insulation Types PFAH and TFE (used in high-temperature applications).

330.108 Equipment Grounding Conductor. Where Type MC cable is used to provide an equipment grounding conductor, it shall comply with 250.118(A)(10) and 250.122.

The interlocked sheath cable construction is not recognized as an EGC. An uninsulated grounding/bonding conductor must be integral to this type of MC cable to qualify the sheath as an EGC.

330.112 Insulation. Insulated conductors shall comply with 330.112(A) or (B).

(A) 1000 Volts or Less. Insulated control and signal conductors in sizes 18 AWG and 16 AWG shall be of a type listed in Table 402.3, with a maximum operating temperature not less than 90°C (194°F) and as permitted by 724.49. Ungrounded, grounded, and equipment grounding conductors 16 AWG and larger shall be of a type listed in Table 310.4(1) or of a type identified for use in Type MC cable.

(B) Over 1000 Volts. Insulated conductors shall be of a type listed in Table 310.4(2) and Table 315.10(A).

330.116 Sheath. Metallic covering shall be one of the following types: smooth metallic sheath, corrugated metallic sheath, or interlocking metal tape armor. The metallic sheath shall be continuous and close fitting. A nonmagnetic sheath or armor shall be used on single conductor Type MC. Supplemental protection of an outer covering of corrosion-resistant material shall be permitted and shall be required where such protection is needed. The sheath shall not be used as a current-carrying conductor.

Informational Note: See 300.6 for protection against corrosion.

330.130 Hazardous (Classified) Locations. Where required to be marked MC-HL, the cable shall be listed and shall have a gas/vapor tight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, and a separate equipment grounding conductor.

ARTICLE 332

Mineral-Insulated, Metal-Sheathed Cable: Type MI

Part I. General

332.1 Scope. This article covers the use, installation, and construction specifications for mineral-insulated, metal-sheathed cable, Type MI.

Type MI cable consists of one or more solid conductors insulated with highly compressed magnesium oxide and enclosed in a continuous copper or alloy steel (e.g., stainless steel) sheath with or without a nonmetallic jacket. (See Exhibit 332.1.) Type MI cable is rated 300 or 600 volts and is available in size 16 AWG and larger with one to seven conductors per cable. It is available in 18 AWG and larger in two conductor cables.

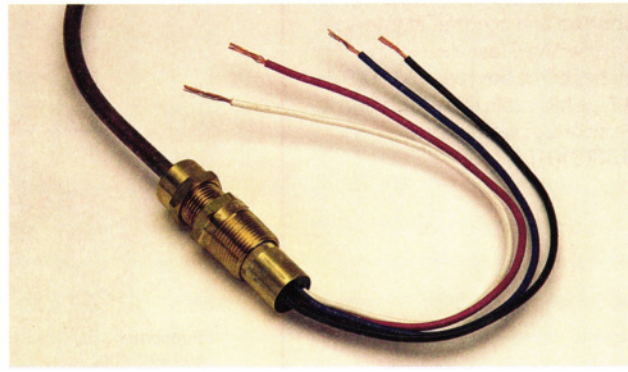

EXHIBIT 332.1 Mineral-insulated (MI) cable with four conductors internal to the cable. *[Courtesy of Tyco Thermal Controls (Canada) Ltd./Pyrotenax]*

332.6 Listing Requirements. Type MI cable and associated fittings shall be listed.

Part II. Installation

332.10 Uses Permitted. Type MI cable shall be permitted as follows:

(1) For services, feeders, and branch circuits
(2) For power, lighting, control, and signal circuits
(3) In dry, wet, or continuously moist locations
(4) Indoors or outdoors
(5) Where exposed or concealed
(6) Where embedded in plaster, concrete, fill, or other masonry, whether above or below grade
(7) In hazardous (classified) locations where specifically permitted by other articles in this *Code*
(8) Where exposed to oil and gasoline
(9) Where exposed to corrosive conditions not deteriorating to its sheath
(10) In underground runs where suitably protected against physical damage and corrosive conditions
(11) In or attached to cable tray

Informational Note: The "Uses Permitted" is not an all-inclusive list.

