



2017 Analysis of Changes with Emphasis to Electrical Changes Coming to the 2018 IRC

Presenter: Keith Lofland

Tuesday, September 12, 2017

8:00 AM – 11:15 AM



Analysis of Changes – 2017 NEC



Training Presentation by:
International Association of Electrical Inspectors

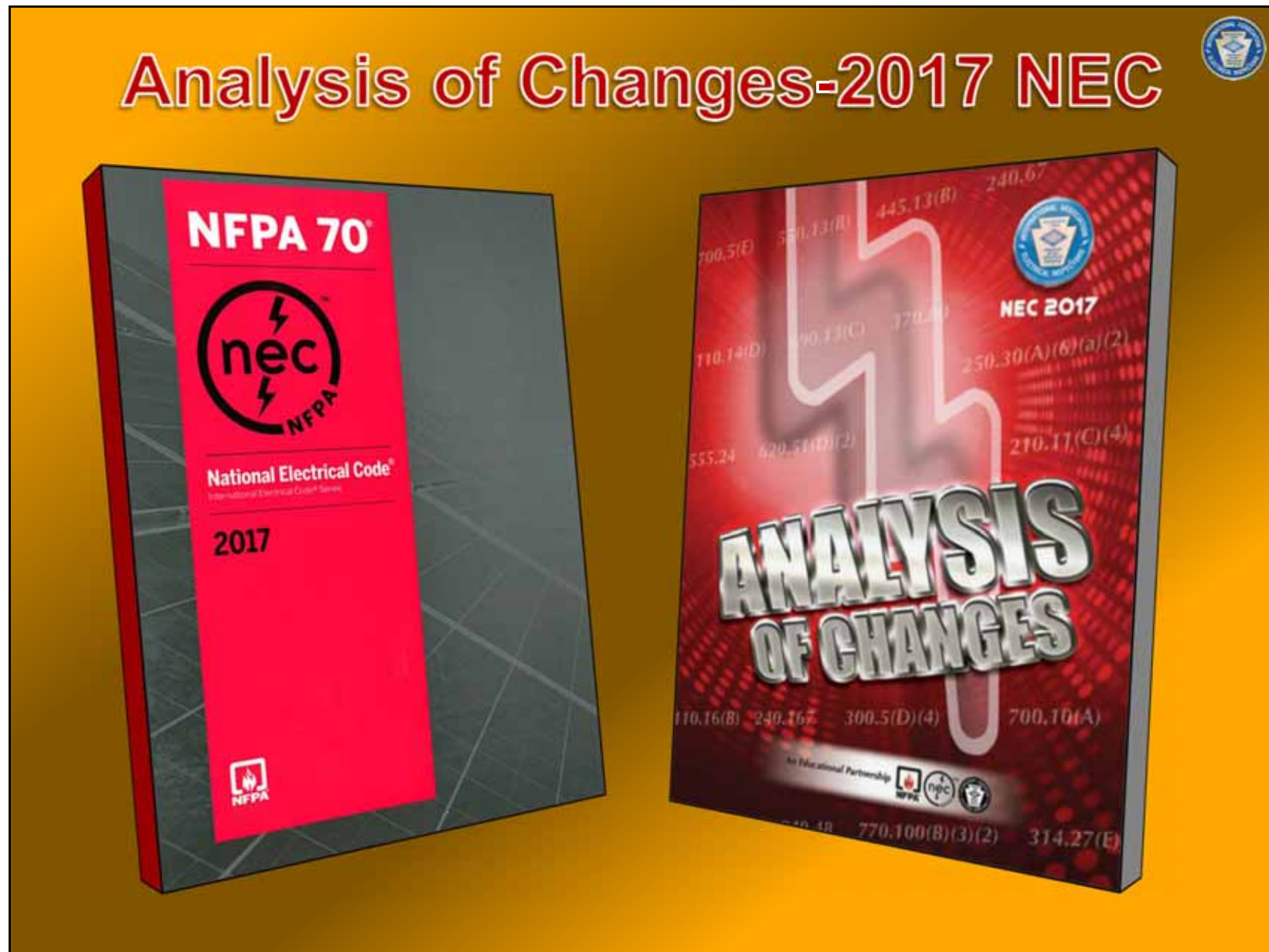


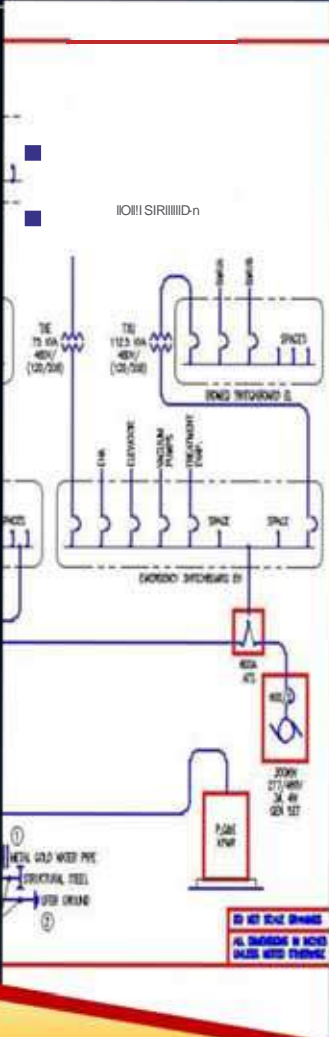
Instructor: L. Keith Lofland

- ▶ IAEI – Director of Education, Codes & Standards
- ▶ Former Chief Electrical Inspector- Garland, TX
- ▶ Chairman: *NEC CMP 7 (CMP 9 past 3 Code cycles)*
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Article 90 Introduction

90.3 Code Arrangement



Chapter 1 - General

Chapter 2 - Wiring and Protection

Chapter 3 - Wiring Methods and Materials

Chapter 4 - Equipment for General Use

Applies generally to all electrical installations

Supplements or modifies
Chapters 1 through 7

Chapter 5 - Special Occupancies

Chapter 6 - Special Equipment

Chapter 7 - Special Conditions

Chapter 8 - Communication Systems

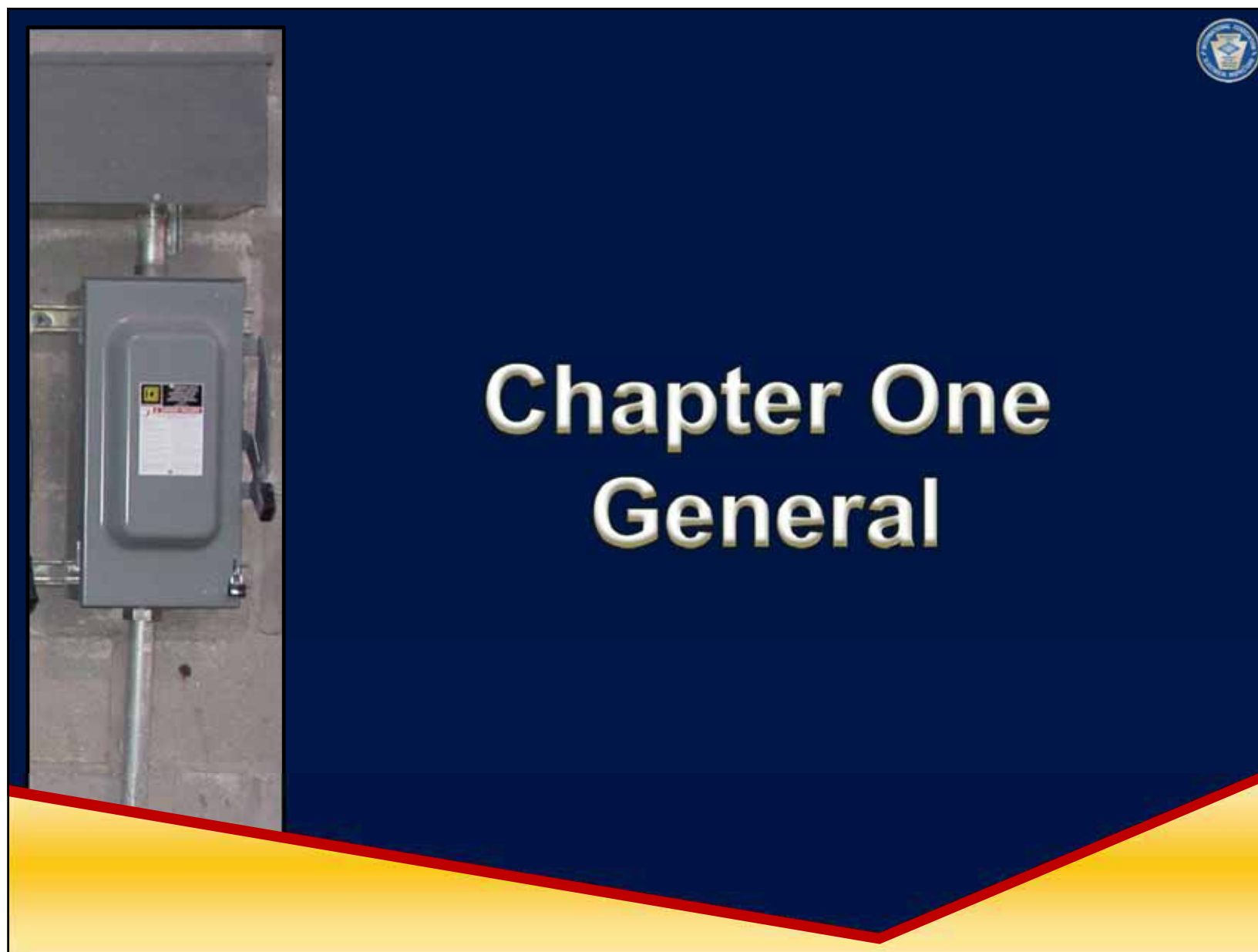
} Chapter 8 is NOT subject to the requirements of Chapters 1 through 7 except where the requirements are specifically referenced in Chapter 8

Chapter 9 - Tables

} Applicable as referenced

Informative Annexes A through J

Information only - not mandatory





Article 100 Definitions: Accessible, Readily (*Readily Accessible*)

- ▶ Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to take actions such as to use tools (**other than keys**), to climb over **or under**, to remove obstacles, or to resort to portable ladders, and so forth
- ▶ Informational Note: Use of keys is a common practice under controlled or supervised conditions and a common alternative to the ready access requirements under such supervised conditions as provided elsewhere in the *NEC*
- ▶ The use of a key is not considered taking an action such as the use of a “tool” to gain ready access
- ▶ Crawling under or over something to get to equipment required to be readily accessible is no longer acceptable

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Article 100 Definitions: Receptacle



Listed locking support and mounting receptacle with compatible attachment fitting



Courtesy of Safety Quick Lighting and Fans Corp

Receptacle. A contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.

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110.14(D)

Electrical Connections - Installations

- ▶ New requirements added for the use of **tightening torque tools** where torqueing is indicated
- ▶ Previous I-Note at parent text of 110.14 has been deleted and replaced with enforceable *Code* text at **new 110.14(D)**
- ▶ Tightening torque tools now required where torqueing is specified on the equipment or in **manufacturer installation instructions**
- ▶ Where a tightening torque is indicated as a numeric value on equipment or in manufacturer installation instructions, **calibrated torque tool shall be used to achieve the indicated torque value** (*unless manufacturer installation instructions provide for an **alternative method** of achieving the required torque*)

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110.14(0) Electrical Connection Torque Tools



Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, a calibrated torque tool is generally required to be used to achieve the indicated torque value

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110.21(A)(2) Equipment Markings - Reconditioned Equipment

- ▶ New **110.21(A)(2)** added to require **refurbished, reconditioned, or remanufactured equipment** to be marked with the **name, trademark, and other descriptive marking** of the organization responsible for reconditioning the electrical equipment
- ▶ New rules added to provides **traceability** and other additional information to manufacturers, owners, installers, and AHJs related to reconditioned equipment
- ▶ The **date of the reconditioning** must also be established on the nameplate or marking
- ▶ AHJ should **never rely solely on equipment's original listing** as basis of approval of reconditioned electrical equipment

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110.21(A)(2) Equipment Markings - Reconditioned Equipment (*cont.*)



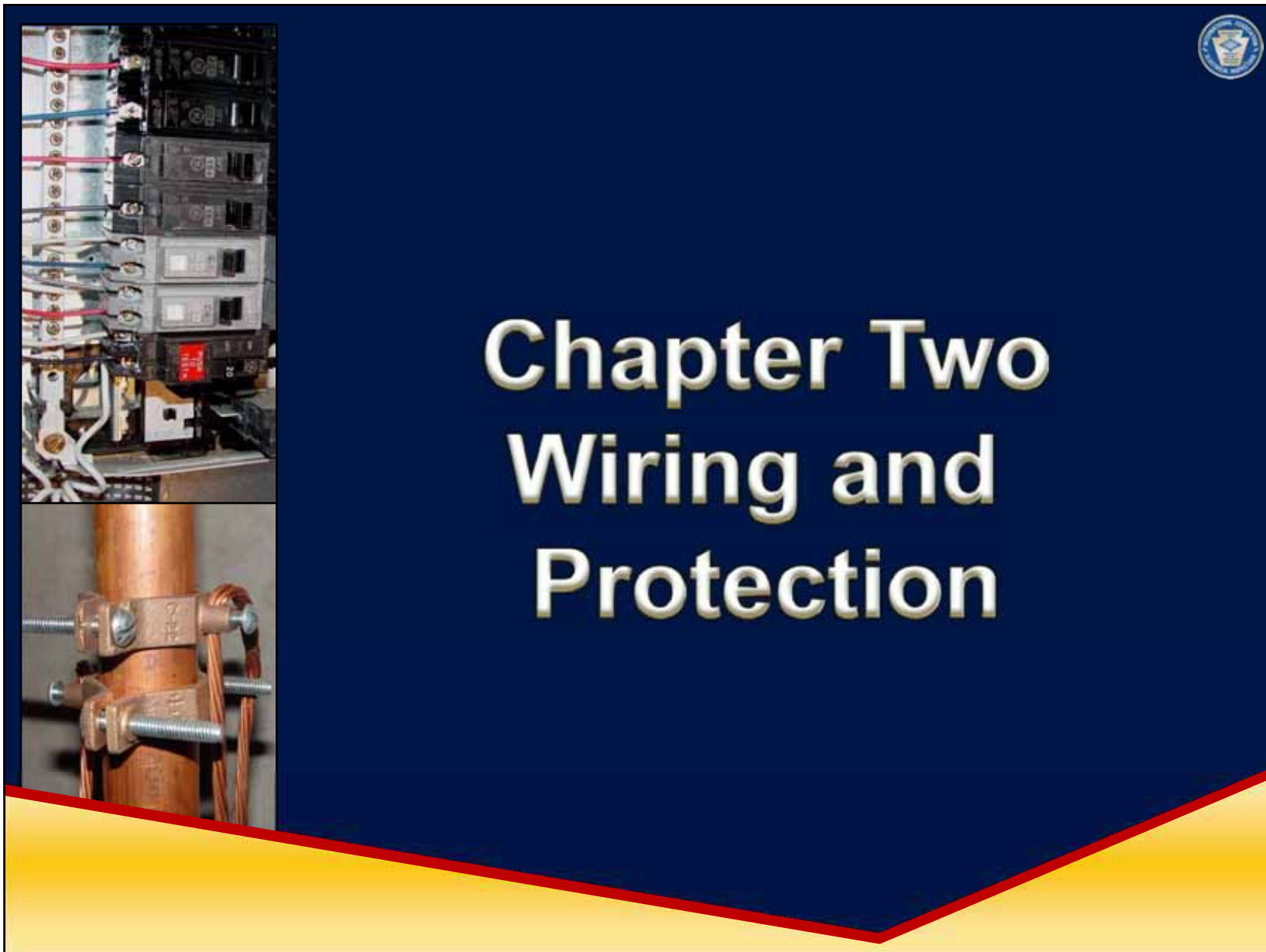
- ▶ **Reconditioned Equipment.** Reconditioned equipment shall be marked with the name, trademark, or other descriptive marking by which the organization responsible for reconditioning the electrical equipment can be identified, along with the date of the reconditioning. Reconditioned equipment shall be identified as “reconditioned” and approval of the reconditioned equipment shall not be based solely on the equipment’s original listing.
- ▶ **Exception:** *In industrial occupancies, where conditions of maintenance and supervision ensure that only qualified persons service the equipment, the markings indicated in 110.21(A)(2) shall not be required.*
- ▶ **Informational Note:** Industry standards are available for application of reconditioned and refurbished equipment. Normal servicing of equipment that remains within a facility should not be considered reconditioning or refurbishing.

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110.21(A)(2) Reconditioned Equipment



Typical marking requirements for reconditioned electrical equipment in accordance with 110.21(A)(2)





210.8 Ground-Fault Circuit-Interrupter Protection for Personnel

- ▶ A new provision was added at the parent text of 210.8 to indicate that measurements from receptacles to objects (*such as a sink*) that would qualify for GFCI protection
- ▶ This distance should be measured as the “**shortest path**” a cord of an appliance connected to a receptacle would take without piercing a:
 - Floor
 - Wall
 - Ceiling
 - Fixed barrier
 - or passing through a door, doorway, or window

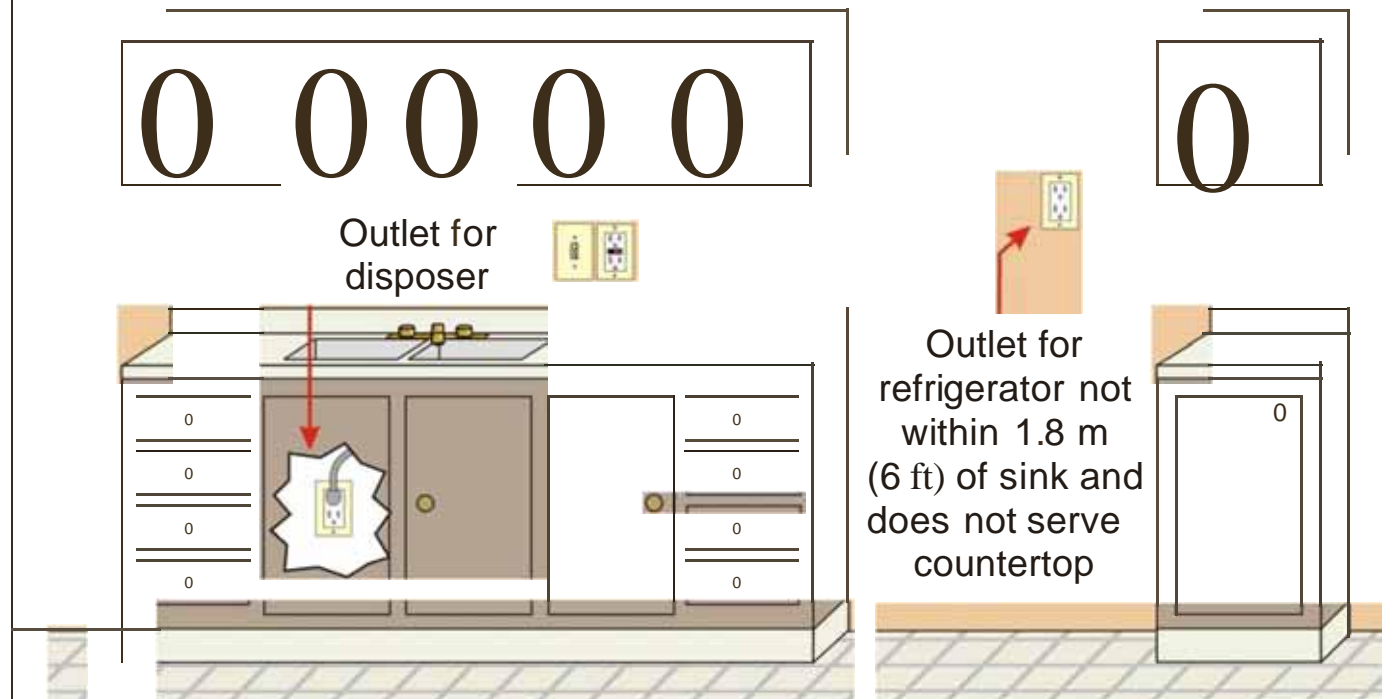
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210.8 Measurements for GFCI Protection

