Part III. Construction Specifications

360.120 Marking. FMT shall be marked according to 110.21.

ARTICLE 362

Electrical Nonmetallic Tubing (ENT)

Part I. General

362.1 Scope. This article covers the use, installation, and construction specifications for electrical nonmetallic tubing (ENT) and associated fittings.

ENT is made of the same material used for polyvinyl chloride (PVC) conduit. The outside diameters of ENT (½-inch through 2-inch trade sizes only) are such that standard couplings and other fittings for rigid PVC conduit can be used.

Because of the corrugations, the raceway can be bent by hand and has some degree of flexibility. ENT is not intended for use where flexibility is necessary, such as at motor terminations to prevent transmission of noise and vibration, or for connection of adjustable luminaires or moving parts. ENT is suitable for the installation of conductors having a temperature rating as indicated on the product. The maximum allowable ambient temperature is 122°F. Exhibit 362.1 shows an example of ENT.

•N **362.2 Reconditioned Equipment.** ENT shall not be reconditioned.

362.6 Listing Requirements. ENT and associated fittings shall be listed.

Part II. Installation

Δ **362.10 Uses Permitted.** For the purpose of this article, the first floor of a building shall be that floor that has 50 percent or more of the exterior wall surface area level with or above finished grade. One additional level that is the first level and not designed for human habitation and used only for vehicle parking, storage, or similar use shall be permitted. The use of ENT and fittings shall be permitted in the following:

(1) In any building not exceeding three floors above grade as follows:

a. For exposed work, where not prohibited by 362.12
b. Concealed within walls, floors, and ceilings

Where exposed and subject to physical damage, ENT is required to be protected and is limited to use in buildings not exceeding three floors above grade. Where concealed or above a suspended ceiling (exposed), ENT is permitted to be installed within walls, floors, or ceilings in buildings of three floors or fewer without the need for fire-rated construction. The three-floor limitation is based on the likelihood that only a small quantity of ENT would be exposed to fire and that the occupants would have adequate time to exit the building before the products of combustion made the building untenable. Exhibit 362.2 illustrates permitted uses of ENT in a building of three floors or fewer.

(2) In any building exceeding three floors above grade concealed within combustible or noncombustible walls, floors, and ceilings where the walls, floors, and ceilings provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies.

Exception to (2): Where an approved automatic fire protective system(s) is installed on all floors, ENT shall be permitted to be

EXHIBIT 362.1 Various sizes of ENT suitable for use. *(Courtesy of Thomas and Betts, A Member of the ABB Group)*

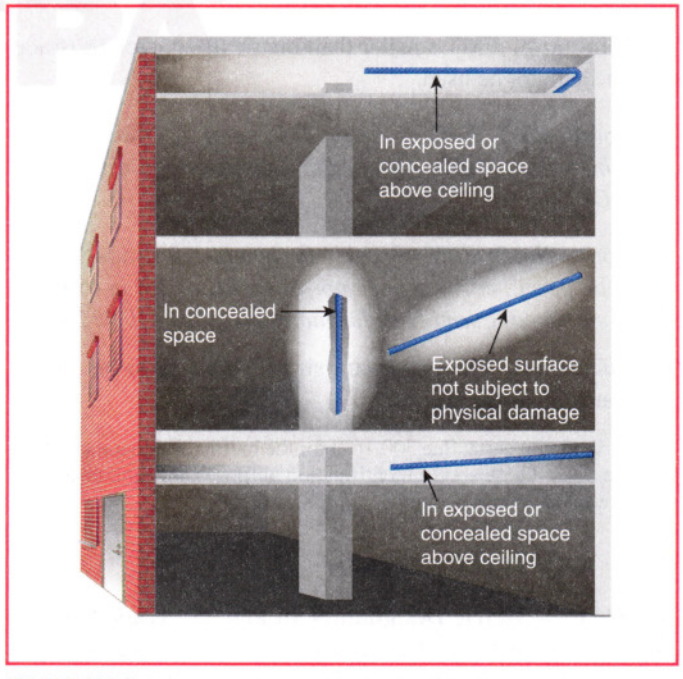

EXHIBIT 362.2 Examples of permitted uses of ENT in a building not exceeding three floors.

used within walls, floors, and ceilings, exposed or concealed, in buildings exceeding three floors above grade.

Informational Note No. 1: A finish rating is established for assemblies containing combustible (wood) supports. The finish rating is defined as the time at which the wood stud or wood joist reaches an average temperature rise of 121°C (250°F) or an individual temperature of 163°C (325°F) as measured on the plane of the wood nearest the fire. A finish rating is not intended to represent a rating for a membrane ceiling.

