**Chapter 8** Communications Systems

CHAPTER

## **COMMUNICATIONS SYSTEMS**

#### INTRODUCTION TO CHAPTER 8— COMMUNICATIONS SYSTEMS

Chapter 8 of the *National Electrical Code* covers the wiring requirements for communications systems such as telephones, radio and TV antennas, satellite dishes, closed-circuit television (CCTV), and cable TV (CATV) systems, as well as network-powered broadband communications systems not under the exclusive control of the communications utility. **Figure 1** 

Communications systems aren't subject to the general requirements contained in Chapters 1 through 4 or the special requirements of Chapters 5 through 7, except where a Chapter 8 rule specifically refers to one of those chapters [90.3]. Also, installations of communications equipment under the exclusive control of communications utilities located outdoors, or in building spaces used exclusively for such installations, are exempt from the *NEC* [90.2(B)(4)]. Figure 2

- Article 800. Communications Circuits. Article 800 covers the installation requirements for telephone wiring and for other related telecommunications purposes such as computer local area networks (LANs), and outside wiring for fire and burglar alarm systems connected to central stations.
- Article 810. Radio and Television Equipment. This article covers antenna systems for radio and television receiving equipment, amateur radio transmitting and receiving equipment, and certain features of transmitter safety. It also includes antennas such as multi-element, vertical rod and dish, and the wiring and cabling that connect them to the equipment.





 Article 820. Community Antenna Television (CATV) and Radio Distribution Systems. Article 820 covers the installation of coaxial cables to distribute limited-energy high-frequency signals for television, cable TV, and closed-circuit television (CCTV), which is often used for security purposes. This article also covers the premises wiring of satellite TV systems where the dish antenna is outside and covered by Article 810.

### **BOD** Communications Circuits

#### **INTRODUCTION TO ARTICLE 800—COMMUNICATIONS CIRCUITS**

This article has its roots in telephone technology. Consequently, it addresses telephone and related systems that use twisted-pair wiring. Here are a few key points to remember about Article 800:

- Don't attach incoming communications cables to the service-entrance power mast.
- It's critical to determine the "point of entrance" for these circuits.
- Ground the primary protector as close as practicable to the point of entrance.
- Keep the grounding conductor for the primary protector as straight and as short as possible.
- Where you locate communications cables above a suspended ceiling, route and support them to allow access via ceiling panel removal.
- Keep these cables separated from lightning protection circuits.
- Where you install communications cables in a Chapter 3 raceway, you must do so in conformance with the NEC requirements for the raceway system.
- Special labeling and marking provisions apply—follow them carefully.

#### **PART I. GENERAL**

ARTICLE

**800.1 Scope.** This article covers circuits that extend voice, audio, video, interactive services, and outside wiring for fire alarm and burglar alarm from the communications utility to the customer's communications equipment up to and including equipment such as a telephone, fax machine, or answering machine [800.2] and communications equipment. Figure 800–1

**Author's Comment:** The telephone utility typically provides twisted-pair communications cable to a Network Interface Device (NID) for dwelling units or small commercial facilities, and backboards for larger facilities.



This article covers circuits that extend voice, audio, video, interactive services, and outside wiring for fire alarms and burglar alarms from the communications utility to the customer's communications equipment [800.2].



#### 800.2 Definitions.

**Abandoned Communications Cable.** A communications cable that isn't terminated to equipment and not identified for future use with a tag.

**Author's Comment:** Section 800.25 requires the accessible portion of abandoned communications cables to be removed.

**Communications Circuit.** The circuit that extends voice, audio, video, interactive services, and outside wiring for fire alarm and burglar alarm from the communications utility to the customer's communications equipment up to and including terminal equipment such as a telephone, fax machine, or answering machine.

**Point of Entrance.** The point within a building at which the communications cable emerges from an external wall, from a concrete floor slab, or from a rigid metal conduit or an intermediate metal conduit connected by a grounding conductor to an electrode in accordance with 800.100. Figure 800–2



Figure 800–2

#### 800.3 Other Articles.

(B) Other Space Used for Environmental Air. Communications cables and raceways identified as suitable for plenum use can be installed above a suspended ceiling or below a raised floor used for environmental air [300.22(C) and 800.154(A)]. Figure 800–3



Figure 800–3

**800.18 Installation of Equipment.** Communications equipment must be listed [800.170] and must be installed in accordance with manufacturer's instructions [110.3(B)].

**800.21 Access to Electrical Equipment Behind Panels Designed to Allow Access.** Access to equipment must not be prohibited by an accumulation of communications cables that prevent the removal of suspended-ceiling panels. Communications cables must be located so that the suspended-ceiling panels can be moved to provide access to electrical equipment.

**800.24 Mechanical Execution of Work.** Equipment and communications cabling must be installed in a neat and workmanlike manner.

**FPN:** Accepted industry practices are described in ANSI/ NECA/BICSI 568, *Standard for Installing Commercial Building Telecommunications Cabling*, and other ANSIapproved standards. **Figure 800–4** 

**Author's Comment:** Other standards include ANSI/ TIA-569-B-2004, *Commercial Building Standard for Telecommunications Pathways and Spaces*; and ANSI/TIA-570-B, *Residential Telecommunications Infrastructure*.





Exposed communications cables must be supported by the structural components of the building so that the communications cable will not be damaged by normal building use. Cables must be secured with straps, staples, cable ties, hangers, or similar fittings designed and installed so as not to damage the communications cable. Figure 800–5



Figure 800–5

Communications raceways and communications cable assemblies must be securely fastened in place and ceiling-support wires or the ceiling grid must not be used to support communications raceways or communications cables [300.11]. Figure 800–6



Figure 800-6

**Author's Comment:** Raceways and cables are permitted to be supported by independent support wires attached to the suspended ceiling in accordance with 300.11(A).

Cables run parallel to framing members or furring strips must be protected where they are likely to be penetrated by nails or screws, by installing the wiring method so it isn't less than  $1\frac{1}{4}$  in. from the nearest edge of the framing member or furring strips, or is protected by a  $\frac{1}{16}$  in. thick steel plate or equivalent [300.4(D)]. Figure 800–7

**800.25 Abandoned Cable.** To limit the spread of fire or products of combustion within a building, the accessible portion of communications cable that isn't terminated at equipment and not identified for future use with a tag must be removed [800.2]. Figure 800–8

Author's Comment: Cables installed in concealed raceways aren't considered "accessible," therefore they're not required to be removed.

Cables identified for future use must be with a tag that can withstand the environment involved. Figure 800–9

#### 800.26 **Communications Circuits**



#### Figure 800–7



Figure 800-8

#### **800.26 Spread of Fire or Products of Combustion.**

Electrical circuits and equipment must be installed in such a way that the spread of fire or products of combustion will not be substantially increased. Openings in fire-rated walls, floors, and ceilings for electrical equipment must be firestopped using methods approved by the authority having jurisdiction to maintain the fire-resistance-rating of the firerated assembly. Figure 800–10



Figure 800–9



**Author's Comment:** Firestop material is listed for the specific types of wiring methods and construction structures.

**FPN:** Directories of electrical construction materials published by qualified testing laboratories contain listing and installation restrictions necessary to maintain the fire-resistive rating of assemblies. Outlet boxes must have a horizontal separation not less than 24 in. when installed in a fire-rated assembly, unless an outlet box is listed for closer spacing or protected by fire-resistant "putty pads" in accordance with manufacturer's instructions.

#### PART II. CABLES OUTSIDE AND ENTERING BUILDINGS

#### **800.44 Overhead Communications Cables.**

**(B)** Above Roofs. Communications cables must have a vertical clearance of at least 8 ft from all points of roofs above which they pass.