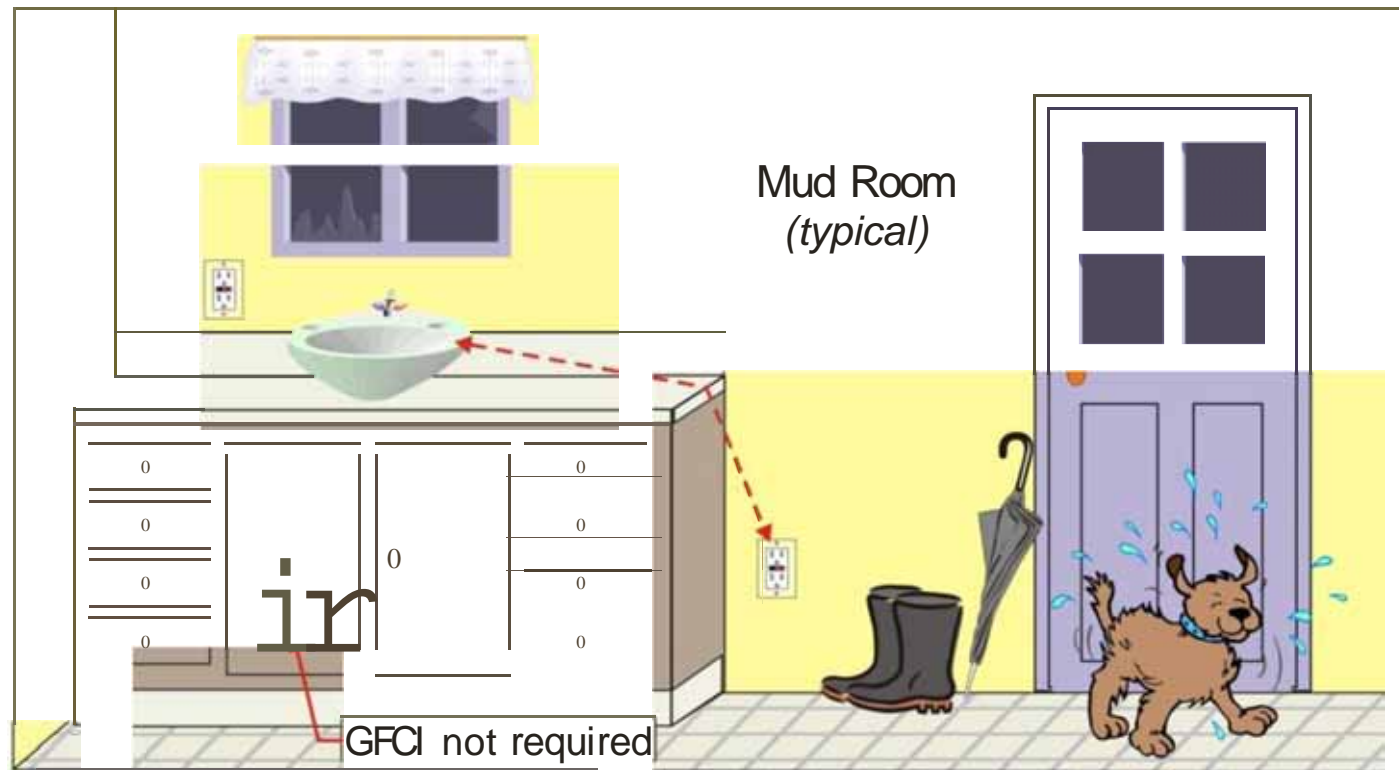
GFCI protection shall be provided as required in 210.8(A) through (E) and installed in a readily accessible location

Note: This illustration could be an office break room or a dwelling unit kitchen



When determining distance from receptacles, distance shall be measured as the "shortest path" the cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, or fixed barrier, or passing through a door, doorway, or window

210.8(A)(7) GFC Protection at Sinks



GFCI required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) **from the top inside edge** of a dwelling unit sink (laundry, utility, mud room, kitchen, wet bar, etc.) **without the measurement piercing a floor, wall, ceiling, or fixed barrier, or passing through a door, doorway, or window**

Note: Same requirement at 210.8(8)(5) for non-dwelling unit sinks



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210.8(E) GFCI Protection - Crawl Space Lighting Outlets



- ▶ GFCI protection is now required for **lighting outlets** not exceeding 120 volts in **crawl spaces** where the space is at or below grade level
- ▶ Applies to **all crawl spaces**, dwelling unit and non-dwelling units alike
- ▶ This new GFCI requirement for lighting outlets was predicated on a fatality of a worker in a crawl space (*broken incandescent light bulb of a keyless lampholder*)
- ▶ Numerous open-bulb keyless or pullchain lampholders installed in crawl spaces and are constantly being damaged

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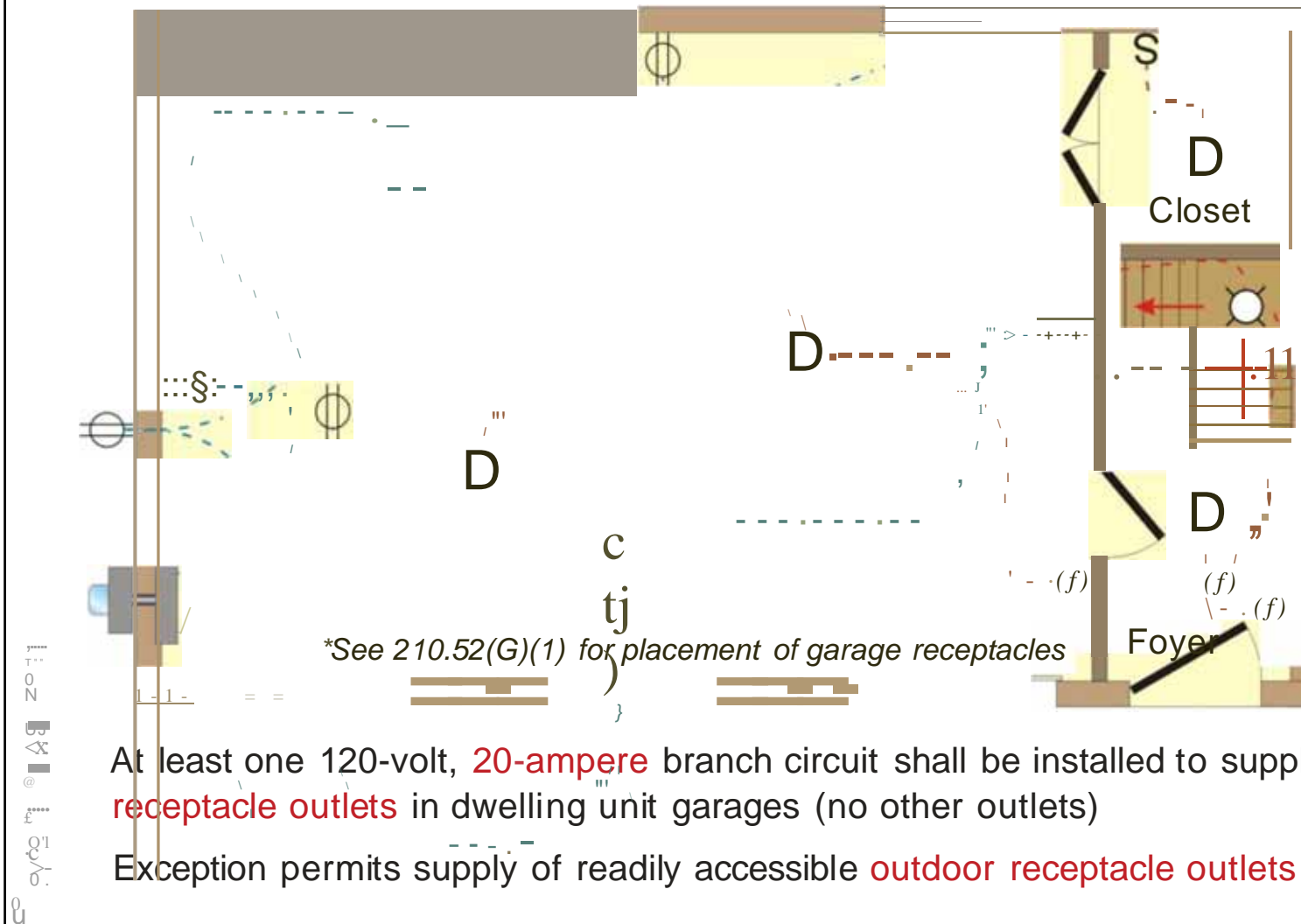


210.11(C)(4) Garage Branch Circuits

- ▶ New requirement added for minimum rated 120 volt, **20 ampere** branch circuit for dwelling unit garage receptacles
- ▶ Garage receptacle outlet branch circuit **prohibited from serving other outlets** (*see exception*)
- ▶ Exception for readily accessible receptacles located **outdoors**
- ▶ 15 ampere rated branch circuit in the modern dwelling unit garage is typically not sufficient for appliance and tools rated at 12 to 16 amperes
- ▶ Lighting outlets in the dwelling unit garage required to be supplied by general lighting circuits

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210.11(C)(4) Garage Branch Circuit (s)





210.52(A)(2)(1) Receptacle Wall Space

- ▶ Fixed cabinets **“that do not have countertops or similar work surfaces”** was added as an item that will constitute a **break in a wall space** for receptacle spacing reasons at dwelling units
- ▶ Separates “fixed cabinets” such as kitchen pantry-type cabinets (*but not limited to kitchen cabinets*) that do not have countertops or similar work surfaces from short desk-type cabinets with countertops that are clearly intended as work surfaces
- ▶ This change will ensure that receptacle outlets are required and installed for such things as laptop computers, printers, televisions, etc.

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210.52(A)(2)(1) Receptacle Wall Space



Any space 600 mm (2 ft) or more in width and unbroken along the floor line by doorways and similar openings, fireplaces, and fixed cabinets **that do not have countertops or similar work surfaces**

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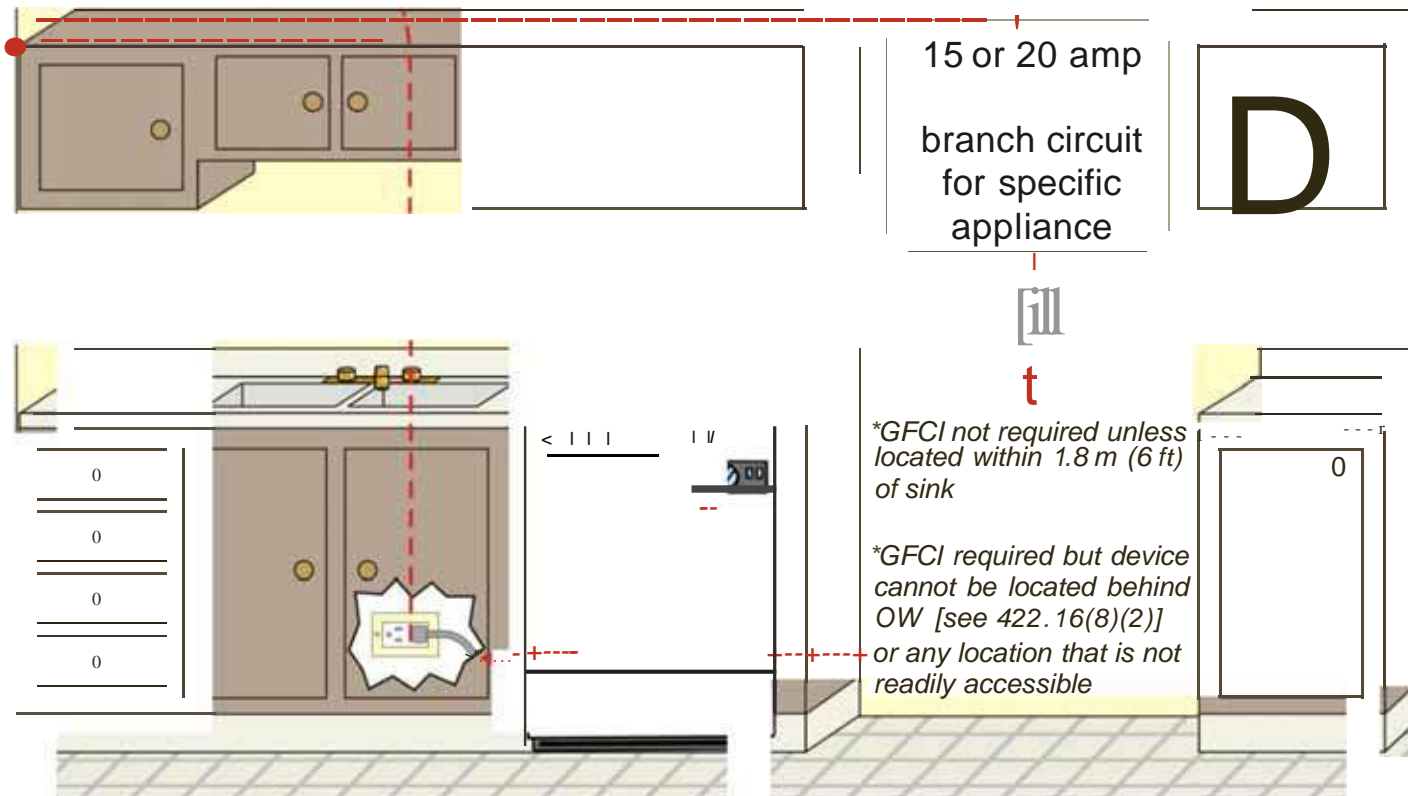
210.52(B)(1) Ex. No. 2

Refrigerator Appliance Branch Circuit

- ▶ Any dwelling unit **kitchen appliance** is now permitted (*by the exception*) to be supplied by an individual branch circuit rated **15 amperes or greater**
- ▶ 210.52(B)(1) requires receptacle outlet serving the **refrigeration equipment** be supplied from one of the 20-ampere rated small-appliance branch circuits
- ▶ Previous exception allowed refrigerator to be supplied by an individual branch circuit rated 15 amperes or greater (*why just refrigerator?*)
- ▶ Revised exception will now allow an individual branch circuit 15 amperes or greater for kitchen appliances such as **garbage disposal, dishwasher**, or permanently installed **microwave**

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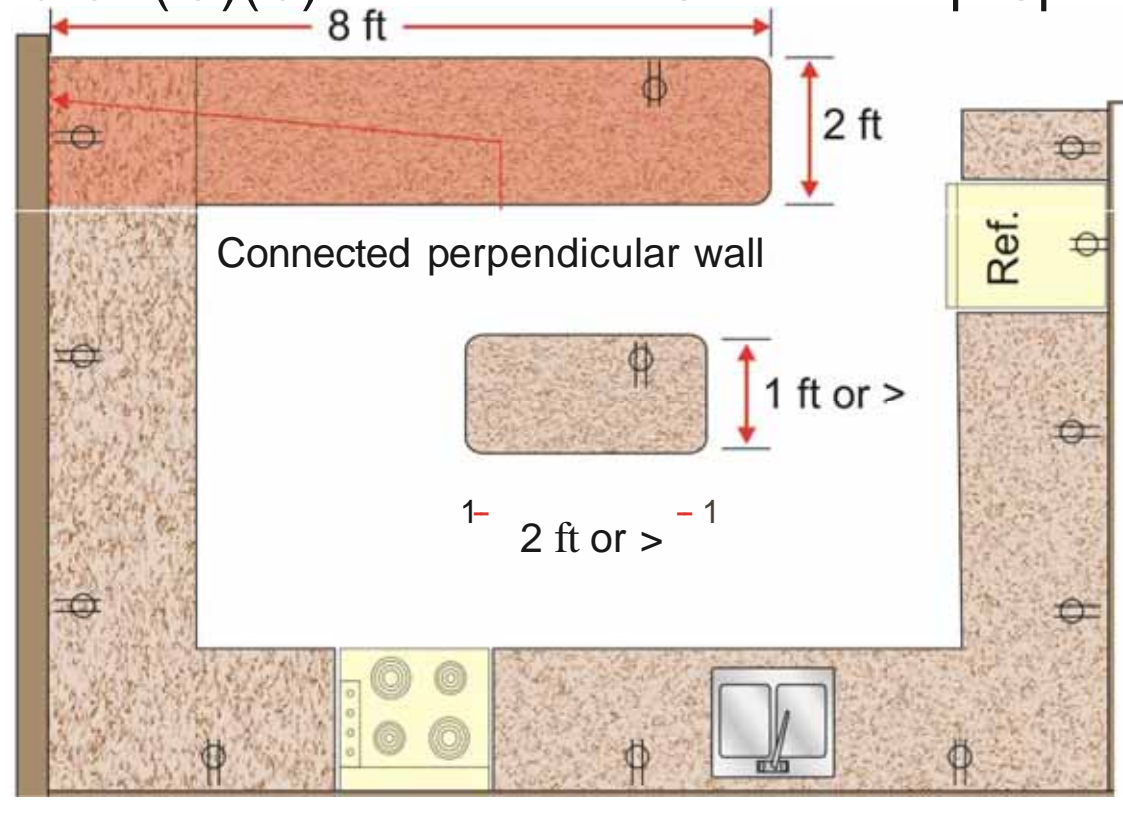
210.52(8)(1) Ex. No 2 Appliance Branch Circuit



Refrigeration equipment generally required to be served by one of the two or more 20-ampere small-appliance branch circuits

The receptacle outlet for **any specific appliance** is permitted to be supplied from an individual branch circuit rated 15 amperes or greater

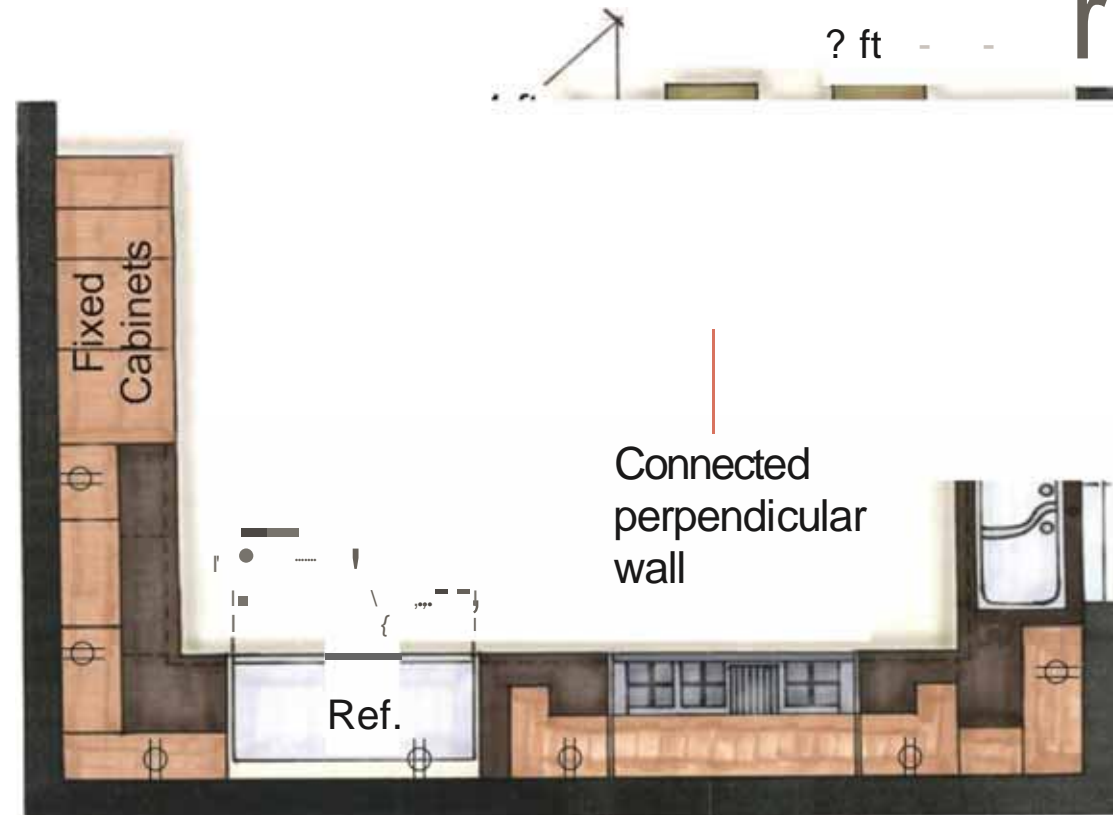
210.52(C)(3) Peninsular Countertop Spaces