Informational Note No. 2: See NFPA 13-2022, *Standard for the Installation of Sprinkler Systems*, a recognized fire sprinkler system(s) standard.

ENT is permitted to be installed within the walls, floors, or ceilings of a building of any height where the walls, floors, or ceilings provide a thermal barrier of material that has at least a 15-minute finish rating. Exposed ENT in the first three floors of a building that exceeds three floors is not permitted or intended except as permitted in 362.10(5). Where installed in a building exceeding three floors, ENT must be installed behind the 15-minute thermal barrier on all floors. Exhibit 362.3 illustrates areas in a building exceeding three floors in which ENT is permitted to be used. In accordance with the exception, fire sprinkler systems can also be used as a construction condition under which an expanded use of ENT is allowed.

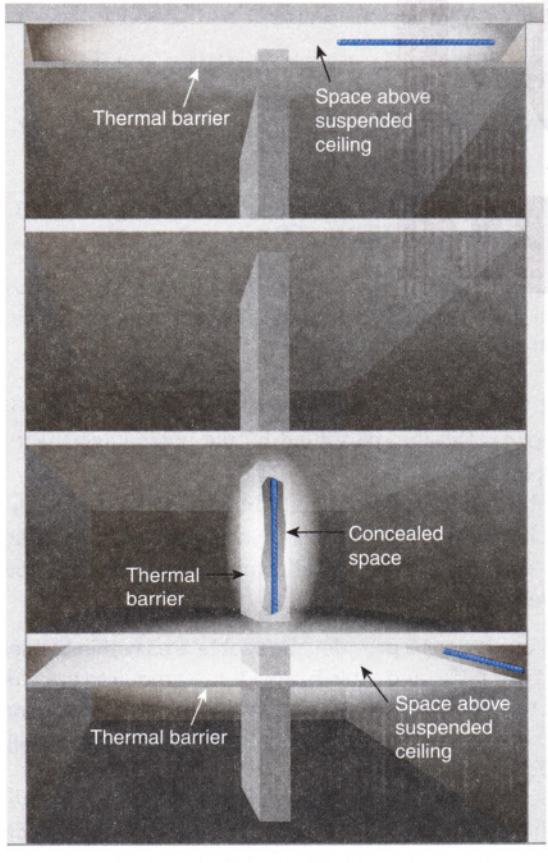

EXHIBIT 362.3 Examples of permitted uses of ENT in a building exceeding three floors.

Interior finish is generally considered to consist of those materials or combinations of materials that form the exposed interior surface of walls and ceilings in a building. Common interior finish materials include plaster, gypsum wallboard, wood, plywood paneling, fibrous ceiling tiles, and a variety of wall coverings. Ordinary paint, wallpaper, or other similar wall coverings not exceeding 1/28 inch in thickness are generally considered incidental to interior finish, except where the AHJ deems them a hazard.

The finish rating of a wall or ceiling finish material is the time required for the unexposed surface of the finish membrane to reach an average temperature rise of 250°F above ambient or an individual temperature rise at any one point not exceeding 325°F when the assembly is tested in accordance with ANSI/UL 263, *Standard for Fire Tests of Building Construction and Materials*, or

COMMENTARY TABLE 362.1 Various Finishes over Wood Framing, One Side (Combustible) with Exposure on Finish Side

Material	Fire Resistance Rating[a] (min.)
Fiberboard, ½ in. thick	5
Fiberboard, flameproofed, ½ in. thick	10
Fiberboard, ½ in. thick, with ½ in.-1:2, 1:2 gypsum-sand plaster	15
Gypsum wallboard, ⅜ in. thick	10
Gypsum wallboard, ½ in. thick	15
Gypsum wallboard, ⅝ in. thick	20
Gypsum wallboard, laminated, two ⅜ in.	28
Gypsum wallboard, laminated, one ⅜ in. plus one ½ in. thick	37
Gypsum wallboard, laminated, two ½ in. thick	47
Gypsum wallboard, laminated, two ⅝ in. thick	60
Gypsum lath, plain or indented, ⅜ in. thick, with ½ in.-1:2, 1:2 gypsum-sand plaster	20
Gypsum lath, perforated, ⅜ in. thick, with ½ in.-1:2, 1:2 gypsum-sand plaster	30
Gypsum-sand plaster, 1:2, 1:3, ½ in. thick, on wood lath	15
Lime-sand plaster, 1:5, 1:7.5, ½ in. thick, on wood lath	15
Gypsum-sand plaster, 1:2, 1:2, ¾ in. thick, on metal lath (no paper backing)	15
Neat gypsum plaster, ¾ in. thick, on metal lath (no paper backing)[b]	30
Neat gypsum plaster, 1 in. thick, on metal lath (no paper backing)[b]	35
Lime-sand plaster, 1:5, 1:7.5, ¾ in. thick, on metal lath (no paper backing)	10
Portland cement plaster, ¾ in. thick, on metal lath (no paper backing)	10
Gypsum-sand plaster, 1:2, 1:3, ¾ in. thick, on paper-backed metal lath	20

Note: For SI units, 1 in. = 25.4 mm.

