One- and Two Family Dwelling Electrical Systems – 2014 *NEC*

AFCIs, GFCIs, and Other Dwelling Unit Requirements

Training Presentation by:
International Association of Electrical Inspectors

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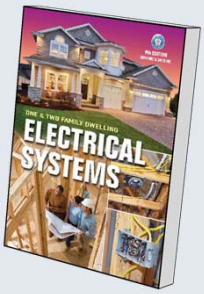
One- and Two Family Dwelling Electrical Systems – 2014 *NEC*

- Presentation based on IAEI's *One- and Two-Family Dwelling Electrical Systems* , 9th edition textbook
- This textbook is based on the requirements contained the 2014 *NEC* and the 2015 *IRC*



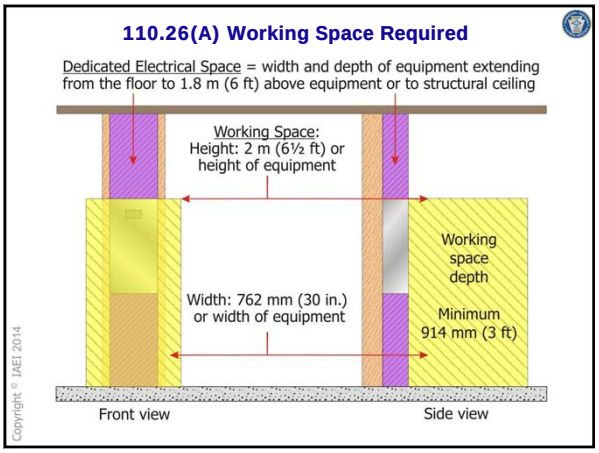
Article 100: Definitions

- **Location, Damp**: "Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture."
- Informational Note: Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses

Article 100: Definitions

- **Location, Dry**: "A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction."
- **Location, Wet**: "Installations under ground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather."


Wet or Damp Location ?


110.26(A) Working Space Required
Dedicated Electrical Space = width and depth of equipment extending from the floor to 1.8 m (6 ft) above equipment or to structural ceiling
Working Space:
Height: 2 m (6½ ft) or height of equipment
Working space depth
Width: 762 mm (30 in.) or width of equipment
Minimum 914 mm (3 ft)
Front view
Side view
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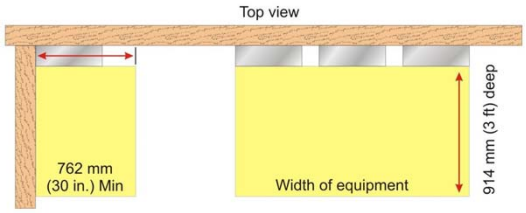
110.26(A)(2) Width of Working Space



The working space must be at least 762 mm (30 in.) wide or as wide as the equipment

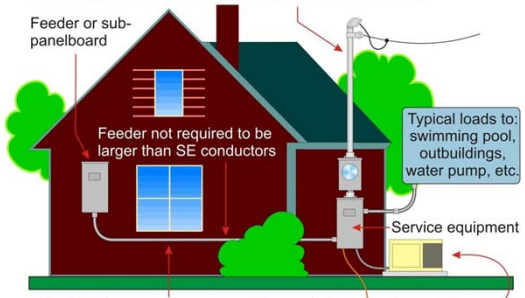
Equipment less than 762 mm (30 in.) wide does not have to be centered in the working space

Minimum Size of Service-Entrance Conductors

- Not less than the calculated load in accordance with Article 220 [230.42(A)]
- Minimum 100 amperes for one-family dwellings as required by the disconnect sizing requirements of 230.79
- Must be equal to or exceed the rating of the overcurrent device in series with service-entrance conductor [230.90(A)]

