

Conduit (LFNC-A), Liquidtight Flexible Nonmetallic Conduit (LFNC-B), or Liquidtight Nonmetallic Conduit (LFNC-C), in Table 4 of Chapter 9. If the conductors are of the same wire size and insulation type, Tables C.5 and C.5(A) (LFNC-A), Tables C.6 and C.6(A) (LFNC-B), or Tables C.7 and C.7(A) (LFNC-C) in Informative Annex C can be used instead of performing the calculations.

Δ 356.24 Bends.

N (A) How Made. Bends in conduit shall be so made that the conduit is not damaged and the internal diameter of the conduit is not effectively reduced. Bends shall be permitted to be made manually without auxiliary equipment. The radius of the curve to the centerline of any bend shall not be less than shown in Table 2, Chapter 9 using the column "Other Bends."

N (B) Number in One Run. The total degrees of bends in a conduit run shall not exceed 360 degrees between pull points.

356.28 Trimming. All cut ends of conduit shall be trimmed inside and outside to remove rough edges.

Δ **356.30 Securing and Supporting.** LFNC shall be securely fastened and supported in accordance with one of the following:

- (1) Where installed in lengths exceeding 1.8 m (6 ft), the conduit shall be securely fastened at intervals not exceeding 900 mm (3 ft) and within 300 mm (12 in.) on each side of every outlet box, junction box, cabinet, or fitting. Where used, cable ties shall be listed for the application and for securing and supporting.

Listing of cable ties for securement and support of flexible metal conduits is necessary because the standard requires markings that identify critical performance characteristics. These characteristics can affect their suitability for the conditions of use, including minimum and maximum operating temperatures and resistance to ultraviolet light for outdoor installations.

- (2) Securing or supporting of the conduit shall not be required where it is fished, installed in lengths not exceeding 900 mm (3 ft) at terminals where flexibility is required, or installed in lengths not exceeding 1.8 m (6 ft) from a luminaire terminal connection for tap conductors to luminaires permitted in 410.117(C).
- (3) Horizontal runs of LFNC supported by openings through framing members at intervals not exceeding 900 mm (3 ft) and securely fastened within 300 mm (12 in.) of termination points shall be permitted.
- (4) Securing or supporting of LFNC shall not be required where installed in lengths not exceeding 1.8 m (6 ft) from the last point where the raceway is securely fastened for connections within an accessible ceiling to a luminaire(s) or other equipment. For the purpose of 356.30, listed liquidtight flexible nonmetallic conduit fittings shall be permitted as a means of support.

356.42 Couplings and Connectors. Only fittings listed for use with LFNC shall be used. Angle connectors shall not be used for concealed raceway installations. Straight LFNC fittings are permitted for direct burial or encasement in concrete.

356.56 Splices and Taps. Splices and taps shall be made in accordance with 300.15.

Δ **356.60 Grounding.** Where equipment grounding is required, a separate grounding conductor shall be installed in the conduit.

Exception No. 1: The equipment grounding conductor shall be permitted to be run separately from the circuit conductors as permitted in 250.134, Exception No. 2, for dc circuits and 250.134, Exception No. 1, for separately run equipment grounding conductors.

Exception No. 2: The equipment grounding conductor shall not be required where the grounded conductor is used to ground equipment as permitted in 250.142.

Part III. Construction Specifications

356.100 Construction. LFNC-B as a prewired manufactured assembly shall be provided in continuous lengths capable of being shipped in a coil, reel, or carton without damage.

356.120 Marking. LFNC shall be marked at least every 600 mm (2 ft) in accordance with 110.21. The marking shall include a type designation in accordance with the definition of *Conduit, Liquidtight Flexible Nonmetallic (LFNC)* in Article 100 and the trade size. Conduit that is intended for outdoor use or direct burial shall be marked.

The type, size, and quantity of conductors used in prewired manufactured assemblies shall be identified by means of a printed tag or label attached to each end of the manufactured assembly and either the carton, coil, or reel. The enclosed conductors shall be marked in accordance with 310.8.

ARTICLE

358

Electrical Metallic Tubing (EMT)

Part I. General

358.1 Scope. This article covers the use, installation, and construction specifications for electrical metallic tubing (EMT) and associated fittings.