At least one receptacle outlet to be installed at each peninsular countertop **long dimension space** with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater

Measurements to be measured from the "**connected perpendicular wall**"

210.52(C)(3) Peninsular Countertop Spaces



At least one receptacle outlet to be installed at each peninsular countertop **long dimension space** with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater

Measurements to be measured from the "**connected perpendicular wall**"

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210.52(6)(1) Dwelling Unit Garages

The diagram illustrates a 3-car garage layout. It features two vehicle bays, each containing a car (one blue, one red). A central area is labeled 'D'. To the right, there is a closet, a set of stairs labeled 'Up', and a foyer. A legend on the left side of the diagram includes symbols for a receptacle outlet, a switch, and a light fixture.

h each attached garage and in each detached garage with electric power, at least one receptacle outlet is required to be installed "in each vehicle bay and not more than 1.7 m (5½ ft) above the floor"

Note: See 210.11(C)(4) for garage branch circuit requirements



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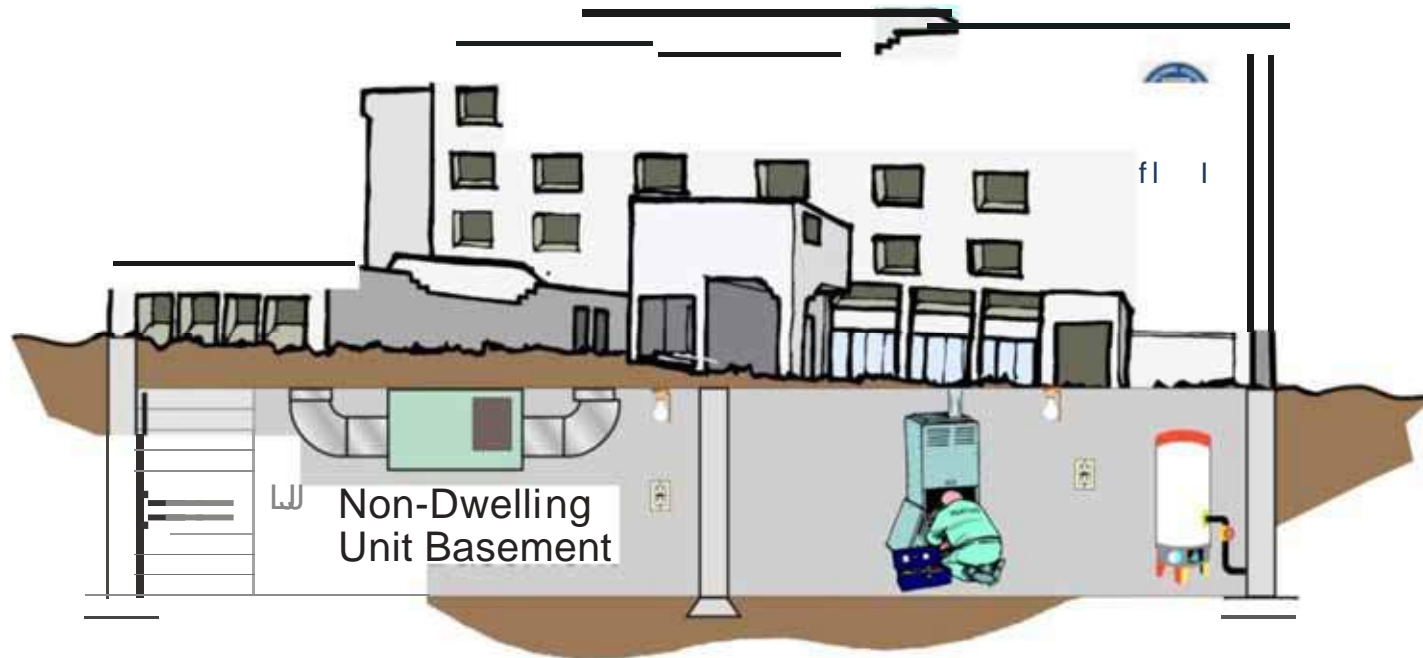
210.70(C) Lighting Outlets Required (All Occupancies)



- ▶ Lighting outlet requirements for storage or equipment spaces added for **non-dwelling unit utility rooms and basements**
- ▶ Title changed from “Other Than Dwelling Units” to “**All Occupancies**”
- ▶ Revised to mirror *Code* text at 210.70(A)(3) for dwelling units
- ▶ This lighting outlet requirement for storage or equipment spaces now applies to both dwelling and non-dwelling unit locations such as:
 - attics
 - underfloor spaces
 - utility rooms and
 - basements

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210.70(C) Lighting Outlet(s) All Occupancies



At non-dwelling unit attics, underfloor spaces, **utility rooms**, and **basements**, at least one lighting outlet containing a switch or controlled by a wall switch must be installed where these spaces are used for storage or contain equipment requiring servicing [See 210.70(A)(3) for dwelling units]

At least one switch to be located at the "usual point of entry" to space with lighting outlet(s) located "at or near the equipment requiring servicing"

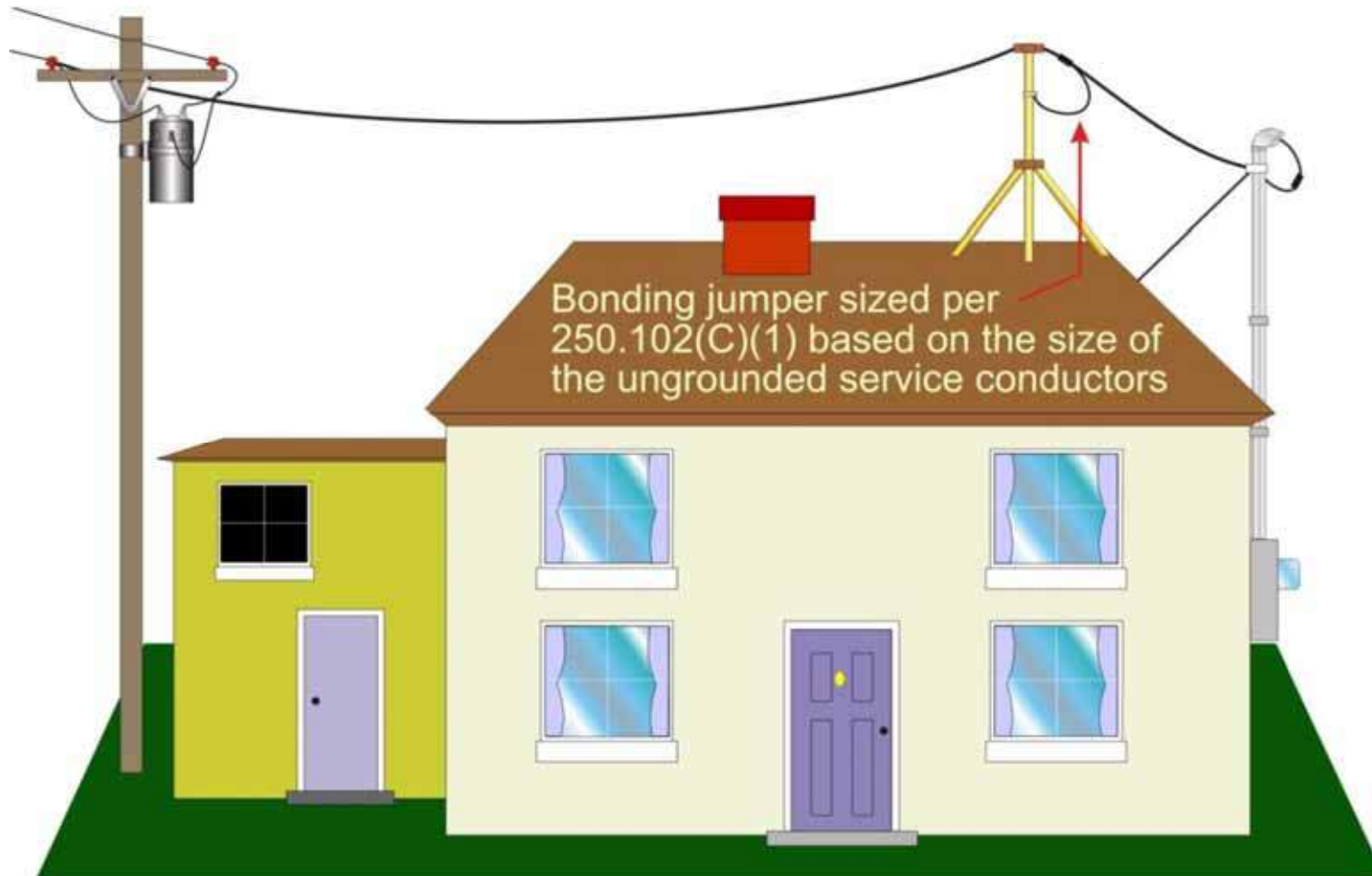


230.29 Supports Over Buildings

- ▶ **Metal support structures** that support overhead service conductors installed over a roof are now **required to be bonded** to the grounded overhead service conductor
- ▶ These metal structures; sometimes referred to as a “**roof jack**” in the field, should be adequately bonded to limit a potential shock hazard
- ▶ The bonding jumper used to accomplish this bonding are to be sized per the requirements of **250.102** and **Table 250.102(C)(1)**
- ▶ This is based on the size of the ungrounded service conductors
- ▶ Similar to bonding requirements for bonding of ferrous metallic raceways used to chase or enclose a grounding electrode conductor *[see 250.64(E)]*

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230.29 Supports Over Buildings



Metal support structures supporting overhead service conductors passing over a roof required to be bonded to grounded overhead service conductor



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Table 240.6(A) Standard Ampere Rating

- ▶ Standard ampere ratings for fuses and inverse time circuit breakers have been revised to be included in a **list format** located at **new Table 240.6(A)**
- ▶ Revision to “list format” style has a long precedence in the *NEC*
- ▶ By converting a long list of items that were previously in long sentences or paragraphs to a “list format” is one way to accomplish this goal
- ▶ This change makes the *Code* more “user friendly”

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Table 240.6(A) Standard Ampacity Ratings for Fuses and Inverse Time Circuit Breakers

The standard ampere ratings for fuses and inverse time circuit breakers shall be considered as shown in Table 240.6(A)

15	20	25	30	35
40	45	50	60	70
80	90	100	110	125
150	175	200	225	250
300	350	400	450	500
600	700	800	1000	1200
1600	2000	2500	3000	4000
5000	6000			

Additional standard ampere ratings for fuses shall be 1, 3, 6, 10, and 601

The use of fuses and inverse time circuit breakers with nonstandard ampere ratings shall be permitted





250.52(A)(2)

Metal In-Ground Support Structure

- ▶ The title of 250.52(A)(2) was changed from “**Metal Frame of a Building**” to “**Metal In-Ground Support Structure**”
- ▶ New title is more in line with the definition of a grounding electrode in Article 100 (*conducting object through which a direct connection to earth is established*)
- ▶ Only one item (*the metal support*) remains that would qualify as a “metal in-ground support structure” grounding electrode
- ▶ To qualify as an in-ground support structure, must be:
 - In direct contact with the earth vertically **3.0 m (10 ft) or more** (*with or without concrete encasement*)

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250.52(A)(2)

Metal In-Ground Support Structure *(cont.)*

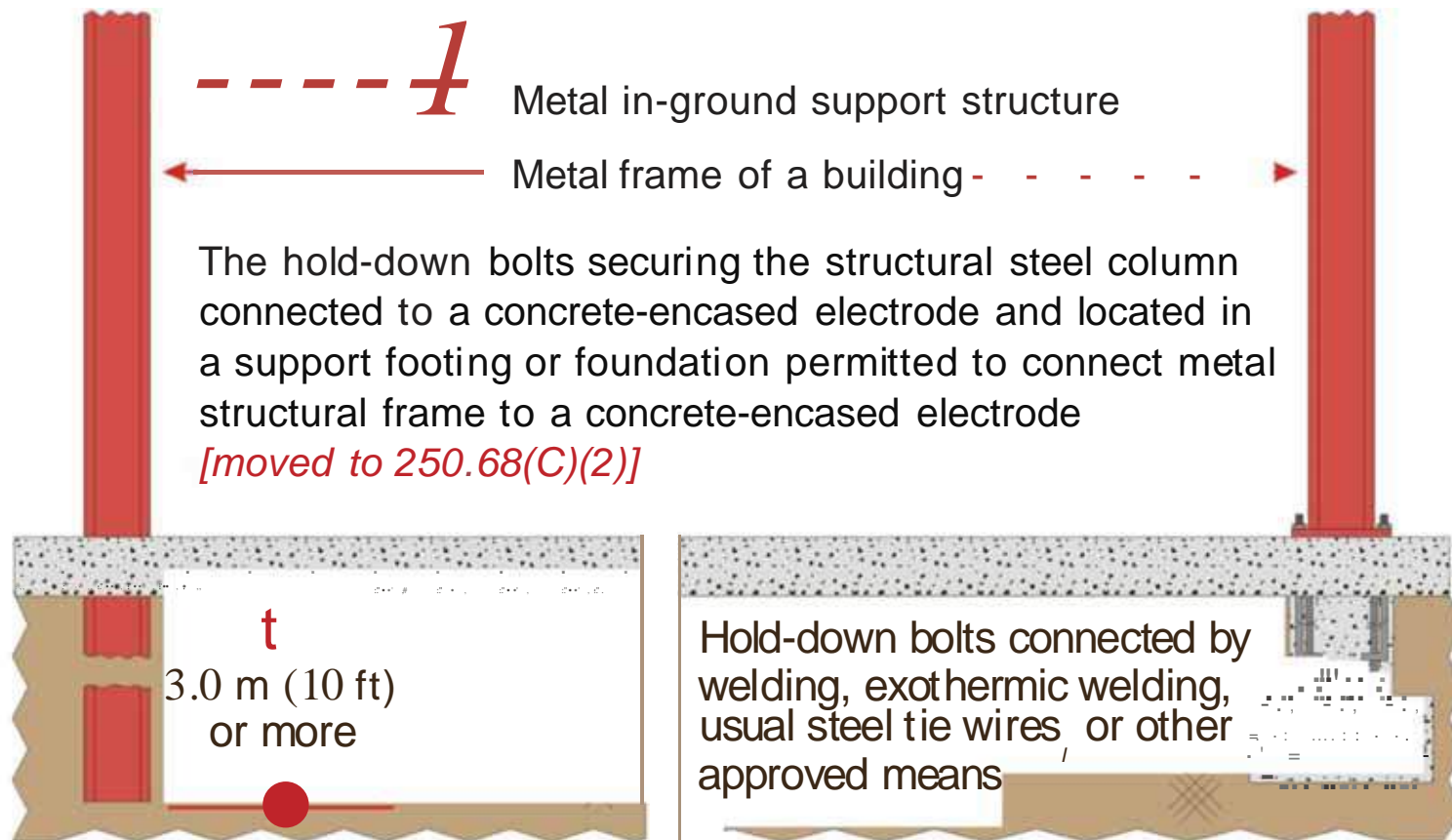
- ▶ Previous condition of a **metal structural member connected to a concrete-encased electrode** through the hold-down bolts, etc. qualifying as a grounding electrode has not been deleted
- ▶ **Relocated to 250.68(C)(2)** (*Grounding Electrode Connections*) as it is no longer appropriate for 250.52(A)(2) (*Electrodes Permitted for Grounding*)
- ▶ Adds clarity to 250.68(C)(2) and should be preserved as a permitted connection method

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250.52(A)(2) Metal n-Ground Support Structures



One or more **structural metal in-ground support structure(s)** in direct contact with the earth **vertically** for 3.0 m (10 ft) or more (*with or without concrete encasement*) qualifies as a grounding electrode (*if multiple are present, only one required to be used*)





250.52(B)(3) Swimming Pools Not Permitted for Use as Grounding Electrodes

- ▶ Third item added to the list of objects that are **prohibited** from being used as a grounding electrode at 250.52(B)
- ▶ The structures and structural reinforcing steel of an **in-ground swimming pool** as described in 680.26(B)(1) and (B)(2) are now **prohibited from being used as a grounding electrode**
- ▶ Important clarification to point out the difference between grounding and bonding
- ▶ Equipotential bonding requirements of 680.26 are to reduce voltage gradients (*difference of voltage potential between two conducting objects*), not to create a grounding electrode system for a building or structure

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250.52(B)(3) Swimming Pools Not Permitted for Use as Grounding Electrodes *(cont.)*

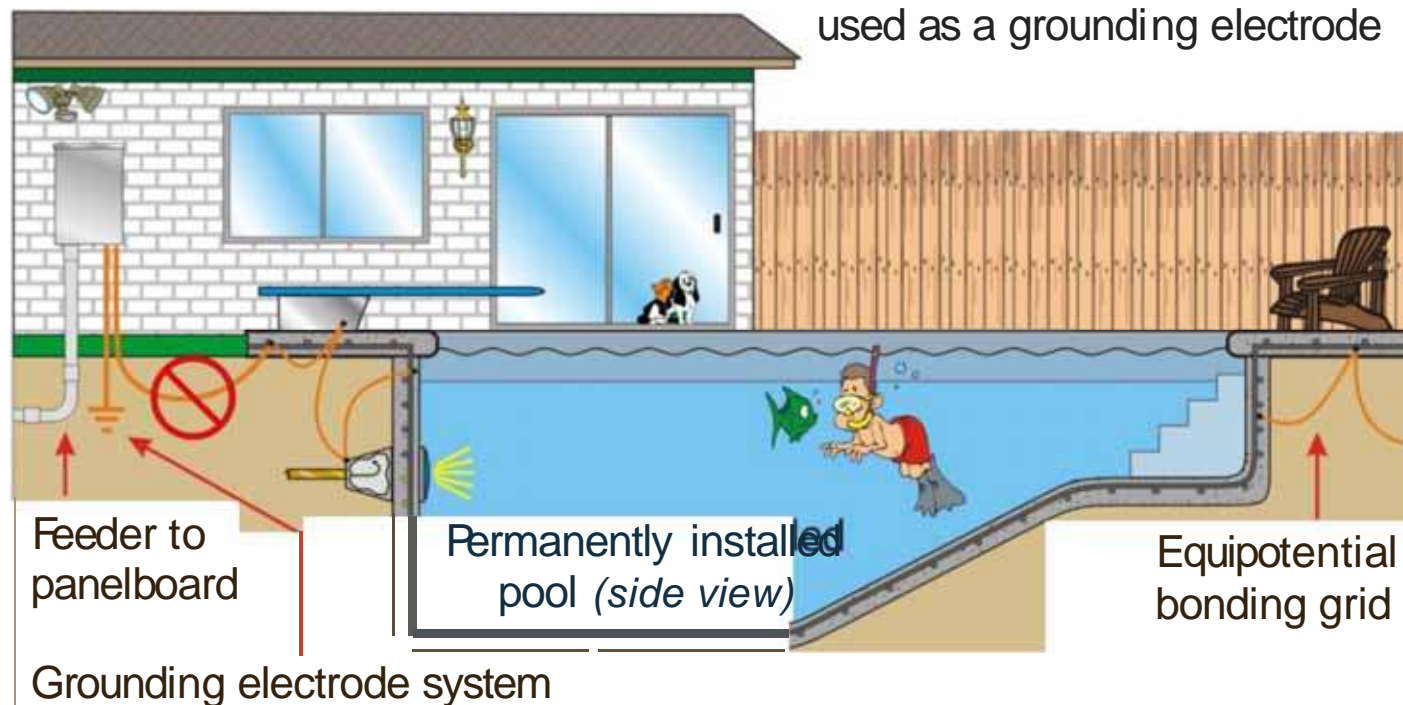
- ▶ Third item added to the list of objects that are **prohibited** from being used as a grounding electrode at 250.52(B) *(cont.)*
- ▶ Items that shall not be used as a grounding electrode include:
 - Underground gas piping systems
 - An aluminum electrode
 - **Structures and structural reinforcing steel of an in-ground swimming pool**