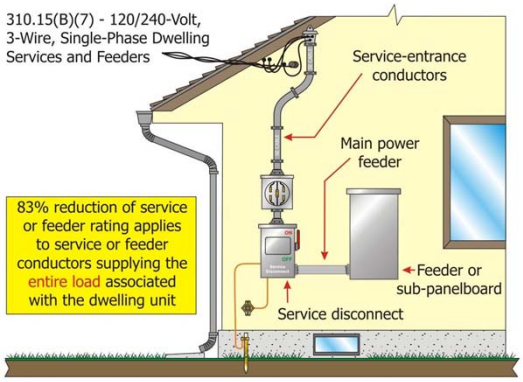
Section 310.15(B)(7) Permitted to be Used

Service-entrance conductors: 83 percent reduction from 310.15(B)(7) can be applied to service rating using Table 310.15(B)(16)



Section 310.15(B)(7) Permitted to be Used

310.15(B)(7) - 120/240-Volt, 3-Wire, Single-Phase Dwelling Services and Feeders



83% reduction of service or feeder rating applies to service or feeder conductors supplying the entire load associated with the dwelling unit

Section 310.15(B)(7) Permitted to be Used

Sizing of Service Conductors for Dwelling(s)

Service conductors and the main power feeder for certain dwellings are permitted to be sized in accordance with 310.15(B)(7)

If a 175-ampere service rating is selected, a service conductor is then sized as follows:

175 amperes × 0.83 = 145.25 amperes per 310.15(B)(7)

If no other adjustments or corrections are required for the installation, then, in accordance with Table 310.15(B)(16), a 1/0 AWG Cu or a 3/0 AWG Al meets this rating at 75°C (167°F)

Reproduction of Example D7 of Informational Annex D of the NEC

250.50 Grounding Electrode System

- These grounding electrodes are required to be used where present. If any of these electrodes are inherent to the building or structure or installed, they shall be used in the grounding electrode system:
  - 250.52(A)(1) Metal underground water pipe
  - 250.52(A)(2) Metal frame of a building or structure
  - 250.52(A)(3) Concrete-encased electrode
  - 250.52(A)(4) Ground ring
  - 250.52(A)(5) Rod and pipe electrode
  - 250.52(A)(6) Other listed electrodes
  - 250.52(A)(7) Plate electrodes
  - 250.52(A)(8) Other local metal underground systems or structures

250.50 Grounding Electrode System

- Where none of the grounding electrodes described in 205.52(A)(1) through (7) exist, one or more of the grounding electrodes specified below shall be installed and used:
  - 250.52(A)(4) Ground ring
  - 250.52(A)(5) Rod and pipe electrode
  - 250.52(A)(6) Other listed electrodes
  - 250.52(A)(7) Plate electrodes
  - 250.52(A)(8) Other local metal underground systems or structures

250.52(A) Grounding Electrodes

Metal underground water pipe in contact with earth for 3.0 m (10 ft) or more [250.52(A)(1)]

Metal frame of building or structure [250.52(A)(2)]

Concrete encased electrodes [250.52(A)(3)]

Ground ring (min. 2 AWG CU) [250.52(A)(4)]

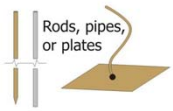
Ground rod or pipe electrodes Min. 2.5 m (8 ft) long [250.52(A)(5)]

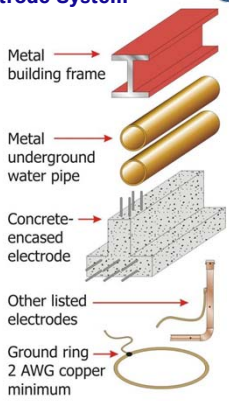
Other listed electrodes [250.52(A)(6)]

Plate electrodes [250.52(A)(7)]