358.6 Listing Requirements. EMT, factory elbows, and associated fittings shall be listed.

Part II. Installation

358.10 Uses Permitted.

(A) Exposed and Concealed. The use of EMT shall be permitted for both exposed and concealed work for the following:

- (1) In concrete, in direct contact with the earth, in direct burial applications with fittings identified for direct burial, or in areas subject to severe corrosive influences where installed in accordance with 358.10(B)
- (2) In dry, damp, and wet locations
- (3) In any hazardous (classified) location as permitted by other articles in this *Code*
- (4) For manufactured wiring systems as permitted in 604.100(A)(2)

(B) Corrosive Environments.

(1) Galvanized Steel and Stainless Steel EMT, Elbows, and Fittings. Galvanized steel and stainless steel EMT, elbows, and fittings shall be permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences where protected by corrosion protection and approved as suitable for the condition.

(2) Supplementary Protection of Aluminum EMT. Aluminum EMT shall be provided with approved supplementary corrosion protection where encased in concrete or in direct contact with the earth.

According to the *UL Guide Information for Electrical Equipment*, category FJMX, galvanized steel EMT installed in concrete, on grade or above, generally requires no supplementary corrosion protection. However, galvanized and stainless steel EMT in concrete slab below grade level or in direct contact with earth is required to be protected from corrosion. Where galvanized steel EMT without supplementary corrosion protection extends directly from concrete encasement to soil burial, severe corrosive effects are likely to occur on the metal in contact with the soil.

Other documents, such as the Steel Tube Institute's 2021 *Guidelines for Installing Steel Conduit/Tubing*, and ANSI/NECA 101-2020, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)*, should be consulted for approval guidance of corrosion-resistant materials or for requirements prior to the installation of nonferrous metal (aluminum) conduit in concrete, since chloride additives in the concrete mix can cause corrosion.

(C) Cinder Fill. Galvanized steel and stainless steel EMT shall be permitted to be installed in cinder concrete or cinder fill where subject to permanent moisture when protected on all sides by a layer of noncinder concrete at least 50 mm (2 in.) thick or when the tubing is installed at least 450 mm (18 in.) under the fill.

Although cinder fill is not commonly used in modern construction, it is still encountered at older building sites. Cinders used as fill may contain sulfur and, when combined with moisture, form sulfuric acid, which can corrode metal raceways.

(D) Wet Locations. All supports, bolts, straps, screws, and so forth shall be of corrosion-resistant materials or protected against corrosion by corrosion-resistant materials.

Informational Note: See 300.6 for protection against corrosion.

(E) Physical Damage. Steel and stainless steel EMT shall be permitted to be installed where subject to physical damage.

358.12 Uses Not Permitted. EMT shall not be used under the following conditions:

- (1) Where subject to severe physical damage
- (2) For the support of luminaires or other equipment except conduit bodies no larger than the largest trade size of the tubing

358.14 Dissimilar Metals. Where practicable, dissimilar metals in contact anywhere in the system shall be avoided to eliminate the possibility of galvanic action.

Stainless steel and aluminum fittings and enclosures shall be permitted to be used with galvanized steel EMT, and galvanized steel fittings and enclosures shall be permitted to be used with aluminum EMT where not subject to severe corrosive influences.

Stainless steel EMT shall only be used with the following:

- (1) Stainless steel fittings
- (2) Stainless steel boxes and enclosures
- (3) Steel (galvanized, painted, powder or PVC coated, and so forth) boxes and enclosures when not subject to severe corrosive influences
- (4) Stainless steel, nonmetallic, or approved accessories

358.20 Size.

(A) Minimum. EMT smaller than metric designator 16 (trade size ½) shall not be used.

Exception: Metric designator 12 (trade size ¾) shall be permitted for enclosing the leads of motors as permitted in 430.245(B).

(B) Maximum. The maximum size of EMT shall be metric designator 155 (trade size 6).

Informational Note: See 300.1(C) for the metric designators and trade sizes. These are for identification purposes only and do not relate to actual dimensions.

