OSHA FactSheet

Electrical Safety Hazards of Overloading Cable Trays

According to the 2005 National Electrical Code® (NEC), a cable tray system is "[a] unit or assembly of units or sections and associated fittings forming a structural system used to securely fasten or support cables and raceways." Cable trays support cable across open spans in the same manner that roadway bridges support traffic. Cable trays are not raceways, and are treated as a structural component of a facility's electrical system. Cable trays are a part of a planned cable management system to support, route, protect and provide a pathway for cable systems.

Cable trays feature flexibility unmatched by conduit, as cables are easier to mark, remove and find in cable trays. Cable trays are available in a number of different configurations, including ladder, ventilated trough, ventilated channel, solid bottom, wire mesh, single rail, and other similar structures. They are manufactured in steel, aluminum, and fiber reinforced plastic (FRP), although aluminum accounts for about 70% of the cable trays used in industry today.

Overloading cable trays

Cable trays come in a wide variety of sizes. The appropriate size and number of cable trays depends directly on the number and size of conductors intended and the allowable fill area as specified in the NEC. Also, since cable trays offer flexibility for modification and expansion, engineers and designers should plan cable tray systems to be sized and designed to anticipate both current and future needs.

Cable tray fill is addressed in the 2005 edition of NEC Sections 392.8, 392.9, 392.10, and 392.12. The type of cable tray (e.g., solid, ventilated), ampacity requirements, and the type and voltage rating of cable used determines the allowable fill for each cable tray — ventilated cable trays provide for the greatest allowable fill due to increased airflow. A generic guideline provided by The Cable Tray Institute indicates that cable trays should not be filled in excess of 40-50% of the inside area of the tray or of the maximum weight based on the cable tray specifications. The NEC provides specific and more detailed requirements for cable tray fill. In any case, the best strategy is to review and follow the rules set out in the NEC and the manufacturer's installation guides when installing cables in cable trays.

Hazards associated with overloaded cable trays

Overfilling and improperly securing wires in cable trays can lead to a number of serious hazards. Weight is one issue; all cable trays and their associated supports are rated for a specific maximum weight, based partly on the allowable fill area and the spacing of the cable tray supports. Overloading cable trays can lead to a breakdown of the tray, its connecting points, and/or supports, causing hazards to persons underneath the cable tray and even leading to possible electric shock and arc-flash/blast events from component failure when the cables are suddenly no longer supported. Additionally, cables in trays can be damaged by improperly securing and installing other cables and wires in the same cable tray.

The NEC requirements for cable tray fill also consider the heat buildup in conductors while current flows. When cable trays are overloaded, excessive heat buildup in and around live conductors can cause the insulation to break down, leading to potential shock hazards or fires. Fires can occur either in the cable tray (which may provide a fire path) or in combustible materials near the cable tray. Furthermore, the improper use of flexible cord could lead to the spread of toxic fumes if a fire were to occur.

Grounding of cable tray systems is essential for personal safety and protection against arc-

ing that can occur anywhere in the wiring system. Proper grounding must be done before cables are installed and tested before cables are energized. In addition to these general requirements, metallic cable tray systems supporting electrical conductors must be electrically continuous and effectively bonded as per the requirements of the 2005 edition of NEC Section 392.7.

Recognizing overloaded cable trays

Recognizing overloaded cable trays is not difficult. The fill values for cable trays specified in the 2005 NEC range from a single layer to roughly a 50% fill of the cross-sectional area of the cable tray. If visual observation reveals a cable tray that is completely full and/or overflowing with cables, chances are that the cable tray is in violation of both the National Electrical Code and OSHA requirements. One of the major culprits associated with overloaded cable trays are abandoned cables within the tray. These abandoned cables should be removed; and in fact, section 590.3(D) and various sections in Chapter 8 of the 2005 NEC specifically require removal of abandoned temporary wiring and communication cable installed within a cable tray.

Wiring methods permitted in cable trays

Any wiring methods used in cable trays must be listed by a Nationally Recognized Testing Laboratory as suitable for use in cable trays and in the environment in which it is installed. Table 392.3(A) of the NEC and OSHA's 1910.305(a)(3)(i) provide corresponding lists of conductors and raceways permitted in cable tray systems. Additionally, NEC Section 392.3(B) and OSHA's 1910.305(a)(3)(i)(B) allow other specific conductors in industrial establishments where maintenance and supervision assure that only qualified persons will service the cable tray systems. Flexible cords are not currently listed for use in cable trays (NEC Article 400, OSHA, 1910.305(g)) as they are prohibited as a replacement for the fixed wiring of a structure. The insulation on flexible cords can break down and become brittle over the years, which can lead to shorts and fires containing toxic fumes.

Standards and regulations that apply to cable trays

Cable trays were first covered in the 1965 edition of the NEC, under Continuous Rigid Cable Supports. Today, the use and installation of cable trays is covered by Article 392 of the NEC, and by OSHA regulations in 29 CFR 1910.305(a)(3) and 1910.399, or comparable standards promulgated by States operating OSHA-approved State plans. Specific permitted uses of cable trays are covered by the 2005 edition of NEC Section 392.3 and OSHA's 1910.305(a)(3)(i); uses not permitted are addressed in NEC 392.4 and OSHA's 1910.305(a)(3)(ii). Other sections and articles of the NEC are referenced throughout Article 392 for specific installation and use issues. The National Electrical Manufacturers Association (NEMA) also publishes three standards that apply to the proper manufacture and installation of cable trays: ANSI/NEMA-VE 1-1998, Metal Cable Tray Systems; NEMA-VE 2-1996, Metal Cable Tray Installation Guidelines; and NEMA-FG-1998, Nonmetallic Cable Tray Systems.

For more information

National Electrical Code®, (2005 Edition) Article 392 (See also NEC Handbook).

OSHA 29 CFR 1910.305(a)(3) and 1910.399.

Cable Tray Institute (http://www.cabletrays.com).

The Cable Tray Manufacturer's Installation and Use Instructions.

This is one in a series of informational fact sheets highlighting OSHA programs, policies or standards. It does not impose any new compliance requirements. For a comprehensive list of compliance requirements of OSHA standards or regulations, refer to Title 29 of the Code of Federal Regulations. This information will be made available to sensory impaired individuals upon request. The voice phone is (202) 693-1999; teletypewriter (TTY) number: (877) 889-5627.

For more complete information:

OSHA Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov

(800) 321-OSHA

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