Exception No. 1: Auxiliary buildings such as garages.

Exception No. 2: Cable clearance over the roof overhang can be reduced from 8 ft to 18 in. if no more than 6 ft of overhead conductors pass over no more than 4 ft of roof and they terminate to a raceway mast or other approved support.

**800.48 Unlisted Cables Entering Buildings.** Unlisted communications cable is permitted in a building if the length

of the cable within the building, from its point of entrance, does not exceed 50 ft and the cable terminates in an enclosure or primary protector. Figure 800–11



Figure 800-11

**FPN No. 2:** The primary protector must be located as close as practicable to the point at which the cable enters the building [800.90(B)]. Therefore, unlisted outside plant communications cables may not be permitted to enter the building if it's practicable to place the primary protector closer than 50 ft to the point of entrance.

**Author's Comment:** The point of entrance is defined as the point within the building where the cable emerges from an external wall, from a concrete floor slab, or from a rigid metal conduit or an intermediate metal conduit connected to an electrode by a grounding conductor in accordance with 800.100 [800.2].

**800.53 Lightning Conductors.** Where feasible, a separation not less than 6 ft must be maintained between communications wiring and lightning protection conductors. Figure 800–12



Figure 800–12

#### **PART III. PROTECTION**

#### **800.90 Primary Protection.**

(A) Application. A listed primary protector is required for each communications circuit.

**(B)** Location. The primary protector must be located as close as practicable to the point of entrance.

**FPN:** The point of entrance is defined as the point within the building where the communications cable emerges from an external wall, from a concrete floor slab, or from a rigid metal conduit or an intermediate metal conduit connected to an electrode by a grounding conductor in accordance with 800.100 [800.2].

**Author's Comment:** Selecting a primary protector location to achieve the shortest practicable primary protector grounding conductor [800.100(A)(4)] helps reduce differences in potential between communications circuits and other metallic systems during lightning events.

#### **PART IV. GROUNDING METHODS**

#### 800.100 Cable Grounding.

- (A) Grounding Conductor. The grounding conductor must be:
- (1) Insulated.
- (2) Copper or other corrosion-resistant conductive material, stranded or solid.
- (3) Not be smaller than 14 AWG.
- (4) As short as practicable and for one- and two-family dwellings, the grounding conductor must not exceed 20 ft in length. Figure 800–13



Figure 800–13

**FPN:** Limiting the length of the grounding conductor helps limit induced potential (voltage) differences between the building's power and communications systems during light-ning events.

Exception: Where the grounding conductor is over 20 ft for one- and two-family dwellings, a separate ground rod not less than 5 ft long [800.100(B)(3)(2)] with fittings suitable for the application [800.100(C)] must be installed. The additional ground rod must be bonded to the power grounding electrode system with a minimum 6 AWG conductor [800.100(D)].

(5) Run in as straight a line as practicable.

Author's Comment: Lightning doesn't like to travel around corners or through loops, which is why the grounding conductor must be run as straight as practicable. (6) Mechanically protected where subject to physical damage, and where run in a metal raceway both ends of the raceway must be bonded to the grounding conductor.

**Author's Comment:** Installing the grounding conductor in PVC conduit is a better practice.

(B) Electrode. The grounding conductor must be connected in accordance with (B)(1), (B)(2), or (B)(3):

(1) Buildings or Structures with an Intersystem Bonding Termination. The grounding conductor for the primary protector and the metallic sheath of communications cable must terminate to the intersystem bonding terminal [Article 100 and 250.94]. Figure 800–14



Figure 800–14

Author's Comment: Bonding all systems to the intersystem bonding termination helps reduce induced potential (voltage) differences between the power and the radio and television systems during lightning events. Figure 800–15

(2) Building or Structure Without Intersystem Bonding Termination. The grounding conductor must terminate to the nearest accessible: Figure 800–16

- (1) Building or structure grounding electrode system [250.50]
- (2) Interior metal water piping system, within 5 ft from its point of entrance [250.52(A)(1)]









- (3) Accessible means external to the building, as covered in 250.94
- (4) Metallic service raceway
- (5) Service equipment enclosure
- (6) Grounding electrode conductor or the grounding electrode conductor metal enclosure

(7) Grounding conductor or the grounding electrode of a remote building or structure disconnecting means [250.32].

800.100

The intersystem bonding terminal must be mounted on the fixed part of an enclosure so that it will not interfere with the opening of an enclosure door. A bonding device must not be mounted on a door or cover even if the door or cover is nonremovable.

(3) In Buildings or Structures Without Intersystem Bonding Termination or Grounding Means. The grounding conductor must connect to:

- (1) Any individual electrodes described in 250.52(A)(1), (A)
  (2), (A)(3), or (A)(4).
- (2) Any individual electrodes described in 250.52(A)(6) and (A)(7), or to a ground rod not less than 5 ft long and <sup>1</sup>/<sub>2</sub> in. in diameter. Figure 800–17



Figure 800–17

**Author's Comment:** The reason communications ground rods only need to be 5 ft long is because that's the length the telephone company used before the *NEC* contained requirements for communications systems. Telephone company ground rods were only 5 ft long because that's the length that would fit in their equipment trailers.

(C) Electrode Connection. Terminations at the electrode must be by exothermic welding, listed lugs, listed pressure connectors, or listed clamps. Grounding fittings that are concreteencased or buried in the earth must be listed for direct burial [250.70]. (D) Bonding of Electrodes. Where a separate grounding electrode, such as a ground rod, is installed for a communications system, it must be bonded to the building's power grounding electrode system with a minimum 6 AWG conductor. Figure 800–18



Figure 800–18

**FPN No. 2:** Bonding all systems to the intersystem bonding termination helps reduce induced potential (voltage) between the power and communications systems during lightning events. **Figure 800–19** 

#### PART V. INSTALLATION METHODS WITHIN BUILDINGS

#### **800.110 Raceways for Communications Circuits.**

**Chapter 3 Wiring Methods.** Where communications cables are installed in a Chapter 3 wiring method, the raceway must be installed in accordance with Chapter 3. Figure 800–20

**Communications Raceways.** Where communications cables are installed in a listed communications nonmetallic raceway, the raceway must be installed in accordance with 362.24 through 362.56. Figure 800–21



Figure 800–19





Author's Comment: In other words, listed communications raceways must be installed according to the following rules for ENT:

- 362.24 Bending radius
- 362.26 Maximum total bends between pull points, 360 degrees
- 362.28 Trimmed to remove rough edges
- 362.30 Supported every 3 ft, and within 3 ft of any enclosure
- 362.48 Joints between tubing, fittings, and boxes



#### Figure 800–21

Raceway fill limitations don't apply when communications cables are installed in a raceway.

Author's Comment: Communications cables are only permitted in a Chapter 3 wiring method as limited by 800.133.

**800.113 Listing of Communications Cables.** Communications cables installed within buildings must be listed.

*Exception:* Unless the length of the cable from its point of entrance, doesn't exceed 50 ft as permitted by 800.48.

#### 800.133 Installation of Communications Cables.

(A) Separation from Power Conductors.

(1) In Raceways, Cable Trays, and Boxes.

(a) With Other Cables in Raceway or Enclosure. Communications cables are permitted to be in the same raceway, cable tray, or enclosure as jacketed cables of any of the following: Figure 800–22

- (1) Class 2 and Class 3 circuits [Article 725].
- (2) Power-limited fire alarm systems [Article 760].
- (3) Optical fiber cables [Article 770].
- (4) CATV systems [Article 820].