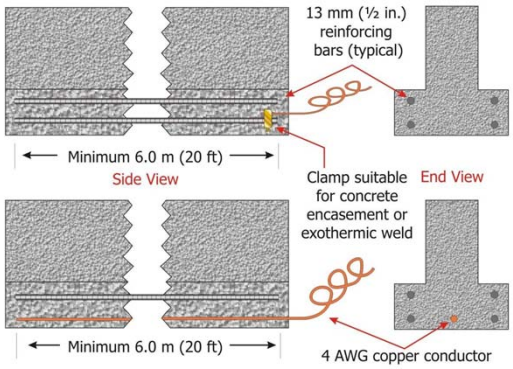
250.50 Grounding Electrode System

- Where present, grounding electrodes required to be used to form the grounding electrode system
- Includes electrodes that are an inherent component of the building construction (metal structure, etc.)
- By exception, existing concrete-encased electrodes not required to be used where doing so involves disturbing concrete footings of existing structures or buildings





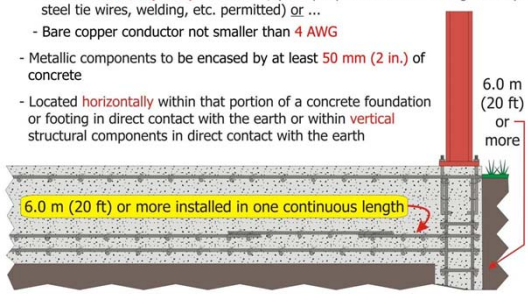
250.52(A)(3) Concrete-Encased Electrodes



250.52(A)(3) Concrete-Encased Electrodes

Concrete-encased electrode to consist of:

- At least one continuous 6.0 m (20 ft) or more length of either:
  - One or more electrically conductive coated steel reinforcing bars or rods not less than 13 mm (½ in.) in diameter, (multiple pieces connected together by steel tie wires, welding, etc. permitted) or ...
  - Bare copper conductor not smaller than 4 AWG
- Metallic components to be encased by at least 50 mm (2 in.) of concrete
- Located horizontally within that portion of a concrete foundation or footing in direct contact with the earth or within vertical structural components in direct contact with the earth



Article 100: Definitions

- **Ground-Fault Circuit Interrupter (GFCI)**. "A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device."
- Informational Note: Class A ground-fault circuit interrupters trip when the current to ground is 6 mA or higher and do not trip when the current to ground is less than 4 mA
- For further information, see UL 943, *Standard for Ground-Fault Circuit Interrupters*

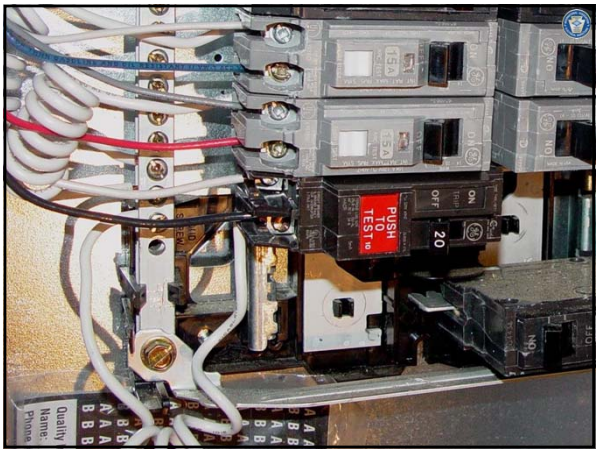
210.8 GFCIs in Readily Accessible Locations

All GFCIs for personnel must be installed in a readily accessible location

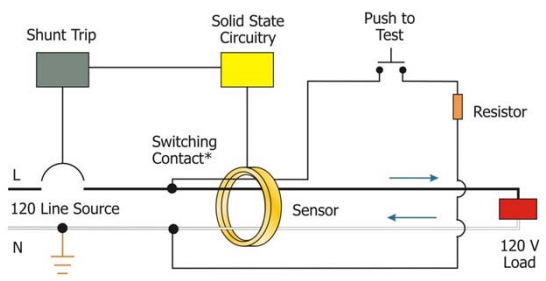
GFCI Protection Required in Dwellings

Bathrooms	210.8(A)(1)
Garages and Accessory Buildings	210.8(A)(2)
Outdoors	210.8(A)(3)
Crawl Spaces	210.8(A)(4)
Unfinished Basements	210.8(A)(5)
Kitchens	210.8(A)(6)
Sinks	210.8(A)(7)
Boathouses	210.8(A)(8)
Bathtub and Shower Stalls	210.8(A)(9)
Laundry Areas	210.8(A)(10)
Boat Hoists	210.8(C)
Dishwashers	210.8(D)
Swimming Pools and Similar Installations	680.XX