358.22 Number of Conductors. The number of conductors shall not exceed that permitted by the percentage fill specified in Table 1, Chapter 9.

Cables shall be permitted to be installed where such use is not prohibited by the respective cable articles. The number of cables shall not exceed the allowable percentage fill specified in Table 1, Chapter 9.

Table 4 of Chapter 9 provides the usable area within the selected conduit or tubing, and Table 5 provides the required area for each conductor. Examples using these tables to calculate a conduit or

tubing size are provided in the commentary following Chapter 9, Notes to Tables, Note 6.

To select the proper trade size of EMT, see the appropriate sub-table for Article 358, Electrical Metallic Tubing (EMT), in Table 4 of Chapter 9. If the conductors are of the same wire size and insulation type, Tables C.1 and C.1(A) for EMT in Informative Annex C can be used instead of performing the calculations.

Δ 358.24 Bends.

(A) How Made. Bends shall be made so that the tubing is not damaged and the internal diameter of the tubing is not effectively reduced. The radius of the curve of any field bend to the centerline of the tubing shall not be less than shown in Table 2, Chapter 9 for one-shot and full shoe benders.

(B) Number in One Run. The total degrees of bends in a tubing run shall not exceed 360 degrees between pull points.

• 358.28 Reaming and Threading.

(A) Reaming. All cut ends of EMT shall be reamed or otherwise finished to remove rough edges.

In addition to a reamer, a half-round file has proved practical for removing rough edges from the interior and exterior of the conduit or tubing. The steel handle of a pair of pump pliers, the nose of side-cutting pliers, or an electrician's knife can be effective on the smaller sizes of EMT as well.

(B) Threading. EMT shall not be threaded.

Exception: EMT with factory threaded integral couplings complying with 358.100 shall be permitted.

358.30 Securing and Supporting. EMT shall be installed as a complete system in accordance with 300.18 and shall be securely fastened in place and supported in accordance with 358.30(A) and (B).

(A) Securely Fastened. EMT shall be securely fastened in place in accordance with the following:

- (1) At intervals not to exceed 3 m (10 ft)
- (2) Within 900 mm (3 ft) of each outlet box, junction box, device box, cabinet, conduit body, or other tubing termination

Type EMT is required to be "securely fastened" at the prescribed intervals as illustrated in Exhibit 358.1.

See also

344.30(A) and its commentary for more information on secure fastening

Exception No. 1: Fastening of unbroken lengths shall be permitted to be increased to a distance of 1.5 m (5 ft) where structural members do not readily permit fastening within 900 mm (3 ft).

Exception No. 2: For concealed work in finished buildings or prefinished wall panels where such securing is impracticable, unbroken lengths (without coupling) of EMT shall be permitted to be fished.

As illustrated in Exhibit 358.2, boxes are permitted to be secured to ceiling or roof support structural members that are spaced not more than 5 feet apart to serve as support for runs of EMT perpendicular to the axis of the ceiling or roof support members.

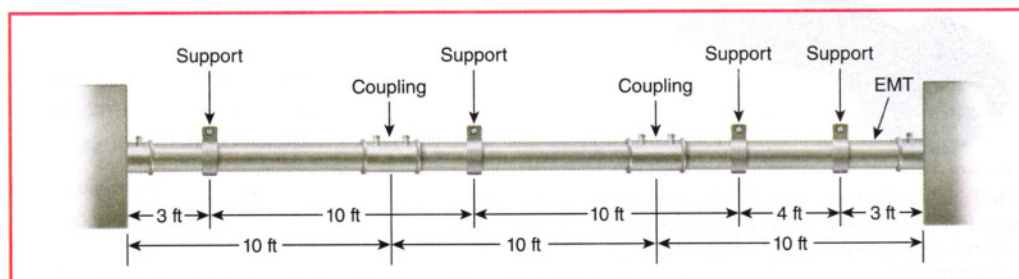
(B) Supports. Horizontal runs of EMT supported by openings through framing members at intervals not greater than 3 m (10 ft) and securely fastened within 900 mm (3 ft) of termination points shall be permitted.

Horizontal runs of EMT are permitted to be supported (but not necessarily secured) by framing members at 10-foot intervals, provided the EMT is secured at least 3 feet from the box or enclosure. See Exhibit 342.2 in the commentary following 342.30(B) (4) for an example.