(b) Class 2, and Class 3 Circuits. Communications conductors are permitted to be within the same cable with Class 2 or Class 3 conductors, provided that communications cables in accordance with Article 800 are used [725.139(D)(1)]. Figure 800–23



#### Figure 800–22



Figure 800–23

#### Author's Comments:

- A common application of this requirement is when a single cable is used for both voice communications and data.
- Listed Class 2 cables have a voltage rating of 150V [725.179(G)], whereas communications cables have a voltage rating of 300V [800.179].

(c) With Power Conductors in Same Raceway or Enclosure. Communications conductors must not be placed in any raceway, compartment, outlet box, junction box, or similar fitting with conductors of electric power or Class 1 circuits.

Exception No. 1: Communications circuits are permitted to be within the same enclosure with conductors of electric power and Class 1 circuits, where separated by a permanent barrier or listed divider.

Author's Comment: Separation is required to prevent a fire or shock hazard that can occur from a short between the communications circuits and the higher-voltage circuits.

Exception No. 2: Communications conductors are permitted to be mixed with power conductors if the power circuit conductors are only introduced to supply power to communications equipment. The power circuit conductors must maintain a minimum  $\frac{1}{2}$  in. separation from the communications circuit conductors.

(2) Other Applications. Communications circuits must maintain 2 in. of separation from electric power or Class 1 circuit conductors.

Exception No. 1: Separation isn't required if all electric power or Class 1 circuit conductors are in a raceway or in metalsheathed, metal-clad, nonmetallic-sheathed, or underground feeder cables, or all communications cables are in a raceway. Figure 800–24



Figure 800-24

**(B)** Support of Conductors. Communications cables are not permitted to be strapped, taped, or attached to the exterior of any raceway as a means of support. Figure 800–25





**Author's Comment:** Exposed cables must be supported by the structural components of the building so that the cable will not be damaged by normal building use. The cables must be secured by straps, staples, cable ties, hangers, or similar fittings designed and installed in a manner that will not damage the cable [800.24].

*Exception: Overhead (aerial) spans of communications wiring can be attached to a raceway-type mast intended for the attachment and support of such conductors.* Figure 800–26



Figure 800-26

Author's Comment: Communications cables must not be supported by, or attached to, the power service mast [230.28].

(C) Wiring in Ducts for Dust, Loose Stock, or Vapor Removal. Communications cables must not be installed in manufactured ducts that transport dust, loose stock, or vapors [300.22(A)].

#### 800.154 Applications of Communications Cables.

Communications conductors and cables must comply with (A) through (D) or, where cable substitutions are made, in accordance with (E).

(A) Ducts or Plenums. Where necessary for direct action upon, or sensing of the contained air, communications cables are permitted to be installed in ducts or plenums if installed in a metal raceway [300.22(B)].

Communications cables identified as suitable for plenum use (CMP) [800.179(A)] can be installed above a suspended ceiling or below a raised floor used for environmental air [300.22(C)]. Communications raceways identified as suitable for plenum use [800.182] are permitted above a suspended ceiling or below a raised floor used for environmental air, if the raceway contains communications cables identified as suitable for plenum use (CMP). Figure 800–27



Figure 800–27

Author's Comment: Communications cables not identified as suitable for plenum use can be installed above a suspended ceiling or below a raised floor used for environmental air, but only if the communications cables not identified as suitable for plenum use are installed in a metal raceway [300.22(C)(1)].

**(B) Riser.** Cables installed in risers must comply with (1), (2), or (3).

(1) Exposed Cables. Cables installed in vertical runs penetrating more than one floor must be CMR [800.179(B)]. Floor penetrations requiring CMR must contain only cables suitable for riser or plenum use. Listed riser or listed plenum communications raceways with CMR and CMP cables are permitted to be installed in risers.

(2) Cables in Metal Raceway. CM cables must be encased in a metal raceway or located in a fireproof shaft having a firestop at each floor.

#### Author's Comments:

- When communications cables are installed in a metal raceway, they aren't required to be riser- or plenum-rated.
- Metal raceways containing circuit conductors from powersupply systems that operate below 50V aren't required to be connected to an equipment grounding conductor [250.86 and 250.162(A)].

(3) One- and Two-Family Dwellings. CM and CMX cables are permitted to be installed for all applications in one- and two-family dwellings.

**Author's Comment:** Communications cables identified as suitable for plenum or riser use aren't required in one- or two-family dwellings.

(C) Other Wiring Within Buildings. Cables installed in building locations other than the locations covered in 800.154(A) through 800.154(D) must be as follows:

(1) Type CMG [800.179(C)] or CM [800.179(D)]. Types CMG, CM, CMR, or CMP cables are permitted to be installed in general-purpose, listed riser communications raceways, and listed plenum communications raceways.

(2) In Raceways. Listed communications cables of any type can be installed in any Chapter 3 raceway.

(3) Nonconcealed Spaces. CMX communications cable [800.182(A)] can be installed where the exposed length of cable doesn't exceed 10 ft.

(4) One- and Two-Family Dwellings. CMX communications cables [800.182(A)] can be installed where they are less than  $\frac{1}{4}$  in. in diameter.

(5) Multifamily Dwellings. CMX communications cables [800.182(A)] can be installed in nonconcealed spaces where they are less than  $\frac{1}{4}$  in. in diameter.

**(D) Cable Trays.** CMP, CMR, CMG, and CM communications cables are permitted to be installed in cable trays.

**(E) Cable Substitutions.** CATV coaxial cable substitutions are permitted as listed in Table 800.154.

**800.156 Dwelling Unit Communications Outlet.** One communications outlet must be installed within each dwelling unit and cabled to the service provider's demarcation point. Figure 800–28



the service provider demarcation point.

Figure 800-28

#### **PART VI. LISTING REQUIREMENTS**

#### **800.179 Listing Requirements for Communications**

**Cables.** Communications cables must be listed as suitable for the purpose in accordance with (A) through (I) and have a voltage rating of 300V, which must not be marked on the cable. Figure 800–29

FPN No. 1: Voltage markings on cables may be misinterpreted to suggest that the cables are suitable for Class 1, or electrical power applications, which they're not.



Figure 800-29

(A) Type CMP. Communications cables identified as suitable for plenum use (CMP) are listed for use in ducts, plenums, and other environmental air spaces because they have adequate fire-resistant and low smoke-producing characteristics [800.154(A)]. Figure 800–30





**(B)** Type CMR. CMR communications riser cables are listed for use in a vertical run in a shaft, or from floor to floor [800.154(B)].

**(C) Type CMG.** CMG communications cables are listed for general-purpose communications use, with the exception of risers and plenums, and must also be listed as being resistant to the spread of fire.

**(D) Type CM.** CM communications cables are listed for general-purpose use [800.154(D)].

(E) Type CMX. CMX communications cables are listed for use in dwellings and for use in a raceway [800.154(B)(3) and (E)].

800.182 Listing Requirements for Communications

**Raceways.** Communications raceways are listed in accordance with (A) through (C).

(A) Plenum Communications Raceways. Communications raceways identified as suitable for plenum use are suitable for use in environmental air spaces.

#### Author's Comments: Figure 800–31

- Communications raceways identified as suitable for plenum use aren't permitted in a duct or plenum space [300.22(B)].
- Where used in environmental air spaces, a listed communications raceway identified as suitable for plenum use must contain communications cables identified as suitable for plenum use (CMP) [800.154(A)].
- Special consideration must be given to raceways in areas that move or transport environmental air in order to reduce the hazards that arise from the burning conductor insulation and cable jackets. Because listed communications cables identified as suitable for plenum use have adequate fire-resistant and low smoke-producing characteristics, they can be installed in environmental air spaces.



Plenum-rated communications raceways are listed as suitable for use in ducts, plenums, or other environmental air spaces, but they are not permitted in a duct or plenum space [300.22(B)].

