Setting the standard for tray-rated fiber optic cable

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For copper wiring installations, engineers often specify tray-rated cables in their system designs to deliver signals and power to industrial control systems, heavy machinery, and other ancillary business equipment. As outlined in the National Fire Protection Association's NFPA 70, these cables must be third-party tested and certified to ensure it can withstand the dangers of harsh industrial environments while exposed in cable trays.

Since 2014, the United Kingdom's Fire Protection Association (FPA) has utilised the NFPA's codes and standards in its Property Risk Management Education and Certification Program. However, with no specific equivalent for fiber optic cables, some fiber optic manufacturers have begun offering "tray-rated" options despite the fact that there is little in the way of specific ratings, testing, or evaluation criteria.

This has led to considerable confusion, as engineers and installers are left to sift through competing claims and interpretations of which products are equivalent to the standards. Companies get requests from engineers, consultants and installers asking about 'tray-rated fiber. But there's no such thing.

Tray-rated cable

One of the most common methods of supporting wire and cable, cable trays are often utilised in harsh industrial environments in manufacturing plants, refineries, oil platforms, utilities, substations, and mining.

The most common form of wire certified to NFPA standards is Tray Cable (TC), a multi-conductor control, signal or power cable rated for 600 volts. Other alternatives include Power Limited Tray Cable (PLTC), Instrumentation Tray Cable (ITC), and Wind Turbine Tray Cable (WTTC). For exposed runs (ER) where cables extend six feet or more outside the tray, even higher standards of crush and impact resistance are required.

The purpose of the tray-rating is to define the mechanical and environmental performance specifications of cables that will be bundled together, often on top of each other, in open trays exposed to harsh indoor or outdoor environments.

At issue is the construction and jacketing of the cable, which can be damaged due to aggressive pulling or bending during installation, impact from falling debris, by heavy cabling, or damaged over time as a result of degradation by weather or infiltration from oil or water. Compared to cabling in enclosed conduit or raceways, a split or broken cable jacket can increase the risk of shock, short circuits, or electrical fire. As a result, the NFPA 70 sets standards for the safe installation and use of this type of wiring.

However, given the codes are primarily focused on fire safety and installation with electrical conductors, the code does not set forth any comparable requirements for fiber. The only mention is in Article 770, which states, "Fiber cables shall be permitted to be installed in cable trays." But this generalised statement is far from sufficient, given that fiber optic cable must stand up to most of the same environmental risks and dangers. This is driving the efforts of manufacturers such as OCC to establish specific benchmarks for fiber optic tray cable, backed by third-party verification testing.

There are some minor variations in the standards given the differences between copper and fiber. For example, crush and impact ratings for metallic cables are slightly higher due to concern that damaged insulation could lead to a short that causes a fire. If fiber is crushed, the consequence is merely attenuation or loss of signal.

Another shift is in the requirement that tray-rated cable in all its forms invariably includes a copper power conductor. Although companies such as OCC offer a hybrid product that combines fiber with a copper wire to deliver the same 600 volts as TC, new options include Fiber Optic Tray Cables (FOTC) with no power conductor.

There are several reasons for this, including that the insulation on copper wiring often must meet different requirements than the jacketing for fiber. Specifying each separately can also reduce costs. For most applications, it is more cost-effective to provide power and tray fiber through separate cables, because there are many configurations that require different jackets.

Power element or not, the cable will have to meet 5 essential requirements: resistance to impact, crush, UV rays, extreme temperature, and fire.

Jacketing options

As with traditional copper TC, much of the mechanical performance for fiber optics is derived by its jacketing. This can range from plastic (PVC or polyurethane) to cables with dual jackets, one of which is interlocked armor. Within these outer jackets, fiber optic components vary from individual to multi-fiber subunits.

The new benchmarks are designed to eliminate confusion and misconceptions about issues such as outer jacketing. A dual-jacket with interlocked armor may sound like the ideal option, but the crush rating can be lower than for a non-armored product. This is, in part, due to the fact that any crimps or indents in the interlocked armor caused during installation can leave a permanent spot for ongoing attenuation issues. In this case, a non-armored product may provide greater durability at a lower cost per foot.

Also affecting the durability is how the fibers are contained within the jacketing. For typical outdoor or long run distribution cable, loose-tube, gel-filled construction is popular due to its low cost. In this type of cable, the fibers are contained in small, rigid tubes, and generally flooded with gel or a powder as a water-blocking agent.

Although acceptable for use in more benign environments, loose-tube cabling tends to be relatively stiff and delivers a lower crush rating, bend radius, and less overall protection of fiber strands than more ruggedised options. In addition, with this type of cable, the gel or powder must first be cleaned off before terminations or splices are made.

However, some manufacturers offer ruggedised, tight buffered alternatives to meet the requirements of the harshest environments. As opposed to loose-tube designs, which only have one thin coating surrounding each optical fiber, ruggedised tight-buffered fibers have two. These options also provide for direct termination of fibers, which reduces the mess, expense of installation (up to 66%) and eliminate steps and materials required.

In the case of Optical Cable Corporation, ruggedness is increased through the use of a pressure-extruded (Core-Locked) or tightly bound outer jacket that firmly binds all the fibers together so that the cable moves as a single, solid unit.

The Core-Locked outer jacket is available on the company's FOTC family of products, which include break-out, riser-rated (BE Series), multiple subcable (GX Series), and high-density, high fiber count (HC Series) options.