under the conditions found in current factory and process automation environments.

Most notably, AWM cables are required to pass only minimal flame-resistance testing. The severity of the testing can be as little as five 15-second applications of flame from a Tirrell burner, applied horizontally to a single cable. A more common AWM flame test requires just 30 seconds of flame, again horizontally applied from a Tirrell burner.

Cables with only AWM recognition may have other limited attributes. These cables are not required to be tested for exposure to Ultraviolet Radiation (UV). These cables may be vulnerable to UV found in outdoor or welding applications, resulting in reduced performance capacity. Additionally, AWM recognized cables can have a temperature range as restrictive as -5C to +60C. Lower quality cable jacket and insulation materials are allowed and this may result in limited mechanical strength and durability. Cables may be stiff rather than flexible, and may not have any particular resistance to oils or lubricants often found in manufacturing facilities.

UL LISTED CABLES

The UL PLTC or ITC listing demonstrates to users these cables meet strict mechanical strength requirements. Listed cables are put through rigorous testing to ensure they retain all necessary performance capabilities under conditions like extreme temperatures, ultraviolet radiation and flame exposure, maintaining connectivity in demanding industrial environments.

PLTC listed cables are built to 300V specifications and intended for use at 300V or less. Power limited circuits are prevalent in today's industrial environments. Cables may be installed in trays and raceways as described in NEC Article 725.

ITC listed cables are also suitable for use in cable trays and raceways or may be used as aerial cable on a messenger, in rack rooms or under raised floors containing industrial process equipment. These cables are also built to 300V specifications, but are intended for use in applications at 150V, 5 amps or less. Many of the common networks used today are well below this threshold, often 24V and milliamps. NEC Article 727 was written specifically for these types of applications and is easy to read and follow.

REGULATIONS AND REQUIREMENTS FOR PLTC AND ITC LISTED CABLES

Flame Retardancy

ITC and PLTC listed cables must meet at least the flame resistance requirement outlined in UL 1685: The Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables. Most listed cables will also meet the requirements for the CSA FT4 Vertical Flame Test. When testing for flame resistance, the cable jacket is what physically protects the internal components of a cable, and what must be able to withstand flame exposure.

Both the UL and CSA flame tests subject ITC and PLTC cables to a significant amount of flame, 70,000 BTUs, from a 10-inch ribbon burner. Cables are bundled into a specific flammable mass and placed in the center of a vertical chamber. Flame is

then applied for 20 minutes. Cables fail if the flame propagates to the top of the eight foot bundle.

Ultraviolet Radiation Stability

When used in applications such as construction, welding and outdoor applications, cables are exposed to ultraviolet radiation, which can reduce the jacket strength over time. Cables may become brittle or even crumble. To prevent performance malfunctions, listed cables must pass the UL 720 hour Xenon Arc test or the 1000 hour Weatherometer test. Cables must maintain tensile strength and elongation integrity after ultraviolet (UV) light exposure for 720 hours of xenon-arc or 1,000 hours weatherometer conditioning. This ensures these cables are suitable for use and will withstand harsh environmental conditions.

Tensile Strength and Elongation

Tensile strength refers to the amount of force it takes to break the insulation or jacket material surrounding the cable. Typically, this measurement is expressed in pounds per square inch, with ultimate tensile strength being the breaking point. Elongation indicates how far the material will stretch before losing its transmission and/or mechanical property, which is generally expressed in percentages.

The outer jacket material used for listed cables is specifically tested for tensile strength and elongation properties. There are minimum requirements for each jacket material type to ensure cables will hold up over long periods of time—even when exposed to typical factory environments. Originally, tensile must be at least 1500 psi and elongation must be at least 10) percent. When testing these properties, cables must retain 80 percent of their original tensile and elongation strength.

Dielectric Withstand Testing

The UL standards for listed cables require that every reel of cable be subjected to a 1.5 KVAC Dielectric Withstand test to insure the cable has no shorts or insulation breakdown.

Temperature Listing

Many industries and applications require their network and connectivity cables to be installed in environments subject to extreme temperatures. Listed cables have requirements for both upper and lower temperature ranges and these will be clearly marked on the cable. If a cable is marked

-40°, -50° C or lower it demonstrates that it is capable of bending without cracking or losing continuity at these extremely low temperatures. Alternatively, cables can also be marked to perform in temperatures reaching 75°, 90°, 105° and 125° C. These temperature ranges allow these cables to be installed outdoors and in diverse factory and process applications, such as freezers or near high temperature apparatuses.

ADDITIONAL LISTINGS AVAILABLE FOR LISTED CABLES

Exposed Run

Cables that are listed ITC-ER or PLTC-ER are acceptable for use in hazardous locations as defined by NEC 725 and NEC 727. The ER stands for Exposed Run and indicates these cables may be run outside of cable tray or conduit as long as they are supported and protected every 1.8m (6'). Some factory equipment allows for easy compliance with these rules.

To earn the ER designation cables must pass the UL 1569 Crush and Impact Tests, which are the exact same tests used for metal clad cable, ensuring the cables strong.

Direct Burial

ITC and PLTC listed cables may also be approved for use in direct burial applications, such as in tank farms or at wellheads. The insulation used on the primary conductors must pass a mechanical water absorption test and a crush test, with the entire cable required to pass a crushing test of 1000 lbf.

CABLE SELECTION

When choosing a cable solution, users will know if their cable is UL listed by reading the legends printed on the cables, which should indicate whether is it classified as ITC or PLTC listed. Further, if an installation is exposed, users will want to ensure the letters ER come after the ITC or PLTC designation. For direct burial installations, cables should be identified by the letters DB or with the words Direct Burial. Both low and high temperature listing will also be included in the print on the cable, eliminating any guesswork.

Along with the mechanical characteristics of each cable, cost-saving benefits should also be considered when selecting network or connectivity cables. Today's tough industrial environments demand careful attention to every aspect of production, including cabling, so efficiency and cost-effectiveness remain driving factors for industry innovation. UL listed cables are price competitive with recognized AWM cables and are built for durability and extended longevity, reducing downtime, equipment repair/replacement and enhancing the capacity for profitability.

CONCLUSION

UL listed cables with superior flame performance, UV stability, mechanical strength and proven electrical integrity are the clear choice over AWM recognized only cables. Whether on the factory floor or in process applications, indoors or out, listed cables will perform reliably under extreme conditions ensuring continued connectivity and application efficiency.

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