COPYRIGHT 2008 Mike Holt Enterprises, Inc. 2008 NEC

#### Figure 800–31

**(B) Riser Communications Raceway.** Communications raceways identified as suitable for riser use are listed as suitable for running vertically through more than one floor.

**Author's Comment:** Listed suitable for riser use communications raceways that run vertically and penetrate more than one floor must contain communications cables identified as suitable for plenum or riser use (CMR and CMP) [800.154(B)(1)].

(C) General-Purpose Communications Raceway. Generalpurpose communications raceways installed in general-purpose areas must only contain CM, CMR, or CMP cables [800.154(D)(1)].

# **800 Practice Questions**

#### ARTICLE 800. COMMUNICATIONS CIRCUITS—PRACTICE QUESTIONS

- 1. Communications cables not terminated at both ends with a connector or other equipment and not identified for future use with a tag are considered abandoned.
  - (a) True

RTICL

- (b) False
- 2. Communications circuits and equipment installed in a location that is \_\_\_\_\_ in accordance with 500.5 shall comply with the applicable requirements of Chapter 5.
  - (a) designed
  - (b) classified
  - (c) located
  - (d) approved
- 3. Communications cables installed \_\_\_\_\_ on the surface of ceilings and walls shall be supported by the building structure in such a manner that the cable will not be damaged by normal building use.
  - (a) exposed(b) concealed(c) hidden(d) a and b
- 4. Openings around penetrations of communications cables and raceways through fire-resistant-rated walls, partitions, floors, or ceilings shall be \_\_\_\_\_ using approved methods to maintain the fire-resistance rating.
  - (a) closed
  - (b) opened
  - (c) draft stopped
  - (d) firestopped
- 5. When practicable, a separation of at least \_\_\_\_\_ shall be maintained between communications cables on buildings and lightning conductors.
  - (a) 6 ft
    (b) 8 ft
    (c) 10 ft
    (d) 12 ft

- 6. In one- and two-family dwellings where it is not practicable to achieve an overall maximum primary protector grounding conductor length of 20 ft, a separate ground rod not less than \_\_\_\_\_ in length shall be driven and it shall be connected to the power grounding electrode system with a 6 AWG conductor.
  - (a) 5 ft
    (b) 8 ft
    (c) 10 ft
    (d) 20 ft
- Communications electrodes must be bonded to the power grounding electrode system using a minimum \_\_\_\_\_\_ copper bonding jumper.
  - (a) 10 AWG(b) 8 AWG(c) 6 AWG(d) 4 AWG
- Communications cables shall be separated by at least 2 in. from conductors of \_\_\_\_\_ circuits, unless permitted otherwise.
  - (a) power(b) lighting(c) Class 1(d) any of these
- 9. Communications plenum cable shall be \_\_\_\_\_ as being suitable for use in other spaces used for environmental air.
  - (a) marked(b) identified(c) approved(d) listed

# BEQUID Radio and Television Equipment

#### **INTRODUCTION TO ARTICLE 810—RADIO AND TELEVISION EQUIPMENT**

This article covers transmitter and receiver equipment—and the wiring and cabling associated with that equipment. Here are a few key points to remember about Article 810:

- Avoid contact with conductors of other systems.
- · Don't attach antennas or other equipment to the service-entrance power mast.
- · Where the mast isn't grounded properly, voltage surges caused by nearby lightning strikes can destroy it.
- · Keep the grounding conductor straight, and protect it from physical damage.
- Where the mast isn't bonded properly, you risk flashovers and possible electrocution.
- Keep in mind that the purpose of bonding is to prevent a difference of potential between metallic objects and other conductive items, such as swimming pools.
- Clearances are critical, and Article 810 contains detailed clearance requirements. For example, it provides separate clearance requirements for indoor and outdoor locations.

#### **PART I. GENERAL**

**810.1 Scope.** Article 810 contains the installation requirements for the wiring of television and radio receiving equipment, such as digital satellite receiving equipment for television signals and amateur radio equipment antennas. Figure 810–1

#### Author's Comment: Article 810 covers:

- VHF/UHF antennas, which receive local television signals.
- Satellite antennas, which are often referred to as satellite dishes. Large satellite dish antennas (often about 6 ft in diameter) usually have a motor that moves the dish to focus on different satellites. The smaller satellite dish antennas (18 in. in diameter) are usually aimed at a single satellite.
- Roof-mounted antennas for AM/FM/XM radio reception.
- Amateur radio transmitting and receiving equipment, including HAM radio equipment (a noncommercial [amateur] communications system).



Figure 810–1

**810.3 Other Articles.** Wiring from the power supply to Article 810 equipment must be installed in accordance with Chapters 1 through 4. Wiring for audio equipment must comply with Article 640 and coaxial cables that connect antennas to equipment must be installed in accordance with Article 820. Figure 810–2



Figure 810-2

Author's Comment: The grounding requirements for antenna cables are contained in 810.20(C) and 810.21, not Article 820.

**810.4 Community Television Antenna.** The antenna for community television systems must be installed in accordance with this article, but the coaxial cable beyond the point of entrance must be installed in accordance with Article 820. Figure 810–3

**Author's Comment:** A community TV antenna is used for multiple-occupancy facilities, such as apartments, condominiums, motels, and hotels.



Figure 810–3

#### PART II. RECEIVING EQUIPMENT— ANTENNA SYSTEMS

**810.12 Support of Lead-in Cables.** Outdoor antennas and lead-in conductors must be securely supported, and the lead-in conductors must be securely attached to the antenna.

Author's Comment: Outdoor antennas aren't permitted to be attached to the electric service mast [230.28]. Figure 810–4



Figure 810-4

#### 810.13 Avoid Contact with Conductors of Other Sys-

**tems.** Outdoor antennas and lead-in conductors must be kept at least 2 ft from exposed electric power conductors to avoid the possibility of accidental contact.

**Author's Comment:** According to the *National Electrical Code Handbook*, "One of the leading causes of electrical shock and electrocution is the accidental contact of radio, television, and amateur radio transmitting and receiving antennas, and equipment with light or power conductors. Extreme caution should therefore be exercised during this type of installation, and periodic visual inspections should be conducted thereafter."

**810.15 Metal Antenna Supports—Grounding.** Outdoor masts and metal structures that support antennas must be grounded in accordance with 810.21.

#### 810.18 Clearances.

(A) Outside of Buildings. Lead-in conductors attached to buildings must be installed so that they can't swing closer than 2 ft to the conductors of circuits of 250V or less, or closer than 10 ft to the conductors of circuits of over 250V. Lead-in conductors must be kept at least 6 ft from the light-ning protection system and underground antenna lead-in conductors must maintain a separation not less than 12 in. from electric power conductors. Figure 810–5



Figure 810-5

*Exception: Separation is not required where the underground antenna lead-in conductors or the electric power conductors are installed in a raceway or cable armor.*  Author's Comment: The NEC doesn't specify a burial depth for antenna lead-in wires.

**FPN No. 1:** The grounding electrode for a lightning protection system must not be used for the building or structure grounding electrode [250.60].

**FPN No. 2:** Metal raceways, enclosures, frames, and metal parts of electric equipment must be bonded or spaced from the lightning protection system in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems.* 

#### Author's Comments:

- Separation from lightning protection conductors is typically 6 ft through air or 3 ft through dense materials such as concrete, brick, or wood.
- Where a lightning protection system is installed, it must be bonded to the building or structure grounding electrode system [250.106].