358.42 Couplings and Connectors. Couplings and connectors used with EMT shall be made up tight. Where buried in masonry or concrete, they shall be concretetight type. Where installed in wet locations, they shall comply with 314.15.

Only listed fittings are permitted per 358.6, and 314.15 specifically requires that fittings for use in wet locations be listed for such use. According to ANSI/UL 797, *Electrical Metallic Tubing — Steel*, listed fittings suitable for use in poured concrete or where exposed to rain are indicated on the fitting or carton. The term *concretetight* or equivalent on the carton indicates suitability for use in poured concrete. The term *raintight* or the equivalent on the carton indicates suitability for use where directly exposed to rain.

EXHIBIT 358.1 Minimum requirements for securely fastening EMT unless an exception applies.



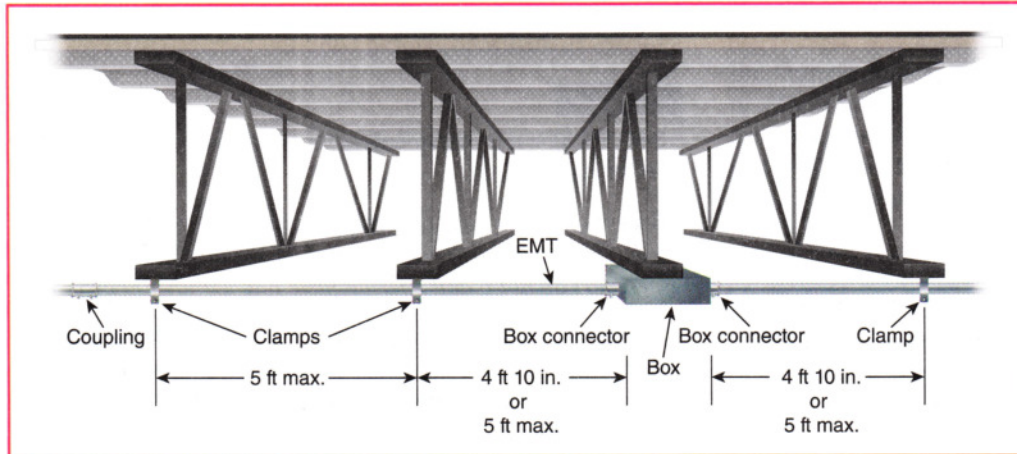


EXHIBIT 358.2 An EMT installation in which the fastening spacing is increased to a maximum of 5 feet.

See also

225.22 and **230.54(A)** for raintight requirements as applied to raceways on exterior surfaces of buildings and to service raceways

Indenter-type fittings, utilized only with metallic-coated EMT, require a special tool supplied by the manufacturer for proper installation. See Exhibit 358.3. Fittings are tested for use only with steel EMT, unless specific marking on the device or carton indicates the fittings are suitable for use with aluminum or

other material. Fittings are designed for dry-locations or concrete tight when installed per the manufacturer's installation instructions.

358.56 Splices and Taps. Splices and taps shall be made in accordance with 300.15.

358.60 Grounding. EMT shall be permitted as an equipment grounding conductor.

Part III. Construction Specifications

358.100 Construction. EMT shall be made of one of the following:

- (1) Steel with protective coatings
- (2) Aluminum
- (3) Stainless steel

358.120 Marking. EMT shall be clearly and durably marked at least every 3 m (10 ft) as required in the first sentence of 110.21(A).



EXHIBIT 358.3 Indenter-type EMT coupling for use with steel EMT (top); Indenter forged crimping tool for proper installation of indenter-type couplings and connectors (bottom). (Courtesy of Hubbell/RACO)

ARTICLE

360

Flexible Metallic Tubing (FMT)

Part I. General

360.1 Scope. This article covers the use, installation, and construction specifications for flexible metallic tubing (FMT) and associated fittings.

FMT is a type of raceway used for certain specific applications, particularly under the requirements of 300.22(B) and (C) for wiring in ducts and other air-handling spaces. Initially intended for use in such locations, FMT is an effective barrier to the gases and