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250.52(8)(3) Not Permitted for Use as Grounding Electrodes

The structures and structural reinforcing steel of an in-ground swimming pool as described in 680.26(8)(1) and (B)(2) are prohibited from being used as a grounding electrode



The provisions of 680.26 for equipotential bonding are to reduce voltage gradients (*difference of voltage potential between two conducting objects*), not to establish a grounding electrode system for a building or structure



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250.66(A), (B) and (C) Sizing of GECs

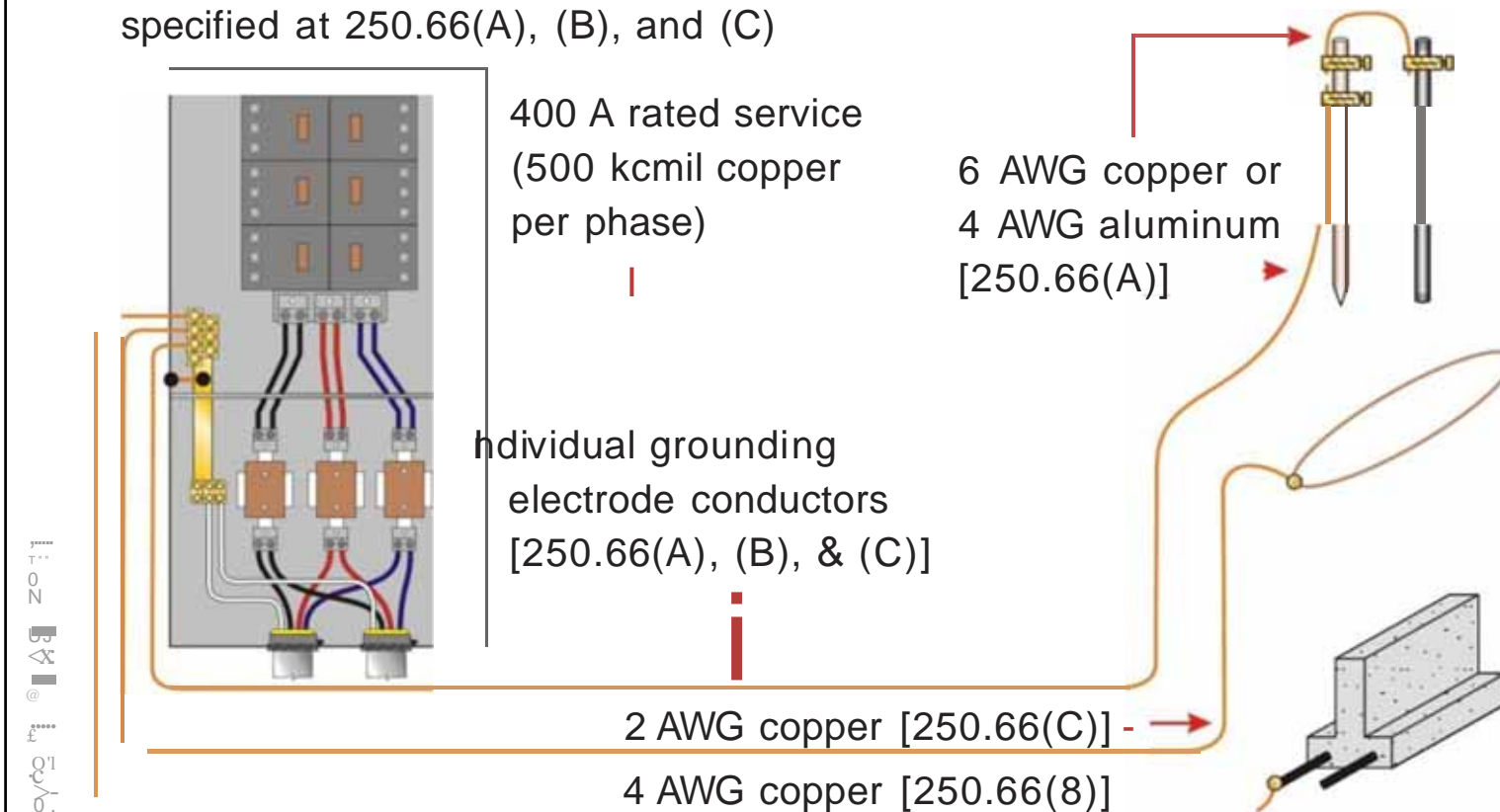
- ▶ The term **“sole connection”** was completely removed from 250.66(A), (B), and (C)
- ▶ New text makes it clear that the action of **“daisy chaining”** grounding electrodes with properly sized bonding jumpers to form a grounding electrode system is an acceptable practice...
- ▶ as long as any downstream grounding electrode would not require a larger grounding electrode conductor or bonding jumper
- ▶ The term **“or bonding jumper”** was added to each subdivision to use the correct terminology when “daisy chaining” occurs past the first grounding electrode in the chain of multiple electrodes

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250.66(A), (B) and (C) Sizing of GECs



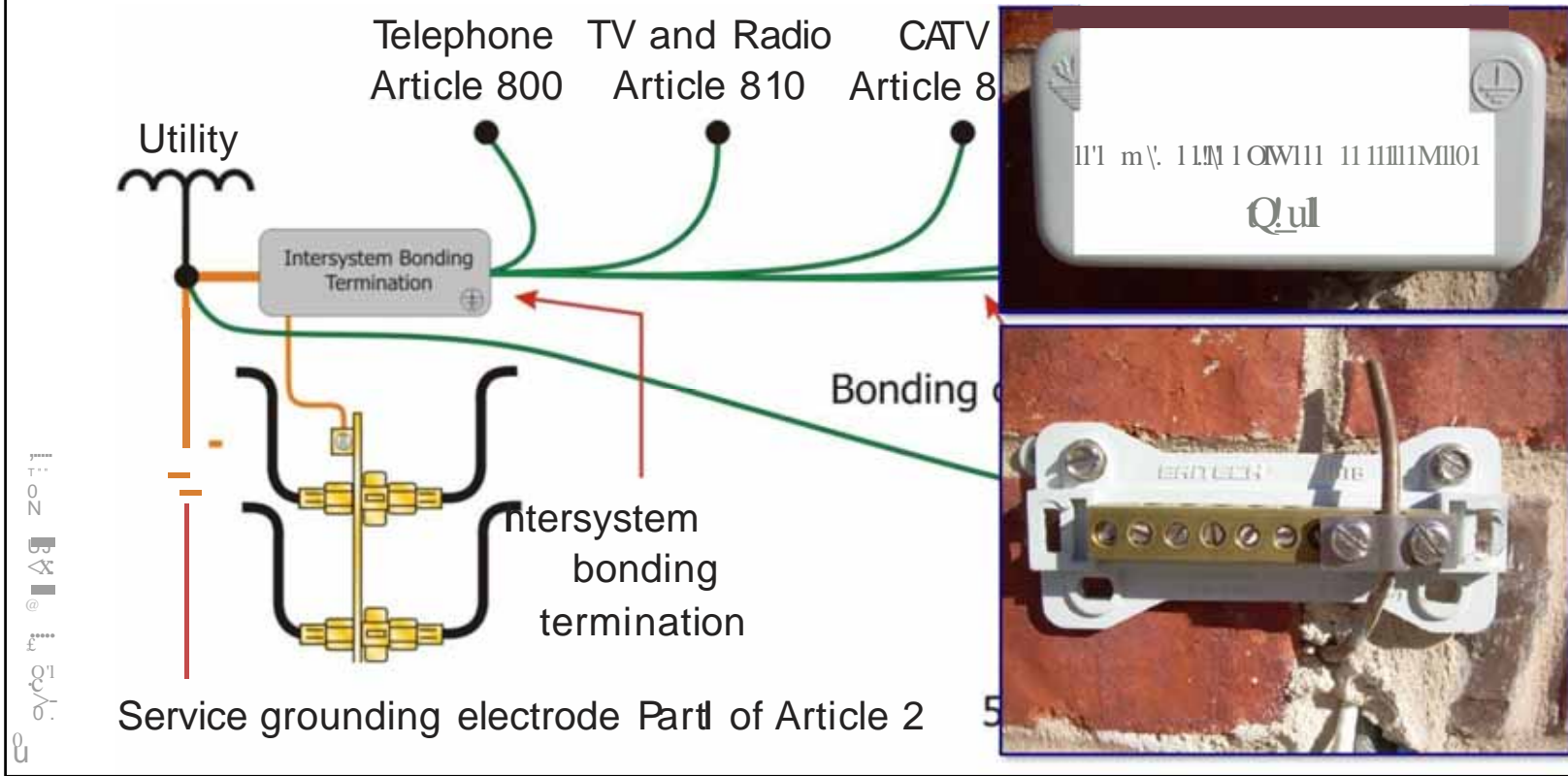
If the grounding electrode conductor **or bonding jumper** connected to the electrodes described at 250.66(A), (B), and (C) **does not extend on to other types of electrodes that require a larger size conductor**, the grounding electrode conductor(s) shall not be required to be larger than the sizes specified at 250.66(A), (B), and (C)



Bonding for Other Communication Systems



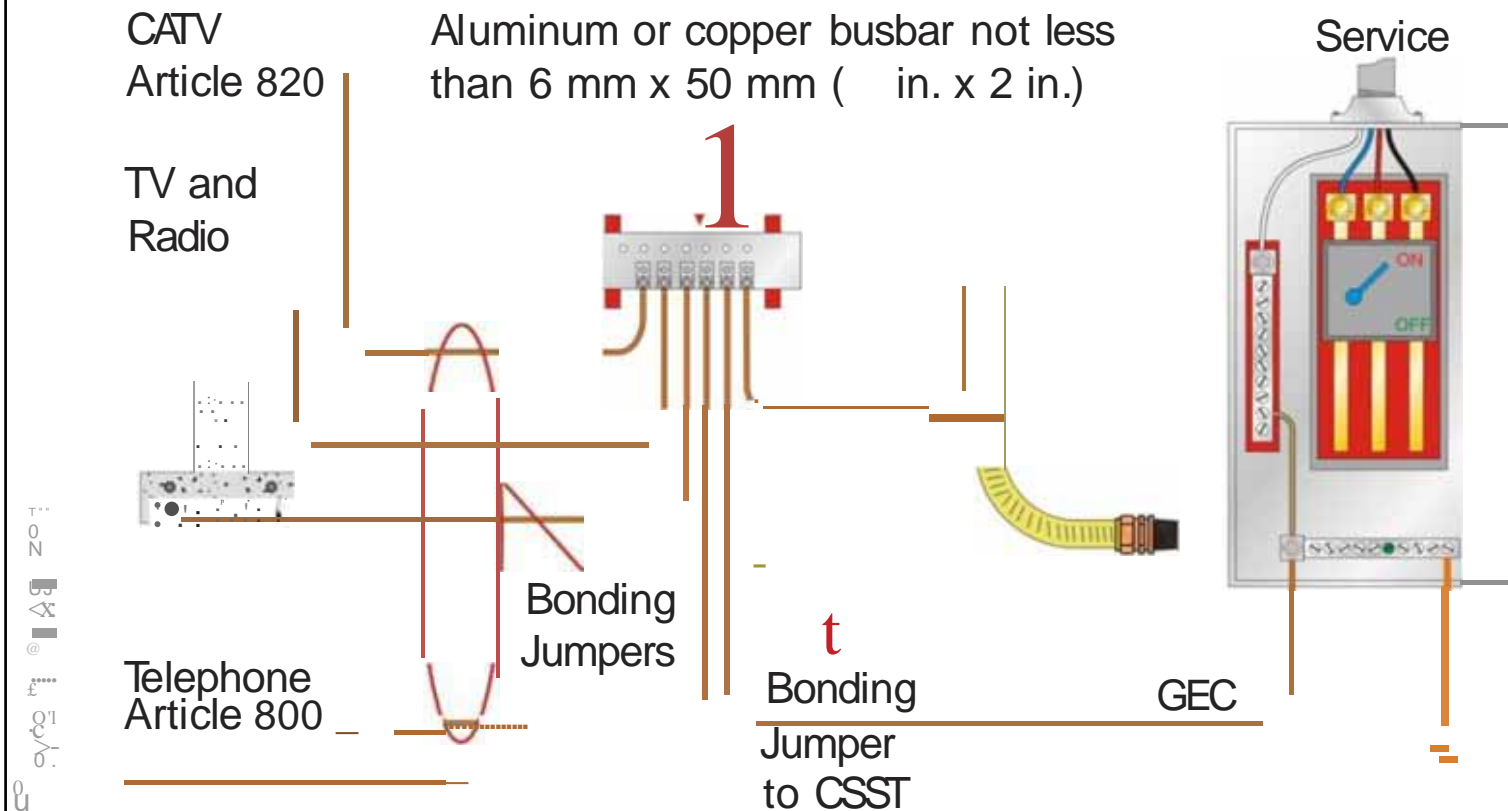
250.94(A) The Intersystem Bonding Termination Device. An intersystem bonding termination (BT) for connecting intersystem bonding conductors shall be provided external to enclosures at the service equipment or metering equipment enclosure and at the disconnecting means for any additional buildings or structures.

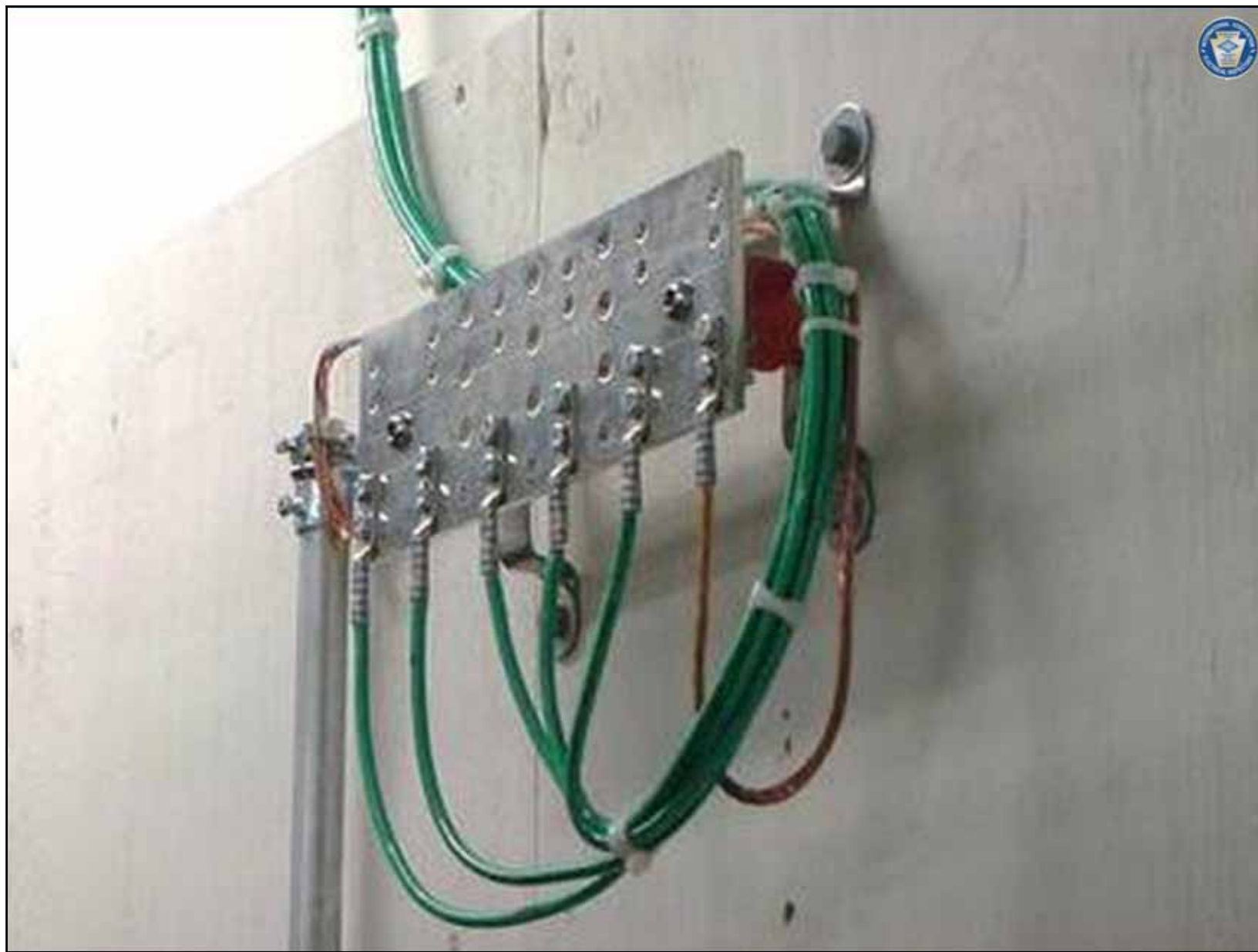




Bonding for Other Communication Systems

250.94(8) Other Means. Connections to an aluminum or copper busbar not less than 6 mm thick x 50 mm wide ($\frac{1}{4}$ in. thick x 2 in. wide) and of sufficient length to accommodate at least three terminations for communication systems **in addition to other connections**.