**(B)** Indoors. Indoor antenna and lead-in conductors must not be less than 2 in. from electrical power conductors.

*Exception No. 1: Separation isn't required if the antenna leadin conductors or the electrical power conductors are installed in a raceway or cable armor.* 

(C) Enclosures. Indoor antenna lead-in conductors are permitted to be in the same enclosure with electric power conductors where separated by an effective, permanently installed barrier. Figure 810–6





#### 810.20 Antenna Discharge Unit.

(A) **Required.** Each lead-in conductor from an outdoor antenna must be provided with a listed antenna discharge unit.

**(B)** Location. The antenna discharge unit must be located outside or inside the building, nearest the point of entrance, but not near combustible material.

**(C)** Grounding. The antenna discharge unit must be grounded in accordance with 810.21.

**810.21 Grounding Conductors.** The antenna mast [810.15] and antenna discharge unit [810.20(C)] must be grounded as follows. Figure 810–7



Figure 810–7

Author's Comment: Grounding the lead-in antenna cables and the mast help prevent voltage surges caused by static discharge or nearby lightning strikes from reaching the center conductor of the lead-in coaxial cable. Because the satellite dish sits outdoors, wind creates a static charge on the antenna as well as on the cable attached to it. This charge can build up on both the antenna and the cable until it jumps across an air space, often passing through the electronics inside the low noise block down converter feedhorn (LNBF) or receiver. Connecting the coaxial cable and dish to the building grounding electrode system (grounding) helps to dissipate this static charge. Nothing can prevent damage from a direct lightning strike. But grounding with proper surge protection can help reduce damage to the satellite dish and other equipment from nearby lightning strikes.

(A) Material. The grounding conductor to the electrode [810.21(F)] must be copper or other corrosion-resistant conductive material, stranded or solid.

**(B) Insulation.** The grounding conductor isn't required to be insulated.

**(C) Supports.** The grounding conductor must be securely fastened in place.

**(D) Mechanical Protection.** The grounding conductor must be mechanically protected where subject to physical damage, and where run in a metal raceway both ends of the raceway must be bonded to the grounding conductor. Figure 810–8



Figure 810–8

**Author's Comment:** Installing the grounding conductor in PVC conduit is a better practice.

(E) Run in Straight Line. The grounding conductor must be run in as straight a line as practicable.

**Author's Comment:** Lightning doesn't like to travel around corners or through loops, which is why the grounding conductor must be run as straight as practicable.

**(F)** Electrode. The grounding electrode conductor must terminate in accordance with (1), (2), or (3).

(1) Buildings or Structures With an Intersystem Bonding Termination. The grounding conductor for the antenna mast and antenna discharge unit must terminate to the intersystem bonding terminal [Article 100 and 250.94]. Figure 810–9





Author's Comment: Bonding all systems to the intersystem bonding termination helps reduce induced potential (voltage) differences between the power and the radio and television systems during lightning events. Figure 810–10



Figure 810-10

(2) In Buildings or Structures Without Intersystem Bonding Termination. The grounding conductor for the antenna mast and antenna discharge unit must terminate to the nearest accessible on the following: Figure 810–11



Figure 810–11

- (1) Building or structure grounding electrode system [250.50]
- (2) Interior metal water piping system, within 5 ft from its point of entrance [250.52(A)(1)], Figure 810–12



Figure 810–12

- (3) Accessible means external to the building, as covered in 250.94
- (4) Metallic service raceway

- (5) Service equipment enclosure
- (6) Grounding electrode conductor or the grounding electrode conductor metal enclosure

(3) In Buildings or Structures Without a Grounding Means. The grounding conductor for the antenna mast and antenna discharge unit must terminate to the nearest accessible on the following:

(1) Any individual electrodes described in 250.52

(2) Structural steel grounded in accordance with 250.52(A)(2)

**(G) Inside or Outside Building.** The grounding conductor can be run either inside or outside the building.

**(H) Size.** The grounding conductor must not be smaller than 10 AWG copper or 17 AWG copper-clad steel or bronze.

**Author's Comment:** Copper-clad steel or bronze wire (17 AWG) is often molded into the jacket of the coaxial cable to simplify the grounding of the satellite dish by eliminating the need to run a separate grounding conductor to the dish [810.21(F)(2)].

(J) Bonding of Electrodes. Where a ground rod is installed to serve as the grounding electrode for the radio and television equipment, it must be connected to the building's power grounding electrode system with a minimum 6 AWG conductor. Figure 810–13



Figure 810–13

**(K)** Electrode Connection. Termination of the grounding conductor must be by exothermic welding, listed lugs, listed pressure connectors, or listed clamps. Grounding fittings that are concrete-encased or buried in the earth must be listed for direct burial [250.70].

#### PART III. AMATEUR TRANSMITTING AND RECEIVING STATIONS—ANTENNA SYSTEMS

**810.51 Other Sections.** Antenna systems for amateur transmitting and receiving stations must also comply with the following requirements:

**Support of Lead-In Cables.** Antennas and lead-in conductors must be securely supported, and the lead-in conductors must be securely attached to the antenna [810.12].

Avoid Contact with Conductors of Other Systems. Outdoor antennas and lead-in conductors must be kept at least 2 ft from exposed electric power conductors to avoid the possibility of accidental contact [810.13].

Metal Antenna Supports—Grounding. Outdoor masts and metal structures that support antennas must be grounded in accordance with 810.21 [810.15].

**810.54 Clearance on Building.** Antenna lead-in conductors must be firmly mounted at least 3 in. away from the surface of the building.

**810.57 Antenna Discharge Units.** Each lead-in conductor from an outdoor antenna must be provided with a listed antenna discharge unit or other suitable means that drain static charges from the antenna system.

*Exception No. 1: Where protected by a continuous metallic shield grounded according to 810.58.* 

*Exception No. 2: Where the antenna is grounded according to 810.58.* 

#### 810.58 Grounding Conductors.

(A) Other Sections. The antenna mast [810.15] and antenna discharge unit [810.57] must be grounded as specified in 810.21.

**(B)** Size of Protective Grounding Conductor. The grounding conductor must be the same size as the lead-in conductors, but not smaller than 10 AWG copper, bronze, or copper-clad steel.

(C) Size of Operating Grounding Conductor. The grounding conductor for transmitting stations must not be smaller than 14 AWG copper or its equivalent.

Article 810

# **810 Practice Questions**

#### ARTICLE 810. RADIO AND TELEVISION EQUIPMENT—PRACTICE QUESTIONS

- 1. Outdoor antennas and lead-in conductors shall be securely supported and the lead-in conductors shall be securely attached to the antenna, but they shall not be attached to the electric service mast.
  - (a) True
  - (b) False
- Indoor antenna and lead-in conductors for radio and television receiving equipment shall be separated by at least \_\_\_\_\_ from conductors of any electric power or Class 1 circuit conductors, unless otherwise permitted.
  - (a) 2 in.(b) 12 in.
  - (c) 12 in.
  - (d) 6 ft

3. Each lead-in conductor from an outdoor antenna shall be provided with a listed antenna discharge unit, unless enclosed in a grounded metallic shield.

(a) True

(b) False

- 4. The grounding conductor for an antenna mast shall be \_\_\_\_\_ protected where subject to physical damage.
  - (a) electrically(b) mechanically(c) arc fault(d) none of these
- 5. The grounding conductor for an antenna mast or antenna discharge unit, if copper, shall not be smaller than 10 AWG.
  - (a) True(b) False

### **Community Antenna Television (CATV) and Radio Distribution Systems**

#### INTRODUCTION TO ARTICLE 820—COMMUNITY ANTENNA TELEVISION (CATV) AND RADIO DISTRIBUTION SYSTEMS

This article focuses on the distribution of television and radio signals within a facility or on a property via cable, rather than their transmission or reception via antenna. These signals are limited energy, but they are high frequency.