[a]From National Institute for Standards and Technology, BMS-92.

[b]Unsanded wood-fiber plaster.

ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*.

The finish rating of wall and ceiling finish materials tested and rated by UL as part of wall and ceiling assemblies can be found in the UL *Fire Resistance Directory*, immediately following the assembly rating and just below the design number. Only assemblies containing combustible support members, however, have published finish ratings. Obviously, limiting ENT to constructions consisting of combustible support members is not the intent. This section is intended to provide a 15-minute thermal barrier as a minimum threshold of acceptability.

Commentary Table 362.1, reproduced from the NFPA *Fire Protection Handbook*, 20th edition (Volume 2, Section 19, Chapter 2, Table 19.2.13), provides ratings for common finish materials. If the finish rating concealing the ENT is unknown or is less than 15 minutes, the ENT can still be used if the installation meets the criteria in 362.10, including the three-floor limitation, where required, and the installation is not prohibited by 362.12. For finish materials not tested and rated in the UL *Fire Resistance Directory*, use Commentary Table 362.1.

See also

10.2.1 of NFPA *101®*, *Life Safety Code®*, for more information regarding classification of interior finish material

(3) In locations subject to severe corrosive influences as covered in 300.6 and where subject to chemicals for which the materials are specifically approved.
(4) In concealed, dry, and damp locations not prohibited by 362.12.
(5) Above suspended ceilings where the suspended ceilings provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies, except as permitted in 362.10(1)a.

Exception to (5): ENT shall be permitted to be used above suspended ceilings in buildings exceeding three floors above grade where the building is protected throughout by an approved automatic fire protective system.

Informational Note No. 3: See NFPA 13-2022, *Standard for the Installation of Sprinkler Systems*, a recognized fire sprinkler system(s) standard.

(6) Encased in poured concrete floors, ceilings, walls, and slabs.
(7) Embedded in a concrete slab on grade where ENT is placed on sand or approved screenings, provided fittings identified for this purpose are used for connections.
(8) For wet locations as permitted in this section or in a concrete slab on or belowgrade, with fittings listed for the purpose.
(9) Metric designator 16 through 27 (trade size ½ through 1) as listed manufactured prewired assembly.

Prewired ENT is a listed assembly whose conductors must be installed at the manufacturing facility, where controlled conditions prevent damage to the conductor insulation. Special tools are required for cutting prewired ENT to prevent nicking of the conductor insulation.

(10) With conductors or cables rated at a temperature higher than the listed temperature rating of ENT if the conductors or cables are not operated at a temperature higher than the listed temperature rating of the ENT.

362.12 Uses Not Permitted. ENT shall not be used in the following:

(1) In any hazardous (classified) location, except as permitted by other articles in this *Code*
(2) For the support of luminaires and other equipment
(3) Where subject to ambient temperatures in excess of 50°C (122°F) unless listed otherwise
(4) For direct earth burial
(5) In exposed locations, except as permitted by 362.10(1), 362.10(5), and 362.10(8)
(6) In theaters and similar locations, except as provided in 518.4 and 520.5
(7) Where exposed to the direct rays of the sun, unless identified as sunlight resistant
(8) Where subject to physical damage

Informational Note: Extreme cold may cause some types of nonmetallic conduits to become brittle and therefore more susceptible to damage from physical contact.

362.20 Size.

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

(B) Maximum. ENT larger than metric designator 63 (trade size 2½) shall not be used.

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.

362.22 Number of Conductors. The number of conductors shall not exceed that permitted by the percentage fill 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 ENT, see the appropriate sub-table for Article 362, Electrical Nonmetallic Tubing (ENT), in Table 4 of Chapter 9. If the conductors are of the same wire size and insulation type, Tables C.2 and C.2(A) for ENT in Informative Annex C can be used instead of performing the calculations.

Δ **362.24 Bends.**

N **(A) How Made.** Bends shall be so made that the tubing will not be damaged and the internal diameter of the tubing will not be effectively reduced. Bends shall be permitted to be made manually without auxiliary equipment, and the radius of the curve to the centerline of such bends 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 tubing run shall not exceed 360 degrees between pull points.

•

362.28 Trimming. All cut ends shall be trimmed inside and outside to remove rough edges.

362.30 Securing and Supporting. ENT shall be installed as a complete system in accordance with 300.18 and shall be securely fastened in place by an approved means and supported in accordance with 362.30(A) and (B).