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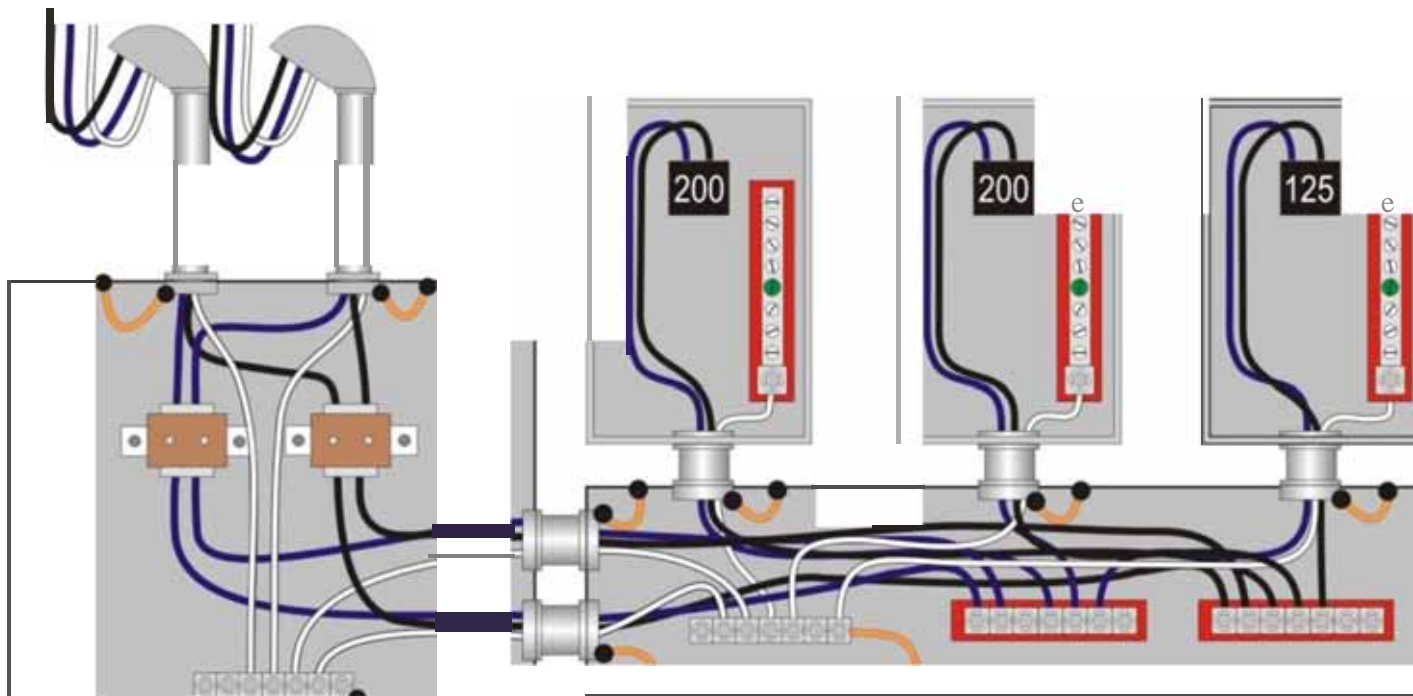
250.102 Grounded Conductor Bonding Conductors and Jumpers



- ▶ For proper sizing of a **grounded conductor**, **main bonding jumper**, **system bonding jumper**, or a **supply-side bonding jumper** for an alternating-current (ac) systems, provisions of 250.102 and Table 205.102(C)(1) must be utilized
- ▶ The term “**Grounded Conductor**” was added to the title of 250.102 to more accurately reflect what the section addresses
- ▶ Change harmonizes the title with the content of the section

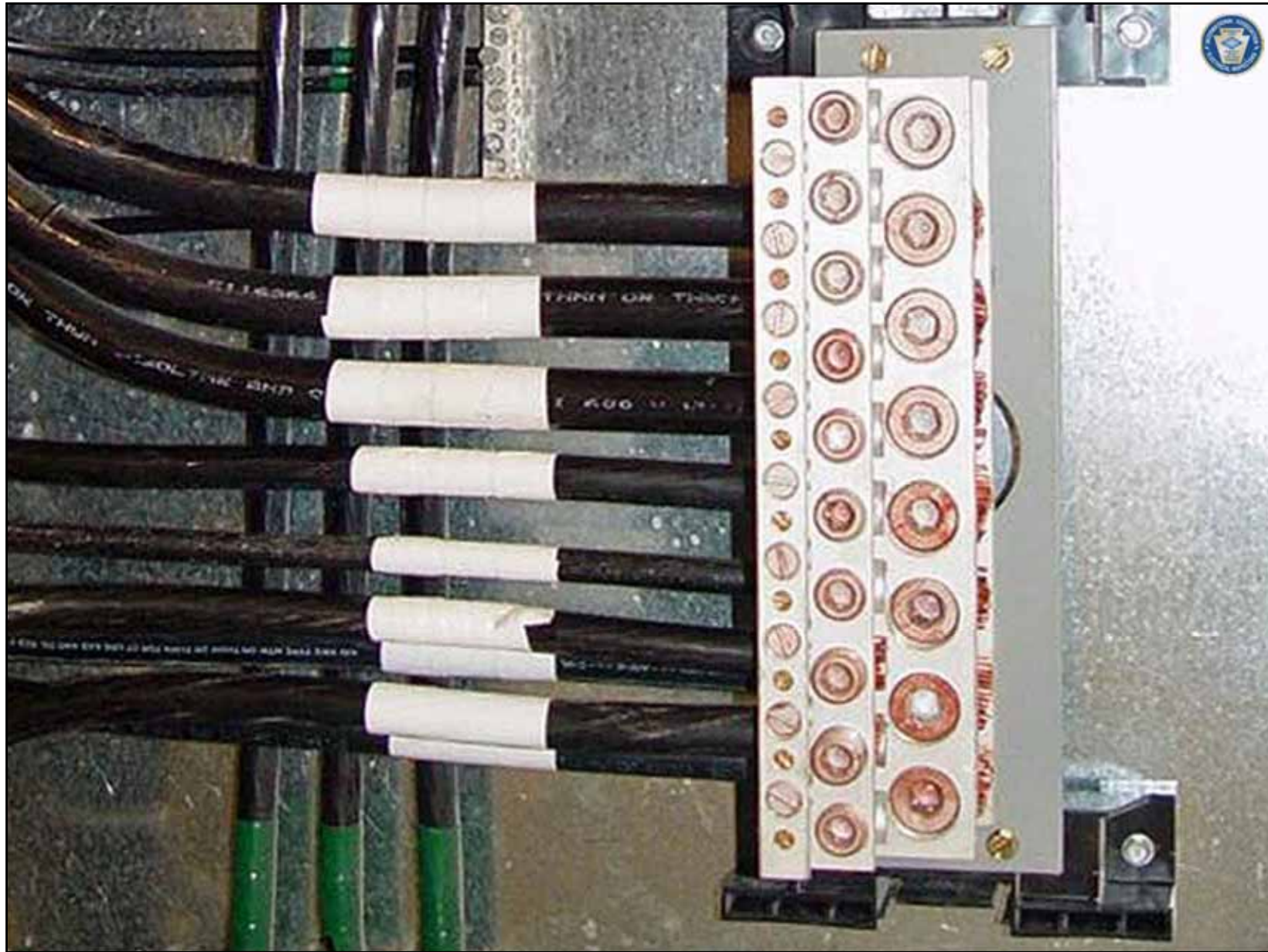
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250.102 **Grounded Conductor,** Bonding Conductors and Jumpers



Grounded conductors, bonding conductors, and bonding jumpers of copper, **aluminum, copper-clad aluminum**, or other corrosion-resistant material are to be sized in accordance with 250.102 and Table 250.102(C)(1)

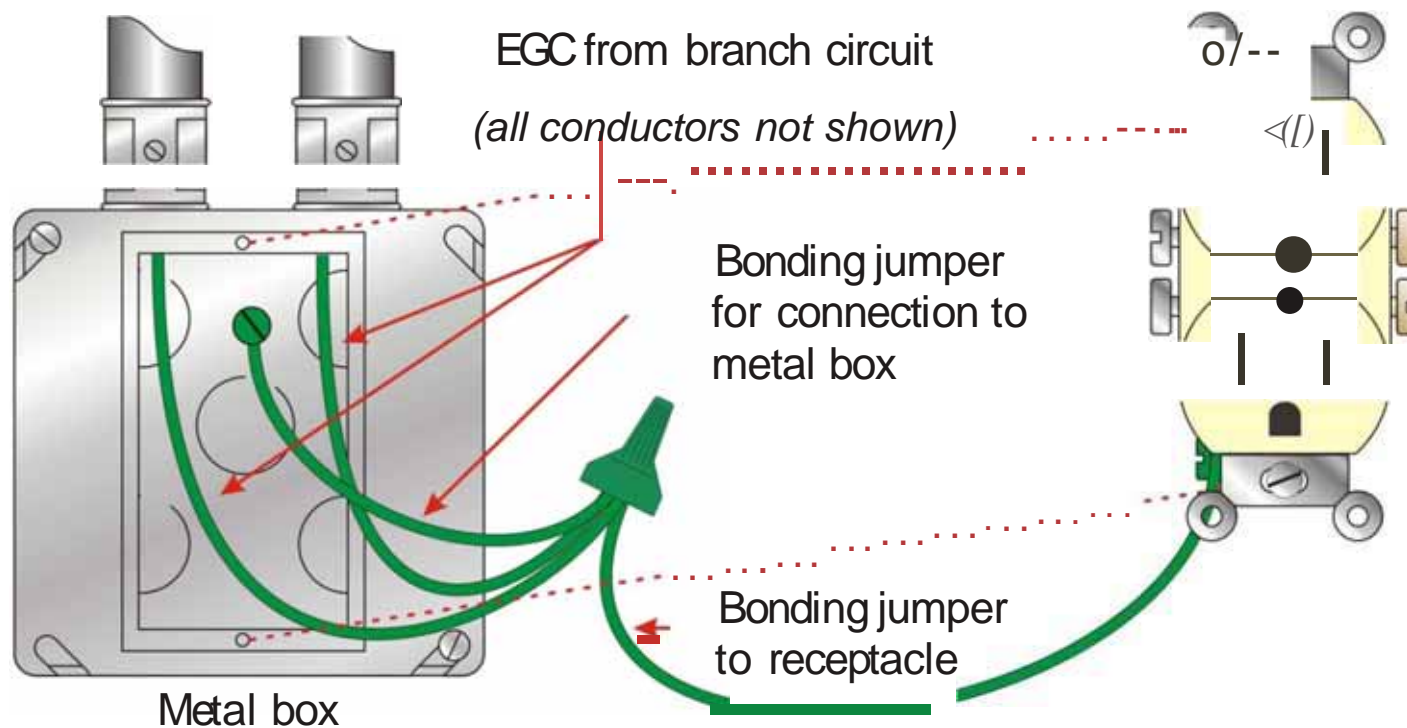
Supply-side bonding jumpers installed in parallel in two or more raceways **or cables** to comply with 250.102(C)(2)



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250.148 Continuity and Attachment of EGC to Boxes

If circuit conductors are spliced within a box, or terminated on equipment within or supported by a box, **all** equipment grounding conductor(s) (EGC) associated with **any of** those circuit conductors shall be connected within the box or to the box with devices suitable for the use



See exception for isolated ground receptacles at 250.146(0)

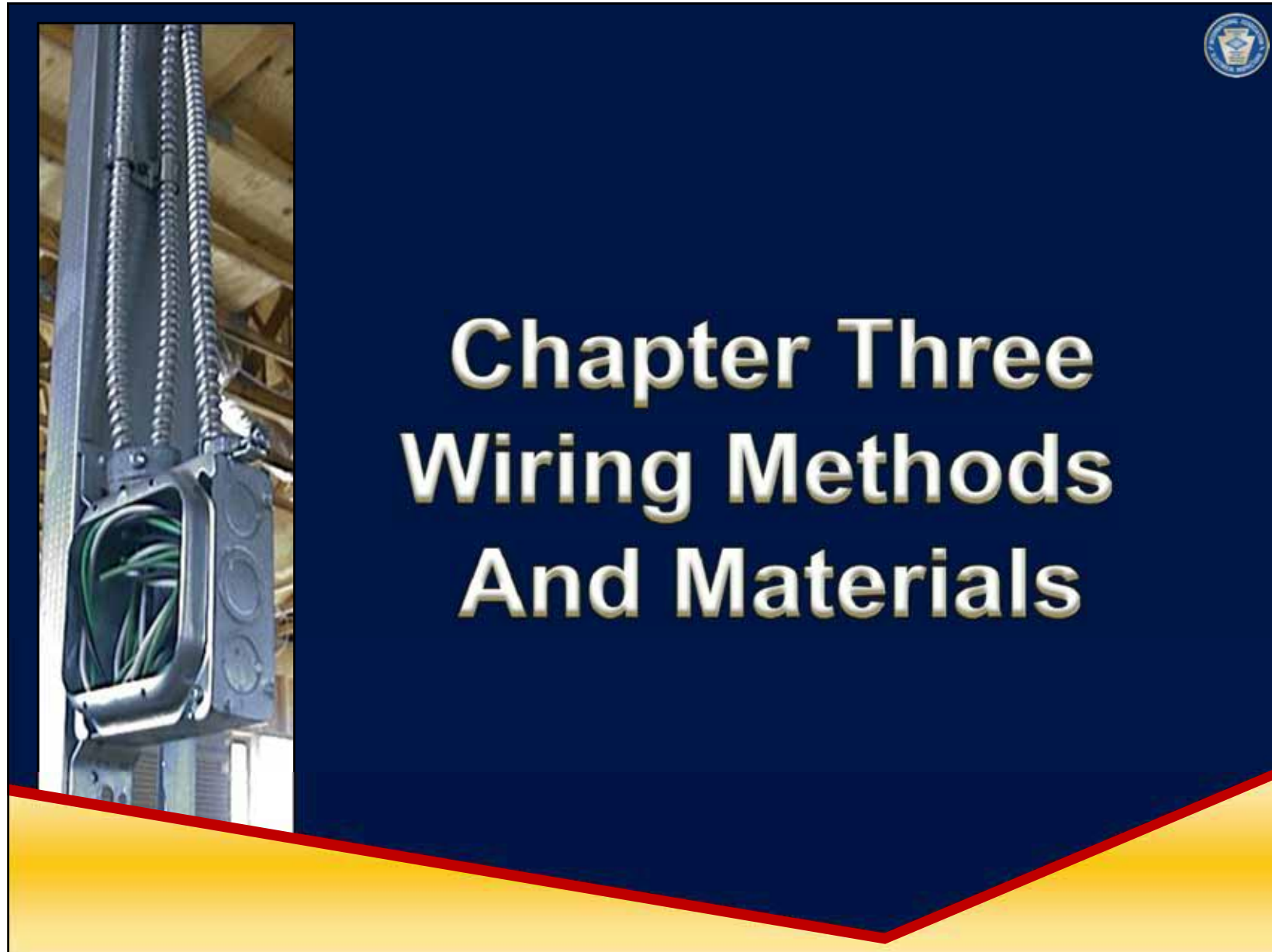




Table 300.5 Minimum Cover Requirements

- ▶ Two **new footnotes** were added to Table 300.5 allowing lesser depths for **listed low voltage lighting system** and for pool, spa, and fountain lighting where part of a listed low-voltage lighting system
- ▶ Removes conflicts between manufacturing instructions that require their secondary wiring to be installed at **lesser depths than Table 300.5**
- ▶ In some instances, these conductors are to be buried at **less than 150 mm (6 in.)** to conform to the manufacturers installation instructions
- ▶ Resolves a conflict between the product standard UL 1838 *[and 110.3(B)]* and Table 300.5

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Table 300.5 Minimum Cover Requirements

Minimum Cover Requirements, 0 to 1000 Volts, Nominal, Burial to Millimeters (Inches)

Location of Wiring Method or Circuit	Type of Wiring Method or Circuit									
	Column (1) Direct-Buried cables or Conductors		Column (2) Rigid Metal Conduit or Intermediate Metal Conduit		Column (3) Nonmetallic Raceways Listed for Direct Burial (No Concrete Encasement)		Column (4) Residential BC (120 Volts or Less, GFC , Max. OCPD of 20 Amperes)		Column (5) Irrigation and Landscape Ltg (30 Volts Max., Type UF or Other identified Cable or Raceway)	
	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
All locations not specified below	600	24	150	6	450	18	300	12	150'-b	6"b
In trench below 50 mm (2 in.) thick concrete or equivalent	450	8	150	6	300	12	150	6	150	6
Under a building (see NEC text)	0	0	0	0	0	0	0	0	0	0
Under min. 102 mm (4 in.) thick concrete exterior slab with no vehicular traffic [slab extending not less than 152 mm (6 in.)]	450	8	100	4	100	4	150 (direct burial) 100 (in raceway)	6 4	150 (direct burial) 100 (in raceway)	6 4
Under streets, highways, roads, alleys, driveways, parking lots	600	24	600	24	600	24	600	24	600	24
One- and two-family dwelling driveways/parking areas, (dwelling-related purposes only)	450	8	450	8	450	8	300	12	450	8
Under or under airport runways	450	18	450	18	450	18	450	18	450	18

Reproduction of NEC Table 300.5 (in part)(see next slide for Footnotes and Notes to table)

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Table 300.5 Minimum Cover Requirements

Minimum Cover Requirements, 0 to 1000 Volts, Nominal, Burial to Millimeters (Inches)

aA lesser depth shall be permitted where specified in the installation instructions of a listed low-voltage lighting system.

bA depth of 150 mm (6 in.) shall be permitted for pool, spa, and fountain lighting, installed in a nonmetallic raceway, limited to not more than 30 volts where part of a listed low-voltage lighting system.

Notes:

1. Cover is defined as the shortest distance in millimeters **mm** (inches **in.**) measured between a point on the top surface of any direct-buried conductor, cable, conduit, or other raceway and the top surface of finished grade, concrete, or similar cover.
2. Raceways approved for burial only where concrete encased shall require concrete envelope not less than 50 mm (2 in.) thick.
3. Lesser depths shall be permitted where cables and conductors rise for terminations or splices or where access is otherwise required.
4. Where one of the wiring method types listed in Columns 1 through 3 is used for one of the circuit types in Columns 4 and 5, the shallowest depth of burial shall be permitted.
5. Where solid rock prevents compliance with the cover depths specified in this table, the wiring shall be installed in **a** metal **raceway**, or a nonmetallic raceway permitted for direct burial. The raceways shall be covered by a minimum of 50 mm (2 in.) of concrete extending down to rock.

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300.5(D)(4)

Protection from Physical Damage

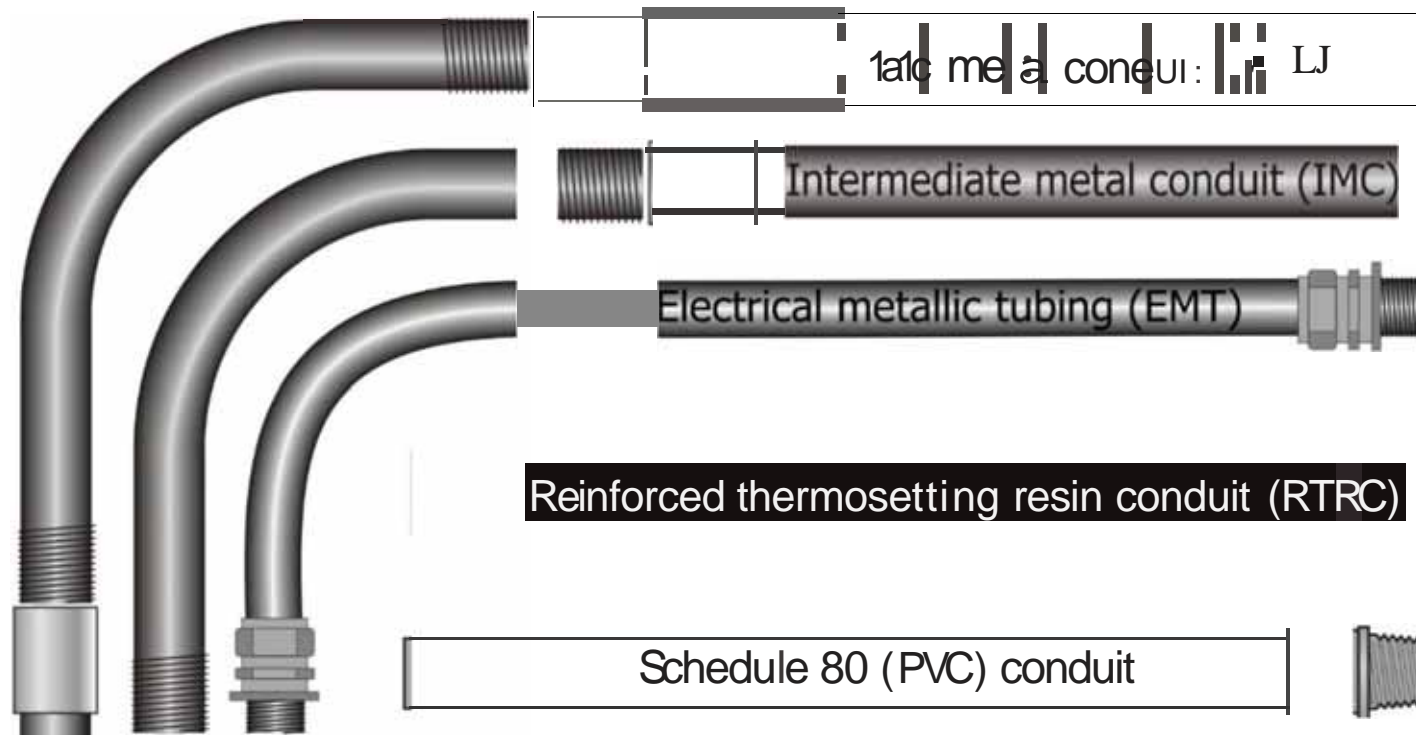
- ▶ **Electrical metallic tubing (EMT)** was added to the list of acceptable wiring method that can be used to provide protection from physical damage for conductors installed underground and subject to physical damage
- ▶ EMT is permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences **where protected by corrosion protection and approved as suitable for the condition**
- ▶ Corrosion protection is a requirement for listed EMT per UL 797 (*Electrical Metallic Tubing - Steel*) and in accordance with 300.6

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300.5(0)(4) Protection from Physical Damage



Where direct-buried conductors and cables are installed in enclosures or raceways and are subject to physical damage, **electrical metallic tubing (EMT)**, rigid metal conduit (RMC), intermediate metal conduit (IMC), reinforced thermosetting resin conduit (RTRC) (Type RTRC-XW), Schedule 80 rigid polyvinyl chloride (PVC) conduit, or equivalent is allowed to be used to provide protection from physical damage