- As with Article 800, you must determine the "point of entrance" for these circuits.
- Ground the incoming coaxial cable as close as practicable to the point of entrance.
- Where coaxial cables are located above a suspended ceiling, route and support them to allow access via ceiling panel removal.
- Clearances are critical, and Article 820 contains detailed clearance requirements. For example, it requires at least 6 ft of clearance between coaxial cable and lightning conductors.
- Where you use a separate grounding electrode, you must run a bonding jumper to the power grounding system.

#### **PART I. GENERAL**

ARTICL

**820.1 Scope.** Article 820 covers the installation of coaxial cables for distributing high-frequency signals typically employed in community antenna television (CATV) systems. Figure 820–1

**Author's Comment:** Coaxial cables that connect antennas to television and radio receiving equipment [810.3] and community television systems [810.4] must be installed in accordance with this article. **Figure 820–2** 

#### 820.2 Definitions.

**Abandoned Cable.** A cable that isn't terminated to equipment and not identified for future use with a tag.

**Coaxial Cable.** A round assembly composed of a conductor inside a metallic tube or shield, separated by dielectric material covered by an insulating jacket. Figure 820–3

CATV Raceway. A raceway for coaxial cables.



Figure 820–1



Figure 820-2



Figure 820–3

**Point of Entrance.** The point within a building where the coaxial cable emerges from an external wall, from a concrete floor slab, or from a rigid metal conduit or an intermediate metal conduit grounded to an electrode in accordance with 820.100. Figure 820–4

#### 820.3 Locations and Other Articles.

**(B)** Ducts, Plenums, and Other Spaces Used for Environmental Air-Handling Purposes. Where necessary for direct action upon, or sensing of the contained air, coaxial cables are permitted to be installed in ducts or plenums if they are installed in a metal raceway as required by 300.22(B).



820.3



Coaxial cables identified as suitable for plenum use [820.179(A)] can be installed above a suspended ceiling or below a raised floor used for environmental air [300.22(C)]. CATV raceways identified as suitable for plenum use [820.182] are permitted above a suspended ceiling or below a raised floor used for environmental air if the raceway contains coaxial cables identified as suitable for plenum use [820.179(A)]. Figure 820–5



Figure 820–5

#### 820.15 Community Antenna Television (CATV) and Radio Distribution Systems

**Author's Comment:** Coaxial cables not identified as suitable for plenum use can be installed above a suspended ceiling or below a raised floor used for environmental air, but only if the coaxial cable is installed in a metal raceway [300.22(C)(1)].

(C) Installation and Use. Equipment must be installed in accordance with manufacturer's instructions [110.3(B)].

**(D) Optical Fiber Cables.** Optical fiber cable must be installed in accordance with Article 770.

**(E) Communications Circuits.** Twisted-pair conductor cable used for communications circuits must comply with Article 800.

**820.15 Power Limitations.** Coaxial cable is permitted to deliver power at a maximum of 60V to equipment that is directly associated with the radio frequency distribution system.

**820.21 Access to Electrical Equipment Behind Panels Designed to Allow Access.** Access to equipment must not be prohibited by an accumulation of coaxial cables that prevent the removal of suspended-ceiling panels. Coaxial cables must be located so that the suspended-ceiling panels can be moved to provide access to electrical equipment.

**820.24 Mechanical Execution of Work.** Equipment and coaxial cabling must be installed in a neat and work-manlike manner.

**FPN:** Accepted industry practices are described in ANSI/ NECA/BICSI 568, *Standard for Installing Commercial Building Telecommunications Cabling*, and other ANSIapproved standards. Figure 820–6

Author's Comment: Other standards include ANSI/ TIA-569-B-2004, *Commercial Building Standard for Telecommunications Pathways and Spaces;* and ANSI/TIA-570-B, *Residential Telecommunications Infrastructure.* 

Exposed coaxial cables must be supported by the structural components of the building so that the coaxial cable will not be damaged by normal building use. Coaxial cables must be secured by straps, staples, cable ties, hangers, or similar fittings designed and installed so as not to damage the coaxial cable. Figure 820–7

Raceways that contain coaxial cables must be securely fastened in place. Ceiling-support wires or the ceiling grid must not be used to support raceways or coaxial cables [300.11]. Figure 820–8



Figure 820–6





**Author's Comment:** Raceways and coaxial cables are permitted to be supported by independent support wires attached to the suspended ceiling in accordance with 300.11(A).

Coaxial cables run through or parallel to framing members or furring strips must be protected where they are likely to be penetrated by nails or screws, by installing the coaxial cables so they aren't less than  $1\frac{1}{4}$  in. from the nearest edge of the framing member or furring strips, or by protecting the coaxial cable with a  $\frac{1}{16}$  in. thick steel plate [300.4(D)]. Figure 820–9

#### Community Antenna Television (CATV) and Radio Distribution Systems







Figure 820–9

**820.25 Abandoned Cable.** To limit the spread of fire or products of combustion within a building, the accessible portion of coaxial cable that isn't terminated at equipment, and not identified for future use with a tag, must be removed [820.2]. Figure 820–10

Cables identified for future use must be with a tag that can withstand the environment involved. Figure 820–11



820.26

Figure 820–10



Figure 820–11

Author's Comment: Cables installed in concealed raceways aren't considered "accessible," therefore they're not required to be removed.

#### 820.26 Spread of Fire or Products of Combustion.

Electrical circuits and equipment must be installed in such a way that the spread of fire or products of combustion will not be substantially increased. Openings in fire-rated walls, floors, and ceilings for electrical equipment must be firestopped using methods approved by the authority having jurisdiction to maintain the fire-resistance-rating of the firerated assembly. Figure 820–12





**Author's Comment:** Firestop material is listed for the specific types of wiring methods and construction structures.

**FPN:** Directories of electrical construction materials published by qualified testing laboratories contain listing and installation restrictions necessary to maintain the fire-resistive rating of assemblies. Outlet boxes must have a horizontal separation not less than 24 in. when installed in a fire-rated assembly, unless an outlet box is listed for closer spacing or protected by fire-resistant "putty pads" in accordance with manufacturer's instructions.

#### PART II. COAXIAL CABLES OUTSIDE AND ENTERING BUILDINGS

#### 820.44 Overhead Coaxial Cables.

(C) On Masts. Aerial coaxial cables must not be attached to a mast that encloses or supports power and lighting conductors. Figure 820–13

**(D)** Above Roofs. Coaxial cables must have a vertical clearance of at least 8 ft from all points of roofs above which they pass.

Exception No. 1: Auxiliary buildings such as garages.



Figure 820-13

Exception No. 2: Cable clearance over the roof overhang can be reduced from 8 ft to 18 in. if no more than 6 ft of overhead conductors pass over no more than 4 ft of roof and they terminate to a raceway mast or other approved support.

#### (F) On Buildings.

(1) Electrical power. Coaxial cable must be separated at least 4 in. from electrical power conductors.

(3) Lightning Conductors. Where practicable, a separation not less than 6 ft must be maintained between coaxial cables and lightning protection conductors.

#### 820.47 Underground Circuits Entering Buildings.

(A) With Electric Conductors. Underground coaxial cables in a pedestal or handhole enclosure must be in a section permanently separated from exposed electric power or Class 1 circuit conductors by a suitable barrier.

(B) Direct-Buried Cables and Raceways. Direct-buried coaxial cable must be separated at least 12 in. from underground power or Class 1 circuit conductors. Figure 820–14

Exception No. 1: Underground coaxial cables need not be separated from service conductors if the service conductors or coaxial cables are installed in a raceway or in cable armor.