332.12 Uses Not Permitted. Type MI cable shall not be used under the following conditions or in the following locations:

(1) In underground runs unless protected from physical damage, where necessary
(2) Where exposed to conditions that are destructive and corrosive to the metallic sheath, unless additional protection is provided

332.17 Through or Parallel to Framing Members. Type MI cable shall be protected in accordance with 300.4 where installed through or parallel to framing members.

332.24 Bending Radius. Bends in Type MI cable shall be so made that the cable will not be damaged. The radius of the inner edge of any bend shall not be less than required as follows:

(1) Five times the external diameter of the metallic sheath for cable not more than 19 mm (¾ in.) in external diameter
(2) Ten times the external diameter of the metallic sheath for cable greater than 19 mm (¾ in.) but not more than 25 mm (1 in.) in external diameter

The minimum bending radius is to prevent mechanical damage to the conductor insulation or the sheath that could result in cracking, a hot spot at the point of damage, or both. Exhibit 332.2 illustrates the minimum bending radius for Type MI cables based upon the external or outside diameter (OD).

332.30 Securing and Supporting. Type MI cable shall be supported and secured by staples, straps, hangers, or similar fittings, designed and installed so as not to damage the cable, at intervals not exceeding 1.8 m (6 ft).

Type MI cable used as part of a fire-rated assembly typically requires more support than do non-fire-rated installations. The manufacturer's instructions will specify the support intervals to achieve the desired fire rating.

See also

300.19(B) for support requirements of fire-resistive cables and conductors

(A) Horizontal Runs Through Holes and Notches. In other than vertical runs, cables installed in accordance with 300.4 shall be considered supported and secured where such support does not exceed 1.8 m (6 ft) intervals.

(B) Unsupported Cable. Type MI cable shall be permitted to be unsupported where the cable is fished between access points through concealed spaces in finished buildings or structures and supporting is impracticable.

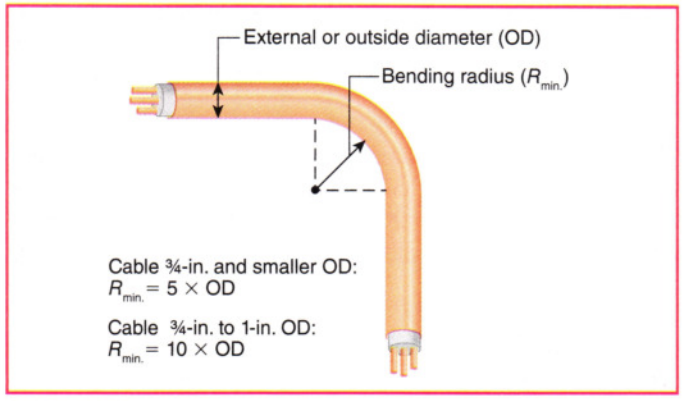

EXHIBIT 332.2 An illustration of the bending radius in Type MI cable.

(C) Cable Trays. All MI cable installed in cable trays shall comply with 392.30(A).

332.31 Single Conductors. Where single-conductor cables are used, all phase conductors and, where used, the neutral conductor shall be grouped together to minimize induced voltage on the sheath.

Because single conductors in a metal sheath can induce voltage on the sheath, all conductors of the circuit must be grouped together to minimize the voltage on the sheath.

Where single conductors enter a ferrous enclosure, inductive heating can occur due to hysteresis loss caused by the magnetic flux occurring in ferrous metals and I^2R losses from the currents induced by the conductor. To minimize this magnetic heating of enclosures, 300.20 requires additional measures, including cutting slots in the metal between the individual holes for each conductor connector. Cable manufacturers offer nonferrous connecting plates that accept individual threaded connections of all circuit conductors, thereby eliminating circulating currents and fully complying with 300.20.

332.40 Boxes and Fittings.

(A) Fittings. Fittings used for connecting Type MI cable to boxes, cabinets, or other equipment shall be identified for such use.

Fittings are required by 332.6 to be listed for use with Type MI cable. As shown in Exhibit 332.3, a complete box connector

EXHIBIT 332.3 A Type MI cable fitting used for terminating cable to an enclosure, to a box, or directly to equipment. *(Courtesy of Tyco Thermal Controls)*