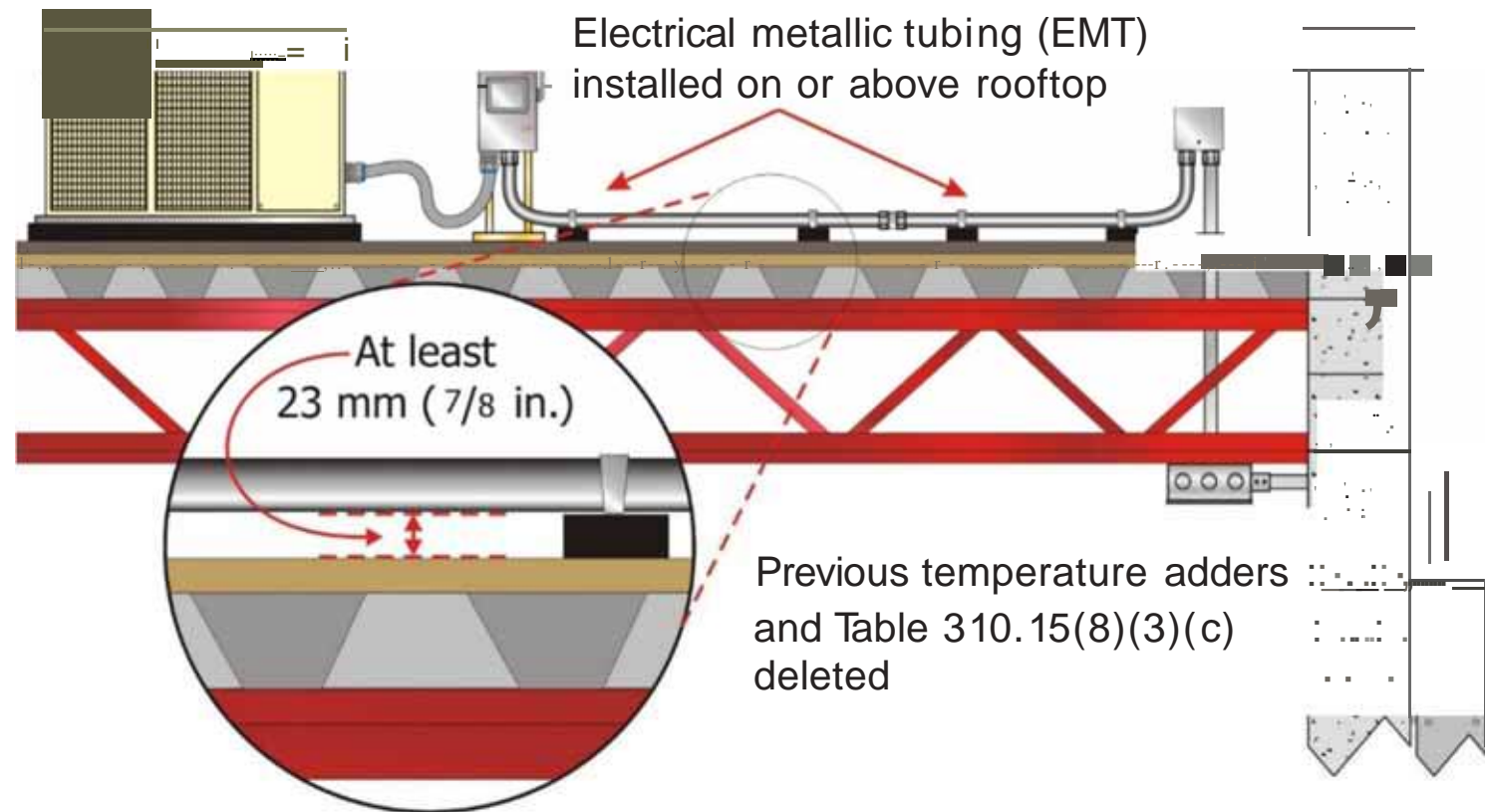
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3 10.15(B)(3)(c) Raceways and Cables on Rooftops (D)

Where raceways or cables are exposed to direct sunlight on or above rooftops, they shall be installed **23 mm (7/8 in.) above the roof** or be subject to a roof top temperature adder of **33°C (60°F)** (see exception for *Type XHHW-2 conductors*)



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310.15(8)(7) 120/ 240 Volt or 208Y/120 Volt, Single-Phase Dwelling Services and Feeders



Single-phase, 120/240-volt services or feeders (100 - 400 ampere) and single-phase, 208Y/120-volt feeders (100 - 400 ampere), supplying the entire dwelling unit load permitted to have an ampacity not less than 83% of the service or feeder rating

Correction or adjustment factors required by 310.15(8)(2) or (3) permitted to be applied to the ampacity associated with the temperature rating of these conductors

Service/feeder ratings addressed by this section are based on the standard ampacity ratings from 240.6(A)



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Informative Annex D - Example 07

Sizing of Service Conductors for Dwelling(s)

[Former Table 310.15(8)(7)]

If no temperature correction or ampacity adjustment factors are required, the following table includes conductor sizes calculated using the requirements in 310.15(8)(7). This table is based on 75°C terminations and without any adjustment or correction factors.

Service or Feeder Rating (Amperes)	Conductor (AWG or kcmil)	
	Copper	Aluminum or Copper- Clad Aluminum
100	4	2
110	3	1
125	2	10
150	1	2/0
175	10	3/0
200	2/0	4/0
225	3/0	250
250	4/0	300
300	250	350
350	350	500
400	400	600



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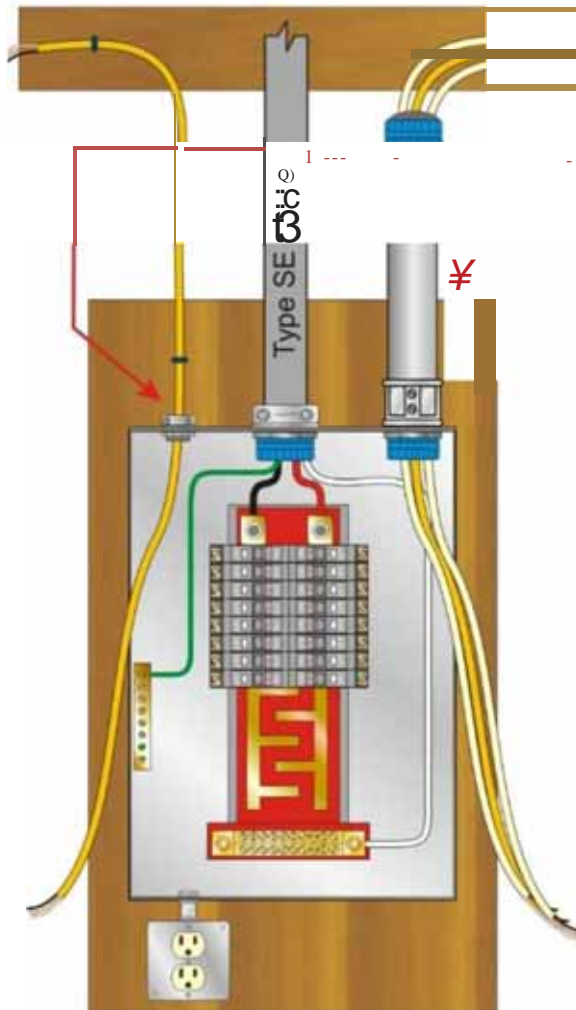


312.5(C), Ex., Item (g) Cable Raceway

- ▶ New sentence added to Item (g) indicating that **Note 2 to the tables in Chapter 9 does not apply** to a “sleeve” of conduit or tubing required by 312.5(C), Exception
- ▶ In order to meet this exception, cables with entirely nonmetallic sheaths permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways not less than **450 mm (18 in.)** and not more than **3.0 m (10 ft)** in length
- ▶ This limited length of raceway is required to be restricted on conductor fill to the limits of **Chapter 9, Table 1** (*53% of the cross-sectional area of the conduit or tubing for one conductor, 31% for two conductors, and 40% for over 2 conductors*)

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312.S(C), Ex., Item (g) Cable Raceway



Main rule: Cables must be secured to cabinet

Exception: Cables with entirely nonmetallic sheaths permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways

Nonflexible raceways must be from 450 mm (18 in.) to 3.0 m (10 ft) in length

Where cables are installed in conduit or tubing, the cable fill cannot exceed the conductor fill permitted for complete conduit or tubing systems by Table 1 of Chapter 9

Note 2 to the tables in Chapter 9 does not apply to this condition (Table 1 of Chapter 9 only applies to "complete conduit or tubing systems")

**See NEC for complete conditions of exception*



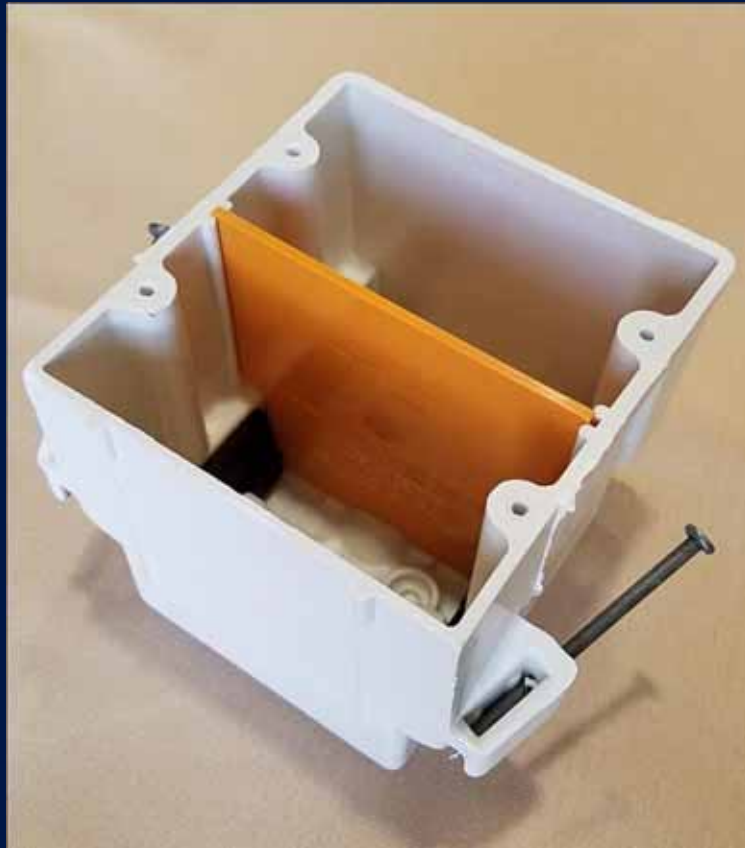
314.16(A) and (B) Box Fill Calculations

- ▶ The volume or space that is occupied by an **internal barrier** in a box or enclosure has been added to the items addressed for performing a box fill calculation
- ▶ **Nonmetallic box barriers** are generally provided with its volume markings, but **metal barriers** for metal boxes are not currently marked with their volume consumption
- ▶ New added sentence at 314.16(B) will also make it clear that **each space** within a box installed with an interior barrier will need to be **calculated separately**
- ▶ Each barrier (if not marked) shall be considered to take up:
 - 8.2 cm³ (**½ in.³**) if **metal**
 - 16.4 cm³ (**1 in.³**) if **nonmetallic**

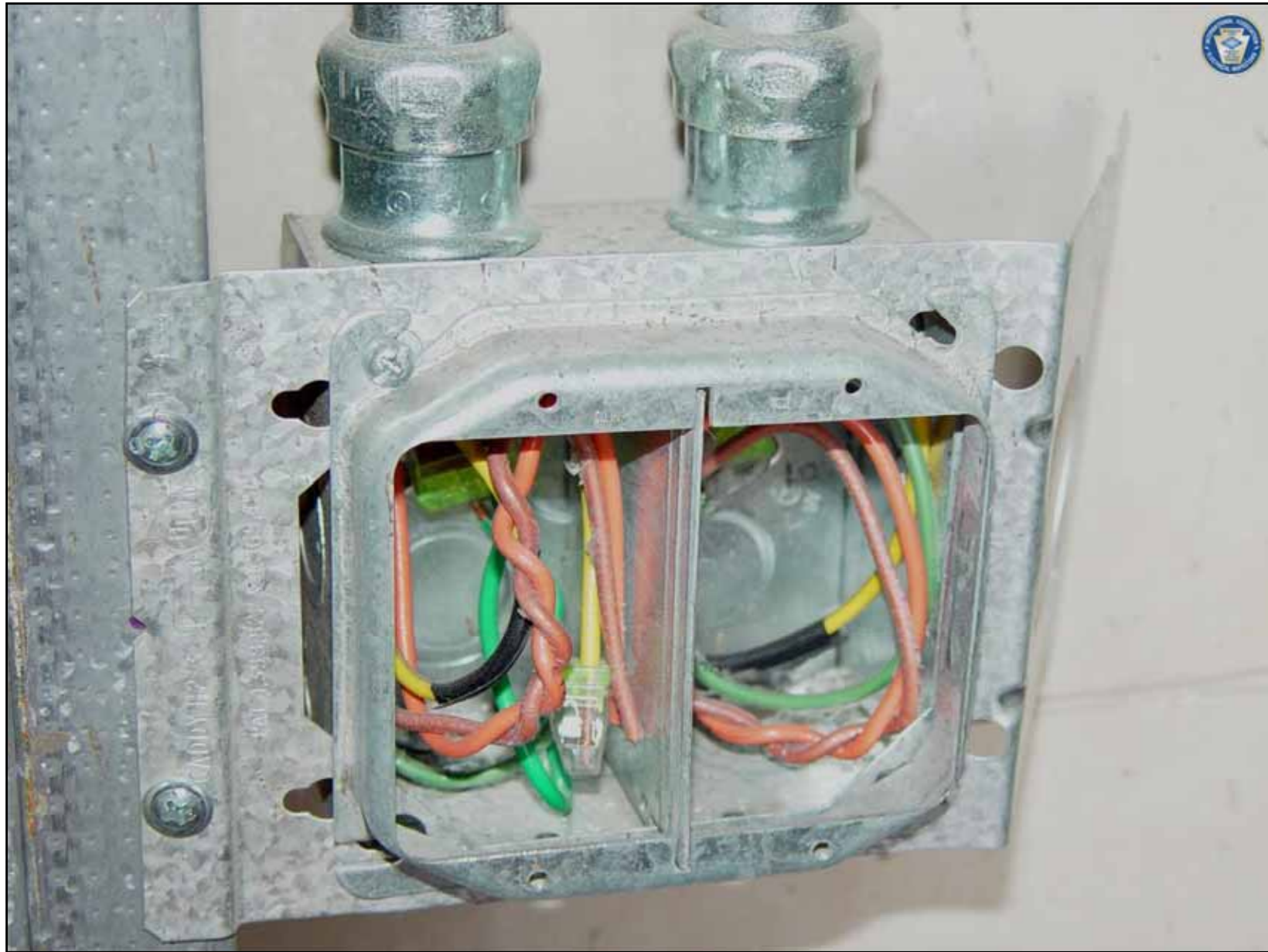
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314.16(A) and (B) Box Fill Calculations



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314.17(B) Cable Entering Metal Box

- ▶ The outside sheath of Type NM or Type UF cable used with **metal box** must now extend not less than **6 mm (¼ in.)** inside the box and beyond any cable clamp
- ▶ Same as currently required for nonmetallic boxes
- ▶ Same protection for cables and their associated conductors is needed when entering a metal box or conduit body as well
- ▶ Assures that cable clamp of a metal box will not be tightened down upon an exposed insulated conductor of a Type NM or Type UF cable

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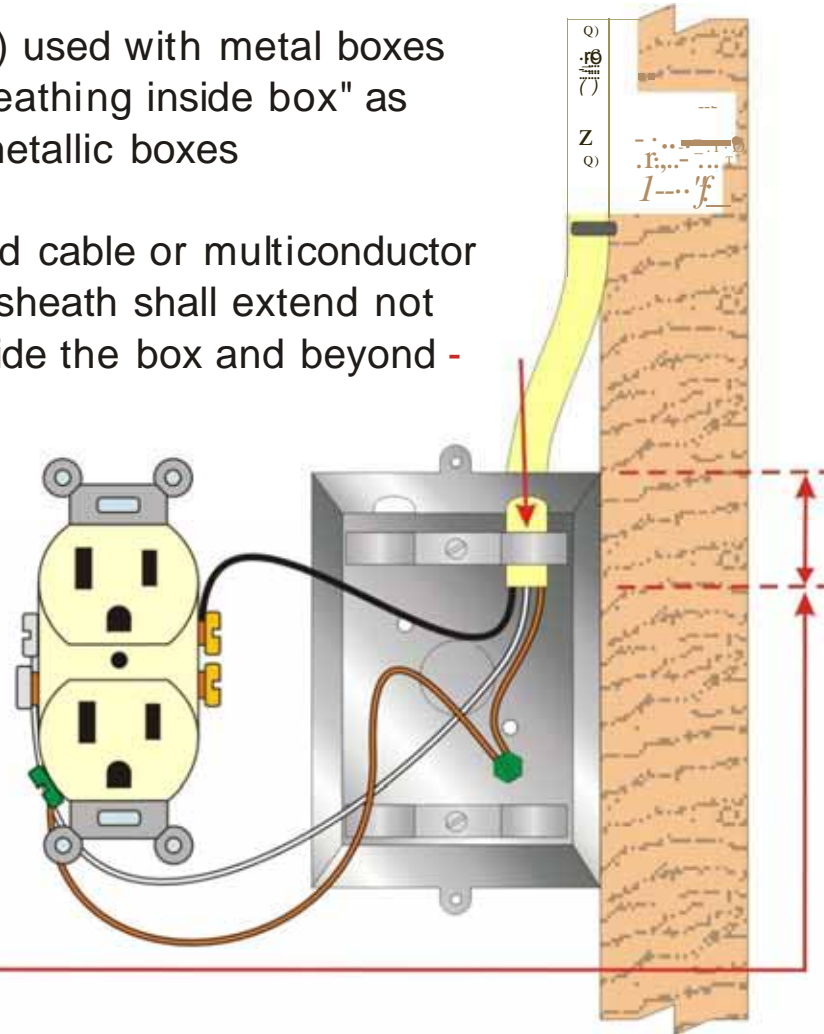
3 14.17(8) Type NM Cable Entering Metal Boxes



Type NM cable (or Type UF) used with metal boxes now requires the same "sheathing inside box" as currently required for nonmetallic boxes

Where nonmetallic-sheathed cable or multiconductor Type UF cable is used, the sheath shall extend not less than 6 mm ($\frac{1}{4}$ in.) inside the box and beyond - any cable clamp

Minimum 6 mm ($\frac{1}{4}$ in.)