Exception No. 2: Underground coaxial cables need not be separated from feeder or branch-circuit power conductors, if the power conductors are installed in a raceway or in metalsheathed, metal-clad, UF, or USE cables, or the coaxial cables have metal cable armor or are installed in a raceway.



Figure 820–14

820.48 Unlisted Cables and Raceways Entering

**Buildings.** Unlisted coaxial cable is permitted in a building if the length of the coaxial cable within the building from its point of entrance does not exceed 50 ft and the coaxial cable terminates at a grounding block. Figure 820–15



Figure 820-15

#### **PART III. PROTECTION**

#### 820.93 Grounding or Interruption of Metallic Members of Coaxial CATV Cables.

(A) Coaxial CATV Cables Entering Building. Coaxial CATV cables entering the building or terminating on the outside of

the building must have the metallic sheath members either grounded as specified in 820.100, or interrupted by an insulating joint as close as practicable to the point of entrance. Figure 820–16

820.100



Figure 820–16

**Author's Comment:** Limiting the length of the grounding conductor helps limit damage to equipment because of a potential (voltage) difference between communications equipment and other systems during lightning events [250.(4)(A)(1) FPN].

#### **PART IV. GROUNDING METHODS**

**820.100 Cable Grounding.** The outer conductive shield of a coaxial cable must be grounded in accordance with the following requirements:

(A) Grounding Conductor.

(1) **Insulation.** The grounding conductor must be insulated and must be listed.

(2) Material. The grounding conductor must be copper or other corrosion-resistant conductive material, stranded or solid.

(3) Size. The grounding conductor must not be smaller than 14 AWG, and is not required to be larger than 6 AWG. It must have a current-carrying capacity equal to the outer conductor of the coaxial cable.

(4) Length. The grounding conductor for CATV systems must be as short as practicable. For one- and two-family dwellings, the grounding conductor must not exceed 20 ft. Figure 820–17



Figure 820–17

FPN: Limiting the length of the grounding conductor will help to reduce potential (voltage) differences between the building's power and CATV systems during lightning events.

Exception: Where it's not practicable to limit the coaxial grounding conductor to 20 ft for one- and two-family dwellings, a separate ground rod not less than 8 ft long, with fittings suitable for the application [250.70 and 820.100(C)] must be installed. The additional ground rod must be bonded to the power grounding electrode system with a minimum 6 AWG conductor [820.100(D)]. Figure 820–18

(5) Run in Straight Line. The grounding conductor to the electrode must be run in as straight a line as practicable.

**Author's Comment:** Lightning doesn't like to travel around corners or through loops, which is why the grounding conductor must be run as straight as practicable.

(6) Physical Protection. The grounding conductor must be mechanically protected where subject to physical damage, and where run in a metal raceway both ends of the raceway must be bonded to the grounding conductor. Figure 820–19

**Author's Comment:** Installing the grounding conductor in PVC conduit is a better practice.



Figure 820–18





(B) Electrode. The grounding conductor must be connected in accordance with (B)(1), (B)(2), or (B)(3).

(1) Buildings or Structures With an Intersystem Bonding Termination. The grounding conductor for the CATV system must terminate to the intersystem bonding terminal. Figure 820–20



Figure 820–20

(2) In Buildings or Structures With a Grounding Means. At existing structures, the grounding conductor must terminate to the nearest accessible: Figure 820–21



(1) Building or structure grounding electrode system [250.50]

(2) Interior metal water piping system, within 5 ft from its

point of entrance [250.52(A)(1)]

Figure 820-21

(3) Accessible means external to the building, as covered in 250.94

820.100

- (4) Metallic service raceway
- (5) Service equipment enclosure
- (6) Grounding electrode conductor or the grounding electrode conductor metal enclosure
- (7) The grounding conductor or the grounding electrode of a remote building or structure disconnecting means [250.32]

The intersystem bonding terminal must be mounted on the fixed part of an enclosure so that it will not interfere with the opening of an enclosure door. A bonding device must not be mounted on a door or cover even if the door or cover is nonremovable.

(3) In Buildings or Structures Without Intersystem Bonding Termination or Grounding Means. The grounding conductor must connect to:

- (1) Any individual electrodes described in 250.52(A)(1), (A)
  (2), (A)(3), (A)(4), or
- (2) Any individual electrodes described in 250.52(A)(5), 250.52(A)(6) and (A)(7). Figure 820–22



Figure 820–22

- (C) Electrode Connection. Terminations to the electrode must be by exothermic welding, listed lugs, listed pressure connectors, or clamps. Grounding fittings that are concrete-encased or buried in the earth must be listed for direct burial [250.70].
- Mike Holt Enterprises, Inc. www.MikeHolt.com 1.888.NEC.CODE (1.888.632.2633)

(D) Bonding of Electrodes. Where a separate grounding electrode, such as a ground rod, is installed for the CATV system, it must be bonded to the building's power grounding electrode system with a minimum 6 AWG conductor. Figure 820–23



Figure 820-23

**FPN No. 2:** Bonding all systems to the intersystem bonding termination helps reduce induced potential (voltage) between the power and CATV system during lightning events. **Figure 820–24** 



Figure 820-24

#### PART V. INSTALLATION METHODS WITHIN BUILDINGS

#### 820.110 Raceways for Coaxial Cables.

**Chapter 3 Wiring Methods.** Where coaxial cables are installed in a Chapter 3 wiring method, the raceway must be installed in accordance with Chapter 3. Figure 800–25





**Communications Raceways.** Where coaxial cables are installed in a listed communications nonmetallic raceway, the raceway must be installed in accordance with 362.24 through 362.56. **Figure 820–26** 

Author's Comment: In other words, listed communications raceways must be installed according to the following rules for ENT:

- 362.24 Bending radius
- 362.26 Maximum total bends between pull points, 360 degrees
- 362.28 Trimmed to remove rough edges
- 362.30 Support every 3 ft, within 3 ft of any enclosure
- 362.48 Joints between tubing, fittings, and boxes

*Exception:* Raceway fill limitations don't apply when coaxial cables are installed in a raceway.



Author's Comment: Coaxial cables are only permitted in a Chapter 3 wiring method as limited by 820.133.

**820.113 Listing of Coaxial Cables.** Coaxial cables installed within buildings must be listed.

*Exception:* Unless the length of the cable from its point of entrance, doesn't exceed 50 ft as permitted by 820.48.

#### 820.133 Installation of Coaxial Cables and Equipment.

(A) Separation from Other Conductors.

(1) In Raceways and Boxes.

(a) With Other Cables in Raceway, Cable Trays, or Enclosure. Coaxial cables are permitted to be in the same raceway, cable tray, or enclosure as jacketed cables of any of the following: Figure 820–27

- (1) Class 2 and Class 3 circuits in compliance with Article 725.
- (2) Power-limited fire alarm circuits in compliance with Article 760.
- (3) Nonconductive and conductive optical fiber cables in compliance with Article 770.
- (4) Communications circuits in compliance with Article 800.

(b) With Power Conductors in Same Raceway or Enclosure. Coaxial cable must not be in any raceway or enclosure with conductors of electric power or Class 1 circuits.



Figure 820-27

*Exception No. 1: Coaxial cables are permitted with conductors of electric power and Class 1 circuits, where separated by a permanent barrier or listed divider.* Figure 820–28



Figure 820–28

**Author's Comment:** Separation is required to prevent a fire or shock hazard that can occur from a short between the higher-voltage circuits and the coaxial cable.

Exception No. 2: Coaxial cables are permitted to be mixed in enclosures other than raceways or cables with power conductors if the power circuit conductors are only introduced to supply power to coaxial cable system distribution equipment. The power circuit conductors must be separated at least <sup>1</sup>/<sub>4</sub> in. from the coaxial cables.