(A) Securely Fastened. ENT shall be securely fastened at intervals not exceeding 900 mm (3 ft). In addition, ENT shall be securely fastened in place within 900 mm (3 ft) of each outlet box, device box, junction box, cabinet, or fitting where it terminates. Where used, cable ties shall be listed for the application and for securing and supporting.

Exception No. 1: Lengths not exceeding a distance of 1.8 m (6 ft) from a luminaire terminal connection for tap connections to lighting luminaires shall be permitted without being secured.

Exception No. 2: 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 luminaire(s) or other equipment.

Exception No. 3: For concealed work in finished buildings or prefinished wall panels where such securing is impracticable, unbroken lengths (without coupling) of ENT shall be permitted to be fished.

As illustrated in Exhibit 362.4, where run on the surface of framing members, ENT is required to be fastened to the framing member every 3 feet and within 3 feet of every box.

As illustrated in Exhibit 362.5, ENT is permitted by Exception No. 1 to be used as luminaire whip without support for lengths not exceeding 6 feet.

See also

300.4(D) for requirements for protection against physical damage

410.117(C) for details on tap conductor wiring

(B) Supports. Horizontal runs of ENT supported by openings in framing members at intervals not exceeding 900 mm (3 ft) and securely fastened within 900 mm (3 ft) of termination points shall be permitted.

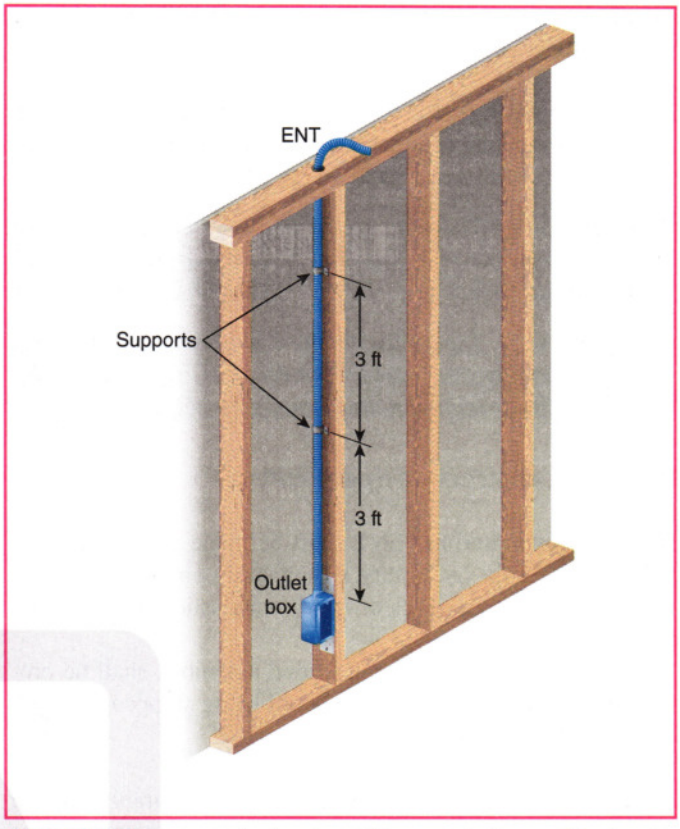

EXHIBIT 362.4 An example showing ENT supported every 3 feet and within 3 feet of the outlet box.

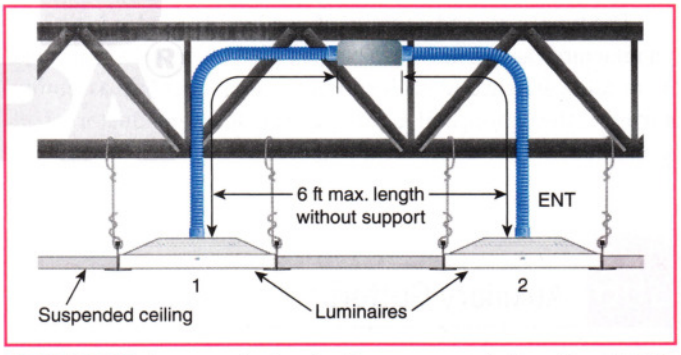

EXHIBIT 362.5 An example showing two unsupported lengths of ENT, each permitted to be installed in a length not to exceed 6 feet.

362.46 Bushings. Where a tubing enters a box, fitting, or other enclosure, a bushing or adapter shall be provided to protect the wire from abrasion unless the box, fitting, or enclosure design provides equivalent protection.

Informational Note: See 300.4(G) for the protection of conductors size 4 AWG or larger.

362.48 Joints. All joints between lengths of tubing and between tubing and couplings, fittings, and boxes shall be by an approved method.