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314.27(E) Separable Attachment Fittings

- ▶ Outlet boxes now permitted to support **listed locking support and mounting receptacles** used in combination with **compatible attachment fittings** for supporting a luminaire, lampholder, or ceiling suspended (paddle) fan
- ▶ Listed locking support and mounting receptacles are **an option** for mounting (*not a requirement*)
- ▶ Recognizes new listed technology designed to power and support luminaires and or ceiling suspended (*paddle*) fans
- ▶ Listed product provides a secure mounting mechanism and will facilitate interchange of luminaires and ceiling suspended (*paddle*) fans in a safe and efficient manner

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314.27(E)

Separable Attachment Fittings (*cont.*)

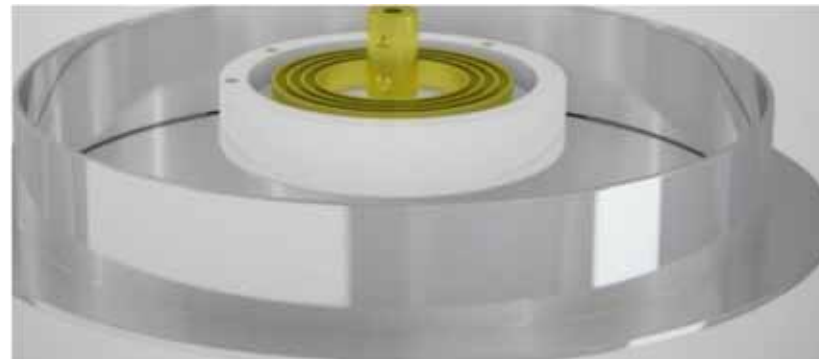
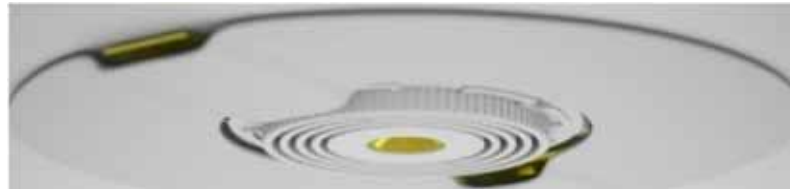
- ▶ New provision for **listed locking support and mounting receptacles** for luminaires coincides with the revised definition of a “**receptacle**” in Article 100
- ▶ **Receptacle.** A contact device installed at the outlet for the connection of an attachment plug, **or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device.** A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.
- ▶ Similar *Code* language was added at **422.18** for support of ceiling-suspended (paddle) fans

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3 14.27(E) Separable Attachment Fittings

CI)

Outlet boxes permitted to support listed locking support and mounting receptacles used in combination with compatible attachment fittings



Courtesy of Safety Quick Lighting **and Fans** Corp.

Separable attachment fittings must be identified for the support of equipment within the weight and mounting orientation limits of the listing

Supporting receptacle installed within a box must be included in box fill calculation



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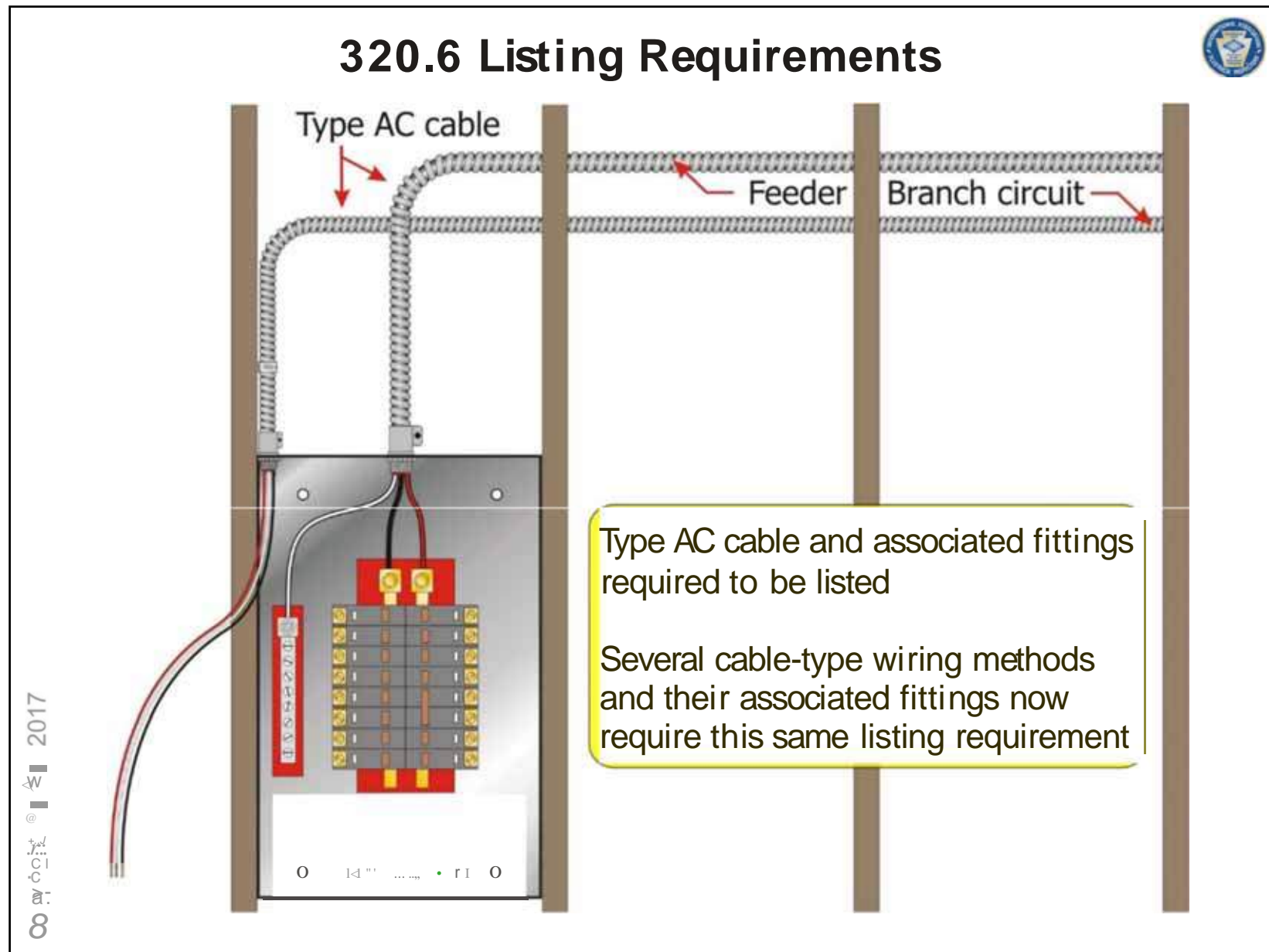


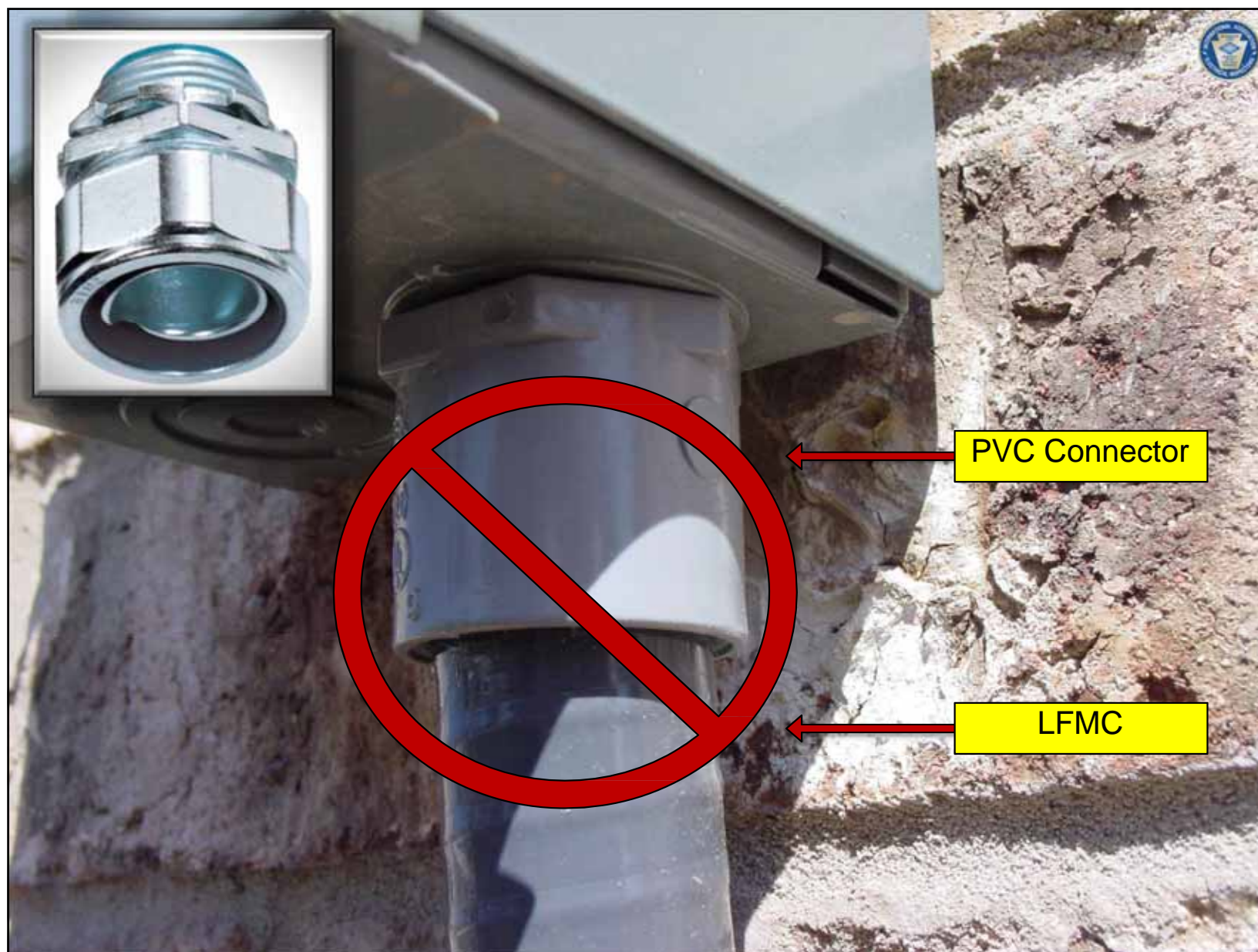


320.6 Listing Requirements

- ▶ New listing requirements were added in a number of the cable-type wiring method articles that will require the **wiring method (cable) and associated fittings** to be **listed**
- ▶ Must be listed for use with each other
- ▶ A non-listed cable-type wiring method may not function correctly with listed termination fittings
- ▶ This will ensure that the cable installed in the field has been evaluated to the appropriate product standard and listed for use in accordance with *NEC* regulations

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320.6 Listing Requirements

- The same requirement that the wiring method (*cable*) and associated fittings be listed occurred at the following locations:

320.6	Type AC cable	FR 1808	PI 1332
322.6	Type FC cable	FR 1801	PI 1334
328.6	Type MV cable	FR 1814	PI 1336
330.6	Type MC cable	FR 1816	PI 1337
332.6	Type MI cable	FR 1806	PI 1338
334.6	Type NM cable	FR 1824	PI 886
336.6	Type TC cable	FR 1833	PI 1339
338.6	Type SE cable	FR 1827	PI 1341
340.6	Type UF cable	FR 1829	PI 887

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336.10(9) Power and Control Tray Cable: Type TC



- ▶ **Type TC-ER** cable with a designation of “**JP**” will now be allowed exposed without a raceway at **dwelling units**
- ▶ There are now 9 different list items under “Uses Permitted” for Type TC cable
- ▶ Type TC-ER cable containing both power and control conductors that is identified for pulling through structural members to be installed in **one- and two-family dwelling units**
- ▶ The “**-ER**” suffix stands for “**Exposed Run**”
- ▶ The “**-JP**” suffix stands for “**Joist Pull**”

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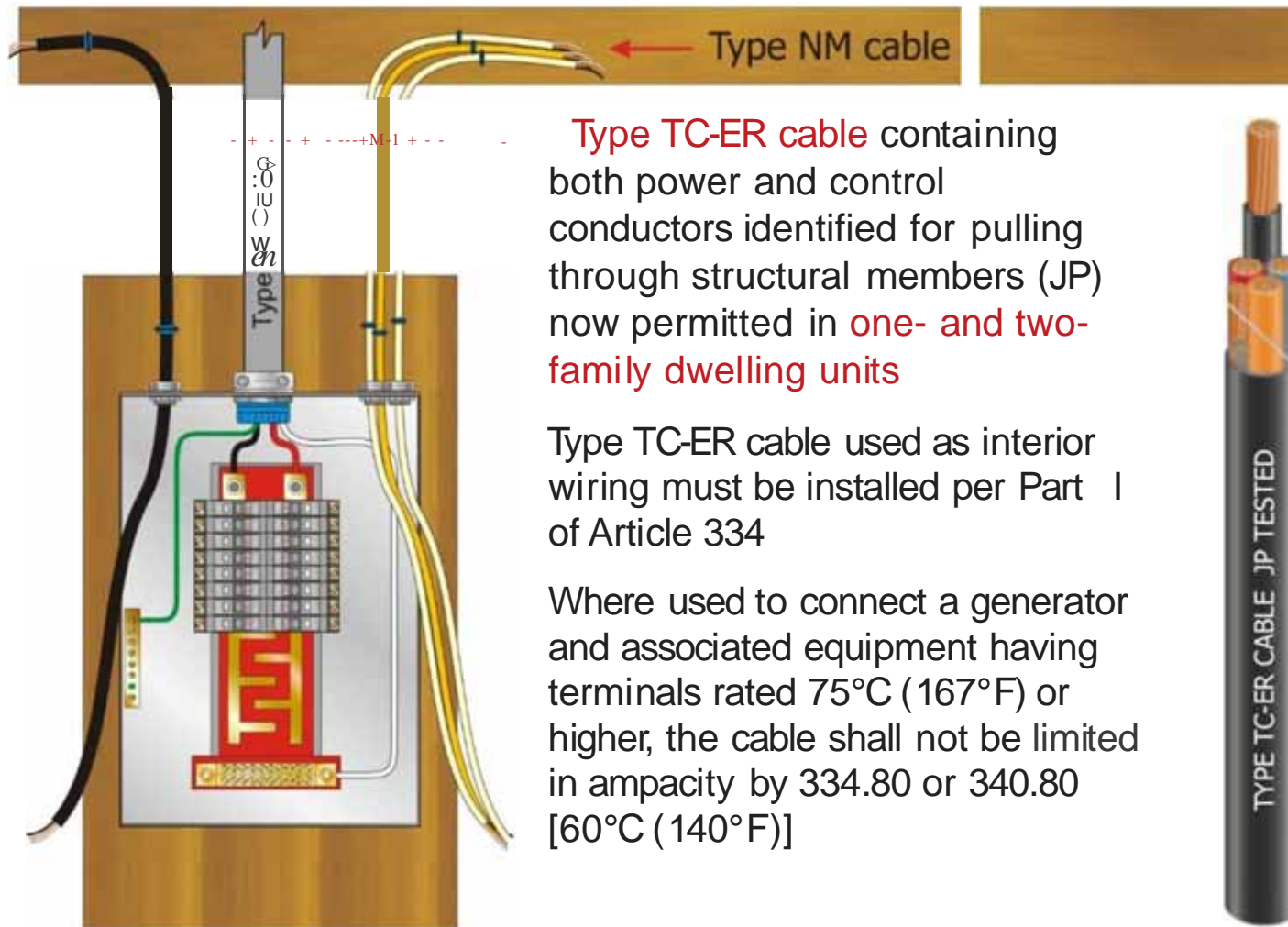
336.10(9) Power and Control Tray Cable: Type TC (*cont.*)

- ▶ Type TC-ER cable meets or exceeds:
 - Construction specifications for nonmetallic-sheathed cable (Type NM cable)
 - UL product standard crush and impact ratings for Type NM cable and Type SE and SER cable
 - UL crush and impact tests for Type MC cable
- ▶ This type of cable has gained popularity when installing a **standby power generator** at a dwelling unit
- ▶ By allowing Type TC-ER cable to be installed exposed in a dwelling unit, the installer can secure the cable to the lower side of joists in unfinished basements or crawl spaces without installing a raceway for the cable

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336.10(9) Uses Permitted for Type TC Cable

ft \ 'W/



Cable illustration courtesy of Southwire



350.28 Trimming of LFMC

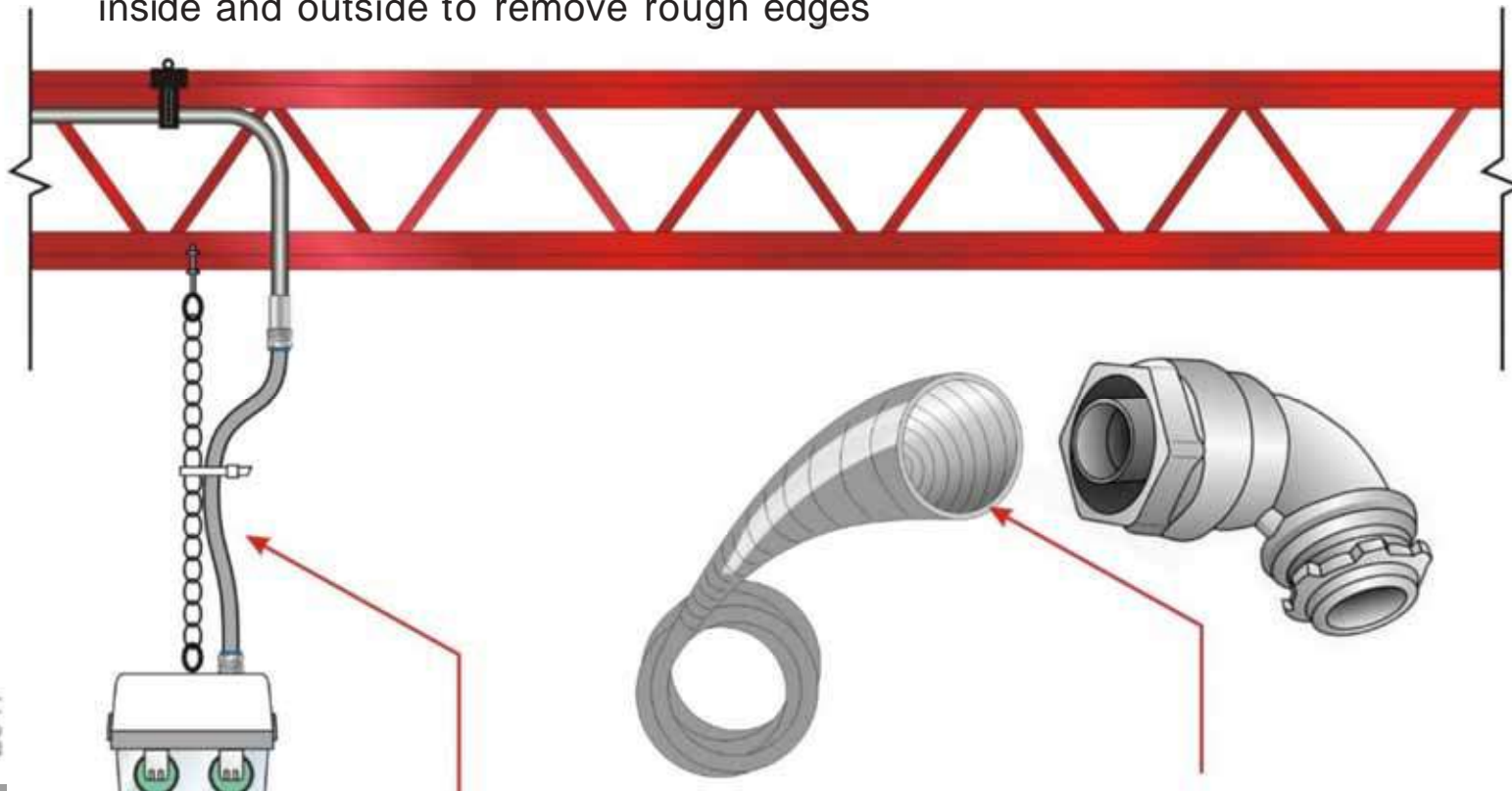
- ▶ New language added requiring cut ends of liquidtight flexible metal conduit (*Type LFMC*) to be **trimmed inside and outside** to remove rough edges
- ▶ Proper trimming of Type LFMC is necessary as to allow the proper installation of the steel grounding ferrule
- ▶ Important to maintain ground continuity of the steel sheath of Type LFMC
- ▶ Trimming of the cut ends should be done to prevent chafing of pulled conductors
- ▶ Provides consistency between Article 350 and Article 356 (LFNC) and other *NEC* articles for trimming and reaming

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350.28 Trimming of LFMC



All cut ends of liquidtight flexible metal conduit (LFMC) shall be trimmed inside and outside to remove rough edges