(2) Other Applications. Coaxial cables must maintain 2 in. of separation from electric power or Class 1 circuit conductors.

Exception No. 1: Separation isn't required if all electric power or Class 1 circuit conductors are in a raceway or in metal-sheathed, metal-clad, nonmetallic-sheathed, or underground feeder cables, or all coaxial cables are in a raceway. Figure 800–29



Figure 820-29

(B) Support of Cables. Coaxial cables are not permitted to be strapped, taped, or attached to the exterior of any raceway as a means of support. Figure 800–30

Author's Comment: Coaxial cables must not be supported by, or attached to, the power service mast [230.28 and 820.44(C)]. Figure 800–31

*Exception: Overhead (aerial) spans of coaxial cables are permitted to be attached to a raceway-type mast intended for the attachment and support of such conductors.* Figure 800–32



Figure 820-30



Figure 820–31

with Table 820.154.

**820.154 Applications of Coaxial Cables and Race-ways.** Coaxial cables must comply with (A) through (D), or where coaxial cable substitutions are made, in accordance

(A) Ducts or Plenums Used for Environmental Air. Where necessary for direct action upon, or sensing of the contained air, coaxial cables are permitted to be installed in ducts or plenums if installed in a metal raceway [300.22(B)].





Coaxial cables identified as suitable for plenum use [820.179(A)] can be installed above a suspended ceiling or below a raised floor used for environmental air [300.22(C)]. CATV raceways identified as suitable for plenum use [820.182] are permitted above a suspended ceiling or below a raised floor used for environmental air if the raceway contains coaxial cables identified as suitable for plenum use [820.179(A)]. Figure 820–33





**Author's Comment:** Coaxial cables not identified as suitable for plenum use can be installed above a suspended ceiling or below a raised floor used for environmental air, but only if the coaxial cables not identified as suitable for plenum use are installed in a metal raceway [300.22(C)(1)].

**(B) Riser Space.** Coaxial cables installed in risers must comply with (1) through (3).

(1) Cables in Vertical Runs. Coaxial cables installed in vertical runs penetrating more than one floor must be CATVR [820.179(B)]. Floor penetrations requiring CATVR must contain only coaxial cables suitable for riser or plenum use. Listed riser or listed plenum communications raceways with CATVR [820.182(B) and CATVP [820.182(A)] coaxial cables are permitted in floor penetrations.

(2) Metal Raceway. Listed coaxial cable Types CATV and CATVX are permitted within metal raceways.

#### Author's Comments:

- When coaxial cables are installed in a metal raceway, they aren't required to be riser- or plenum-rated.
- Metal raceways containing circuit conductors from powersupply systems that operate below 50V aren't required to be connected to an equipment grounding conductor [250.86 and 250.112(l)].

(3) One- and Two-Family Dwellings. CATV [820.179(C)] and CATVX [820.179(D)] coaxial cables are permitted to be installed in one- and two-family dwellings.

FPN: See 820.26 for the firestop requirements for floor penetrations.

(C) Other Wiring Within Buildings. Coaxial cables installed in building locations other than the locations covered in 820.154(A) and 820.154(B) must comply with the following:

(1) General. Types CATV, CATVX, CATVR, or CATVP coaxial cables installed in listed riser CATV raceways [820.182(B)] and listed plenum CATV raceways [820.182(A)].

(2) In Raceway. CATVX coaxial cable in a Chapter 3 raceway.

(3) Nonconcealed Spaces. CATVX coaxial cable in nonconcealed spaces where the exposed length of coaxial cable doesn't exceed 10 ft.

(4) One- and Two-Family Dwellings. CATVX coaxial cables less than <sup>3</sup>/<sub>8</sub> in. in diameter.

(5) Multifamily Dwellings. CATVX coaxial cables less than  $\frac{3}{8}$  in. in diameter.

**(D) Cable Trays.** Types CATVP, CATVR, and CATV cables are permitted to be installed in cable trays.

**(E) Cable Substitutions.** CATV cable substitutions are permitted as listed in Table 820.154.

#### **PART VI. LISTING REQUIREMENTS**

820.179 Listing Requirements for Coaxial Cables.

Coaxial cables are listed in accordance with (A) through (D) and marked according to Table 820.170.

(A) Type CATV Coaxial Cable. CATVP cable is listed for use in ducts, plenums, and other environmental air spaces [820.154(A)]. Figure 820–34





**Author's Comment:** Cables identified as suitable for plenum use can be installed in environmental air space, but they are not permitted to be installed in ducts or plenums! See 820.3(B) in this textbook for details.

**(B)** Type CATVR. CATVR coaxial cable is listed for use in a vertical run in a shaft, or from floor to floor, and has fire-resistant characteristics capable of preventing the carrying of fire from floor to floor [820.154(B) and 820.154(B)(1)].

(C) Type CATV. Coaxial cable is listed for general-purpose use, with the exception of risers, plenums, and other environmental air spaces [820.154(C)(1)].

**(D)** Type CATVX. CATVX limited-use community antenna television coaxial cable is listed for use in dwellings and for use in raceways [820.154(B)].

#### 820.182 Listing Requirements for Coaxial Race-

**Ways.** Nonmetallic CATV raceways are listed in accordance with (A) through (C).

(A) Plenum Coaxial Raceways. Raceways identified as suitable for plenum use are listed for use in environmental air spaces. Figure 820–35



Author's Comment: Where used in environmental air spaces, listed coaxial raceways identified as suitable for plenum use must contain coaxial cables identified as suitable for plenum use (CATVP) [820.179(A)].

**(B) Riser Coaxial Raceways.** Raceways identified as suitable for riser use are listed as being suitable to be run vertically through more than one floor.

**Author's Comment:** Listed raceways identified as suitable for plenum or riser use run vertically and penetrating more than one floor can only contain coaxial cables identified as suitable for plenum or riser use (CATVR and CATVP) [820.179(B)].

(C) General-Purpose Coaxial Raceways. General-purpose raceways for coaxial cables can contain CATV, CATVX, CATVR, or CATVP cables.

Article 820

# 820 Practice Questions

#### ARTICLE 820. COMMUNITY ANTENNA TELEVISION (CATV) AND RADIO DISTRIBUTION SYSTEMS—PRACTICE QUESTIONS

- 1. CATV coaxial cable can deliver power to equipment that is directly associated with the radio frequency distribution system if voltage is not over \_\_\_\_\_ volts and if the current supply is from a transformer or other powerlimiting device.
  - (a) 60

ARTICL

- (b) 120
- (c) 180
- (d) 270
- 2. Exposed CATV cables shall be secured by hardware such as straps, staples, cable ties, hangers, or similar fittings designed and installed so as not to damage the cables.
  - (a) True
  - (b) False
- Overhead coaxial cables for a CATV system shall be separated by at least \_\_\_\_\_ from lightning conductors, where practicable.
  - (a) 3 in.
  - (b) 6 in.
  - (c) 2 ft
  - (d) 6 ft

- 4. The conductor used to ground the outer cover of a CATV coaxial cable shall be \_\_\_\_\_.
  - (a) insulated(b) 14 AWG minimum(c) bare(d) a and b
- Limiting the length of the primary protector grounding conductors for community antenna television and radio systems reduces voltages between the building's \_\_\_\_\_\_ and communications systems during lightning events.
  - (a) power(b) fire alarm(c) lighting(d) lightning protection
- 6. Coaxial cables for CATV shall be listed.
  - (a) True
  - (b) False
- 7. CATV cables installed in other spaces used for environmental air shall be Type CATVP.
  - (a) True(b) False

Mike Holt Enterprises, Inc. • www.MikeHolt.com • 1.888.NEC.CODE (1.888.632.2633)

CHAPTER

8