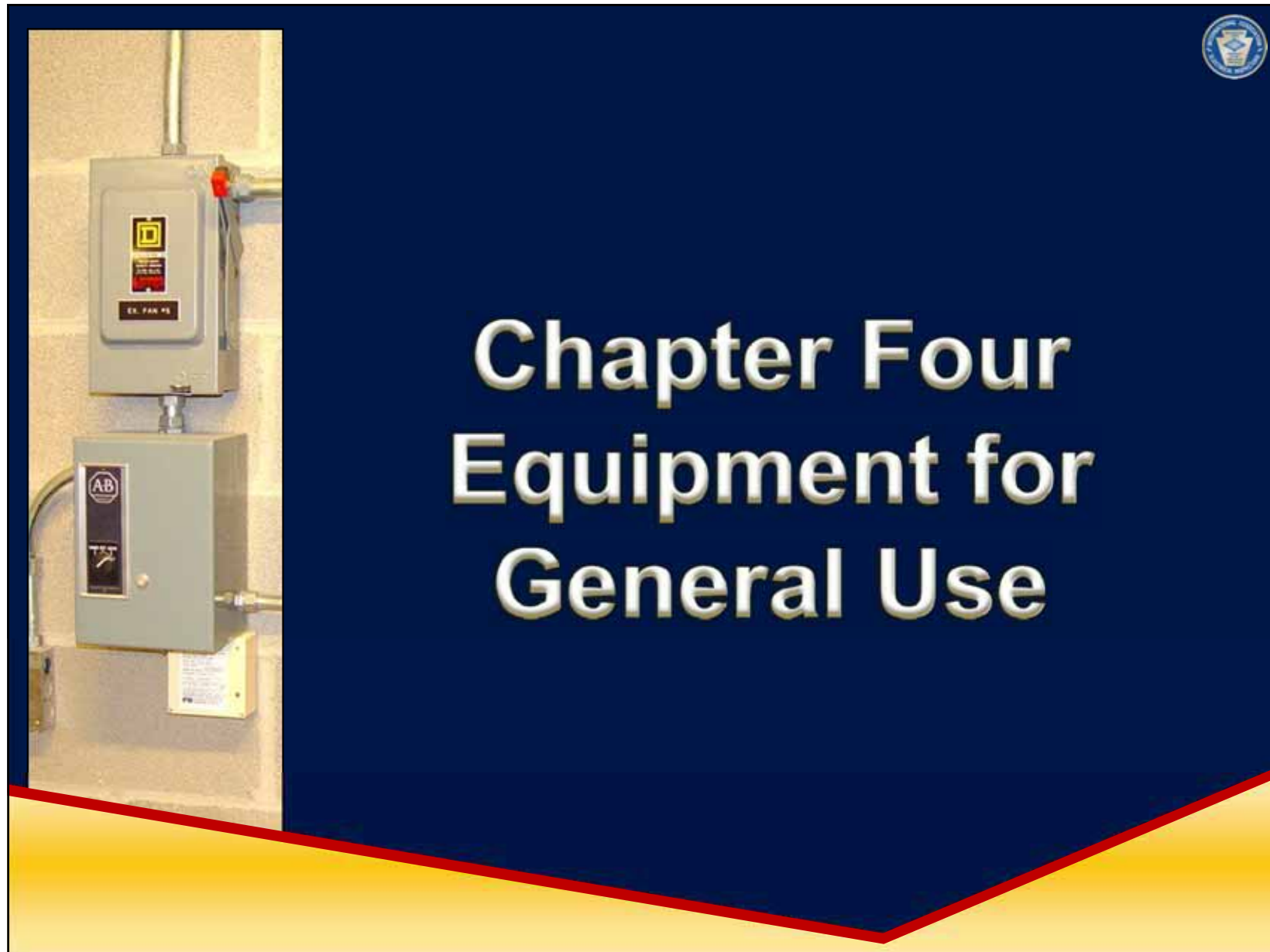
Trim cut ends of LFMC

Liquidtight flexible metal conduit installed where flexibility is necessary after installation

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404.2(C) Grounded Conductor at Switch Locations

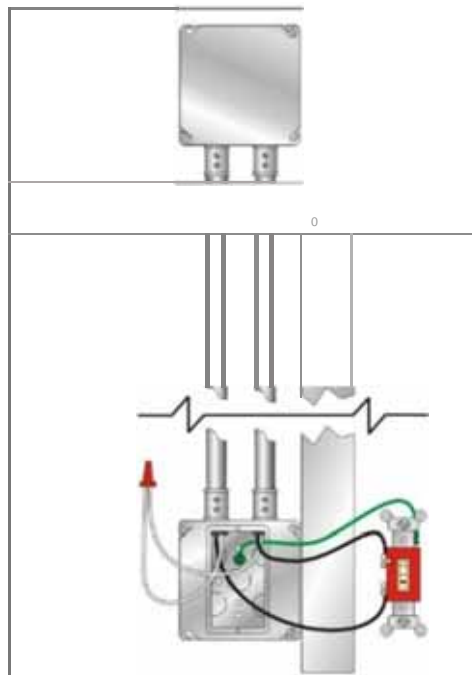
- ▶ The previous seven “conditions” in which a grounded conductor was not required to be installed at lighting switch locations has been revised and reduced to only **five “conditions”**
- ▶ Previous condition **(4) and (5) moved** from these conditions to the parent text of 404.2(C) and reworded into positive language
- ▶ Enforceable language was added to require the grounded conductor to be **connected and used** by the switching device rather than simply be “present” at the switch enclosure
- ▶ Exception added to **exclude replacement or retrofit switches** installed in locations prior to local adoption of 404.2(C) where the grounded conductor cannot be extended without removing finish materials
- ▶ New exception also puts a limit to the number of electronic lighting control switches on a branch circuit **(5)** or feeder **(25)**

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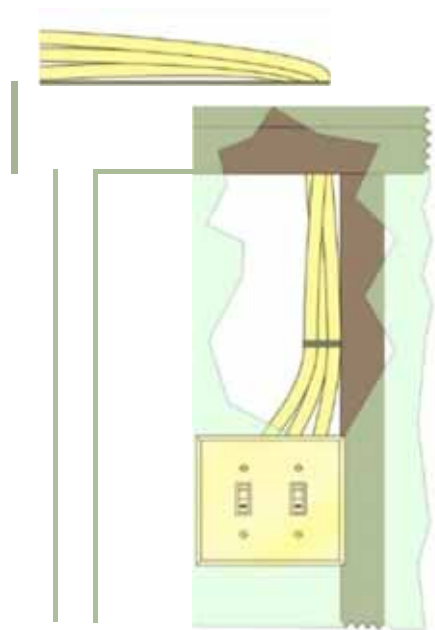
404.2(C) Grounded Conductor at Switch Locations

A grounded conductor is generally required to be **installed and connected to the switching device** at locations where switches control lighting loads that are supplied by a grounded general-purpose branch circuit

Grounded conductor is generally **NOT** required at the following locations:



Raceway system
large enough for all
contained conductors



Accessible for the
installation of additional
cable without removing
finish materials

(Courtesy of Leviton/Cheetah USA)

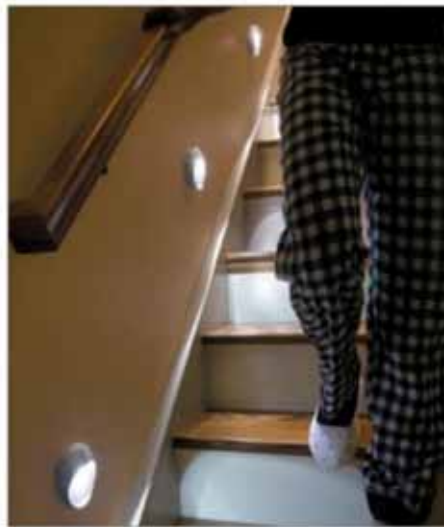


Snap switches with
integral enclosures
comply with 300.1S(E)

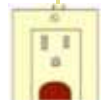
404.2(C) Grounded Conductor at Switch Locations

A grounded conductor is generally required to be **installed and connected to the switching device** at locations where switches control lighting loads that are supplied by a grounded general-purpose branch circuit

Grounded conductor is generally **NOT** required at the following locations:



Where lighting in the area is controlled by automatic means (*such as a motion sensor*)



Where a switch controls a receptacle load



Switch for non-habitation type room or occupancies as defined by applicable building code

404.2(C) Grounded Conductor at Switch Locations



A grounded conductor is generally required to be **installed and connected to the switching device** at locations where switches control lighting loads that are supplied by a grounded general-purpose branch circuit

Grounded conductor is generally **NOT** required at the following locations:



Where **multiple switch locations** control the same lighting load such that the entire floor area of the room or space is visible from the single or combined switch locations, the grounded circuit conductor shall only be **required at one location**

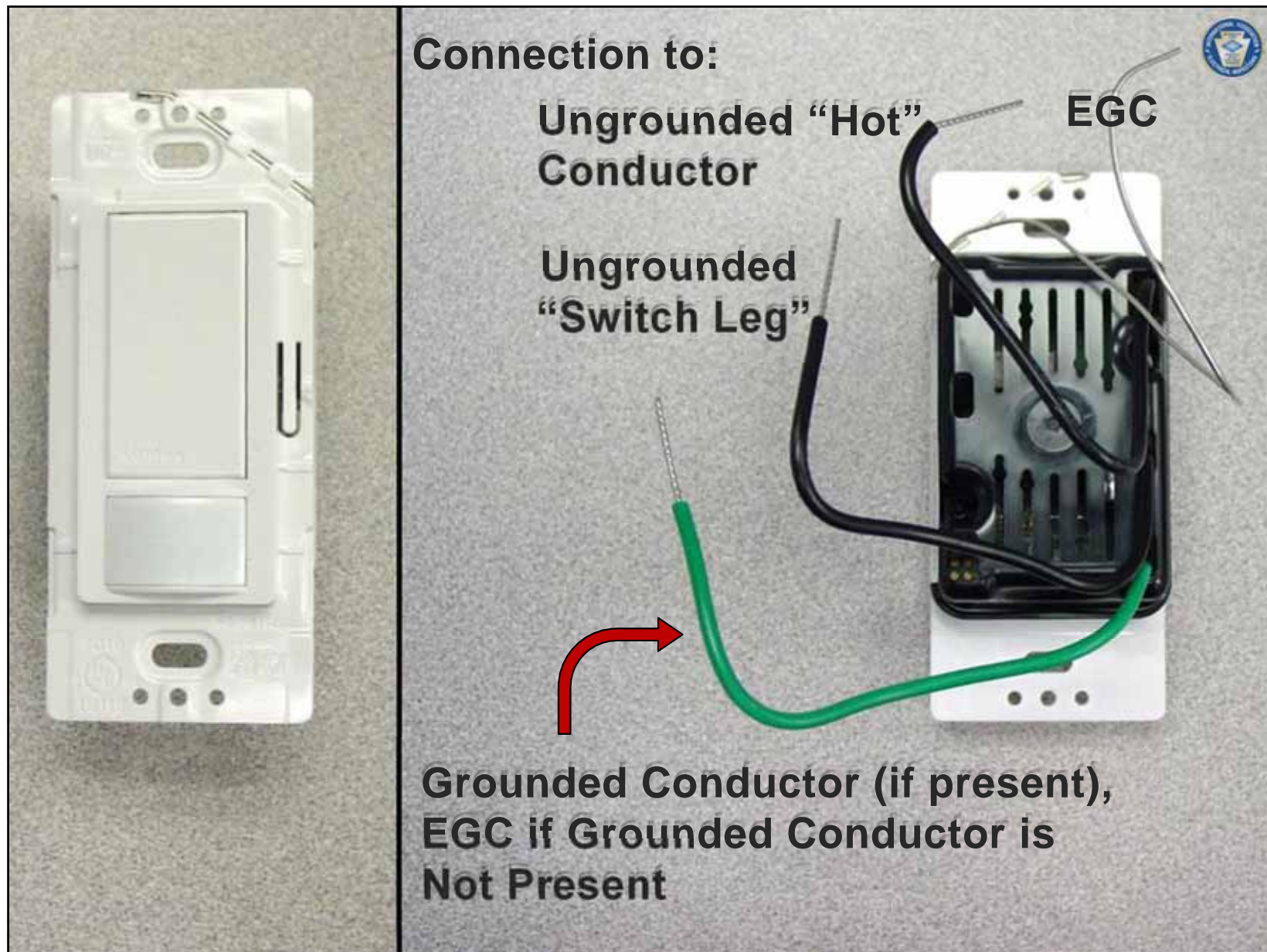


404.22

Electronic Lighting Control Switches

- ▶ New provisions added for “Electronic Lighting Controlled Switches” **prohibiting current** on the **equipment grounding conductor** with a future effective date
- ▶ In conjunction with revisions to 404.2(C), electronic lighting control switching devices to be listed and **“shall not introduce current on the equipment grounding conductor during normal operation”**
- ▶ Currently, readily-available existing listed electronic lighting control switching devices requiring EGC to be used as grounded conductor per the **manufacturer’s instructions**
- ▶ This probation on introducing current on the EGC requirement has a future effective date on **January 1, 2020**

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406.2 Definition: Outlet Box Hood

- ▶ Definition for the term “**outlet box hood**” was added at 406.2
- ▶ Outlet box hoods commonly referred to in the field as “in-use” covers or “bubble” covers
- ▶ All outlet box hood covers should be required to be listed for use in a wet location when installed in a wet location
- ▶ Relied upon to provide environmental protection for enclosed devices such as GFCI receptacle outlet devices
- ▶ **Nonmetallic** outlet box hoods are typically constructed of UV resistant polycarbonate while the **metal enclosures** are typically made of powder-coated cast zinc

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406.2 Definition: Outlet Box Hood



A housing shield intended to fit over a faceplate for flush-mounted wiring devices, or an integral component of an outlet box or of a faceplate for flush-mounted wiring devices.



The hood does not serve to complete the electrical enclosure; it reduces the risk of water coming in contact with electrical components within the hood, such as attachment plugs, current taps, surge protective devices, direct plug-in transformer units, or wiring devices.

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406.3(F) Receptacle with USB Charger

- ▶ New provisions added pertaining to 125-volt 15- or 20-ampere receptacle that additionally provides Class 2 power in the form of a **USB outlet and charger**
- ▶ New provisions require these devices to be **listed** and constructed such that the Class 2 circuitry is **integral with the receptacle**
- ▶ **Universal Serial Bus (USB)** is an industry standard that defines the cables, connectors and communications protocols used in a bus for connection, communication, and power supply between computers and electronic devices
- ▶ Some Class 2 power supply and Class 2 output connector(s) are intended to be secured and directly connected to a duplex receptacle (*not integral with the receptacle*)

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406.6(D) Receptacle Faceplate (*Cover Plates*) with Integral Night Light and/or USB Charger

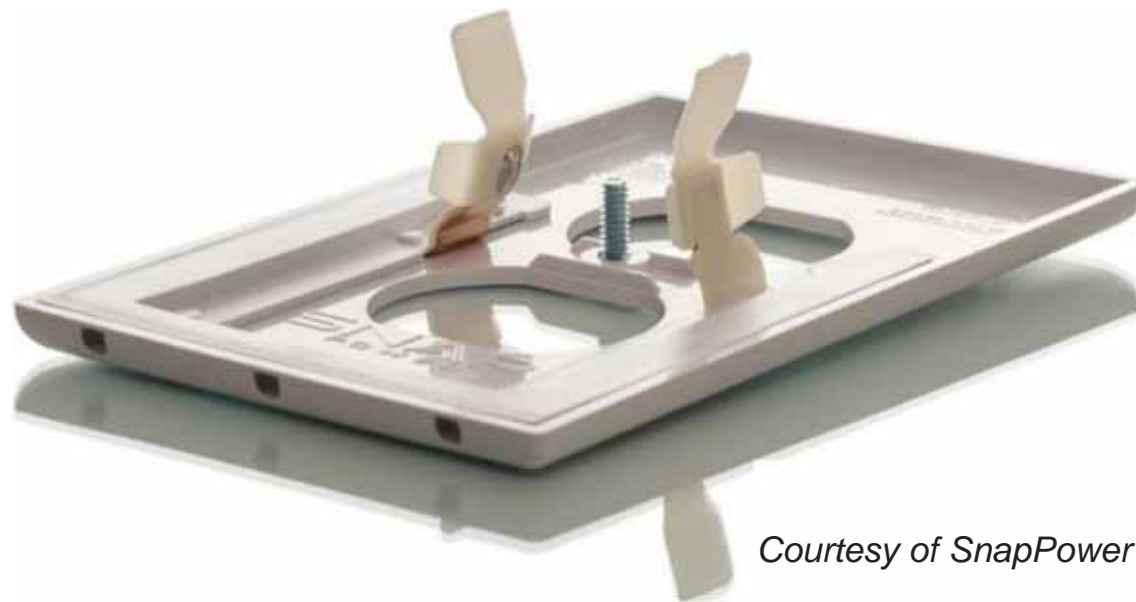
- ▶ New requirements were added pertaining to receptacle faceplates with **integral night lights and/or USB chargers**
- ▶ These faceplates must be **listed** and constructed such that the night light and/or Class 2 circuitry is “**integral with the flush device cover plate**”
- ▶ Plug-in night light/covers that is not “integral with the flush device cover plate,” but simply designed to be plugged directly into a receptacle outlet presents a problem
- ▶ The ease in removing these night light-type covers from the receptacle outlet increases its safety hazard

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406.6(0) Receptacle Faceplate (Cover Plates) with Integral Night Light and/ or USB Charger

Receptacle faceplates shall be installed so as to completely cover the opening and seat against the mounting surface



Courtesy of SnapPower

A flush device cover plate that additionally provides a night light and/or Class 2 output connector(s) shall be listed

The night light and/or Class 2 circuitry must be integral with the flush device cover plate



Courtesy of SnapPower



406.9(B)(1) Extra-Duty Outlet Box Hoods

- ▶ Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood **need not be marked "extra duty"**
- ▶ These power outlets (*other listed products*) typically locate a receptacle behind a hinged steel cover, which is not an outlet box hood, and need not be identified as "extra duty"
- ▶ This has caused some **confusion over the lack of "extra duty" identification** on these types of listed assemblies
- ▶ This change provides needed clarity and eliminates confusion within the electrical industry

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406.9(8)(1) Extra-Duty Outlet Box Hoods



An outlet box hood installed at an enclosure for 15 and 20 amperes, 125 and 250 volt receptacles in a wet location to provide weatherproof protection whether or not an attachment plug cap is inserted or not must be listed and identified as "extra duty"



Must be Marked "Extra Duty"



"Extra Duty" Not Required

Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood need not be marked "extra duty"



406.12 Tamper-Resistant Receptacles

- ▶ Requirements for tamper-resistant (*TR*) receptacles **expanded** to locations **where small children are likely to congregate** and have ready access to energized receptacle outlets
- ▶ TR receptacles expanded to **250 volt receptacles** as well as 125 volt receptacles
- ▶ Receptacles rated at 250 volts are commonly used for air-conditioning and heating units in dwelling units, guest rooms and guest suites of hotels and motels as well as other locations
- ▶ TR receptacle requirements expanded to other dwelling unit areas such as **mobile and manufactured homes**
- ▶ Reorganized to put the areas that require TR receptacles into a **list format**

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406.12

Tamper-Resistant Receptacles *(cont.)*



- ▶ Requirements for tamper-resistant (*TR*) receptacles **expanded** to locations **where small children are likely to congregate**:
 - Dwelling units (210.52)
 - **Mobile and manufactured homes (550.13)**
 - Guest rooms and guest suites of hotels and motels
 - Child care facilities
 - **Preschools and elementary education facilities**
 - **Medical and dental waiting rooms**
 - **Places of assembly occupancies (518.2)**
 - **Dormitories**

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406.12 Tamper-Resistant Receptacles



All 15- and 20-ampere, 125- and **250-volt** nonlocking-type receptacles in areas specified in 406.12(1) through (7) must be listed tamper-resistant receptacles:
 (1) Dwelling units in all areas specified in 210.52 **and 550.13**; (2) Guest rooms and guest suites of hotels and motels; (3) Child care facilities



(4) Preschools/elementary educational facilities; (5) Waiting rooms, etc. in medical/dental offices; (6) Places of waiting-transportation, gymnasiums, etc.;
 (7) Dormitories