(Note: See Chapter 14 for additional information)



GFCI Principles of Operation



*Receptacle-type GFCI devices switch both the phase and neutral

210.8(A) GFCI for Dwelling Units

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the following locations shall have GFCI protection for personnel:

1. Bathrooms
2. Garages (accessory buildings)
3. Outdoors

   Ex. to (3): Receptacles that are not readily accessible and are supplied by a dedicated branch circuit for electric snow-melting or deicing equipment

4. Crawl spaces — at or below grade level

Note: These GFCI devices shall be installed in a readily accessible location

210.8(A) GFCI for Dwelling Units *(cont.)*

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the following locations shall have GFCI protection for personnel:

5. Unfinished basements

   Ex. to (5): A receptacle supplying only a permanently installed fire alarm or burglar alarm system

6. Kitchens — where the receptacles are installed to serve the countertop surfaces
7. Sinks — [where receptacles are installed within 1.8 m (6 ft) of the outside edge of the sink]
8. Boathouses

Note: These GFCI devices shall be installed in a readily accessible location

210.8(A) GFCI for Dwelling Units *(cont.)*

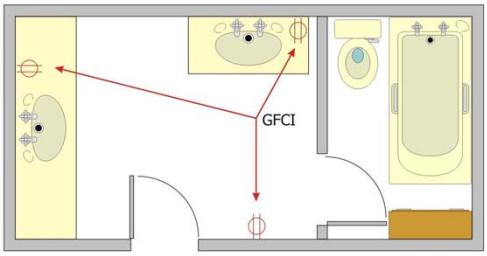
All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the following locations shall have GFCI protection for personnel:

9. Bathtub and Shower Stalls – [where receptacles are installed within 1.8 m (6 ft) of the outside edge of the bathtub or shower stall]
10. Laundry Areas

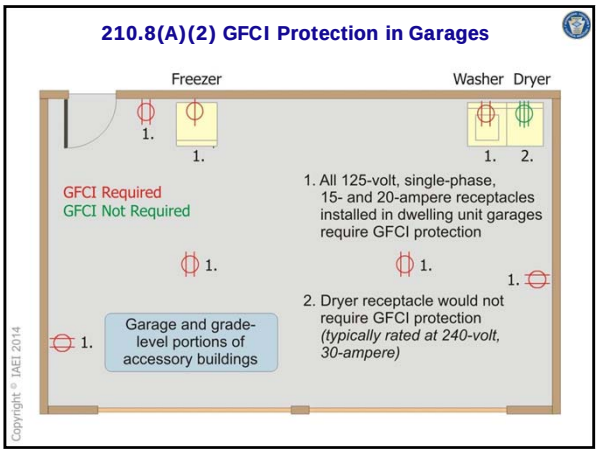
Note: These GFCI devices shall be installed in a readily accessible location

210.8(A)(1) GFCI Protection for Bathrooms

A bathroom is defined as "an area including a basin with one or more of the following: a toilet, a urinal, a tub, a shower, a bidet, or a similar plumbing fixtures"



A bathroom with (2) basins, a toilet, and a tub


210.8(A)(2) GFCI Protection in Garages
Freezer
Washer
Dryer
1.
1.
1.
2.
GFCI Required
GFCI Not Required
1. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in dwelling unit garages require GFCI protection
1.
1.
1.
2. Dryer receptacle would not require GFCI protection (typically rated at 240-volt, 30-ampere)
1.
Garage and grade-level portions of accessory buildings
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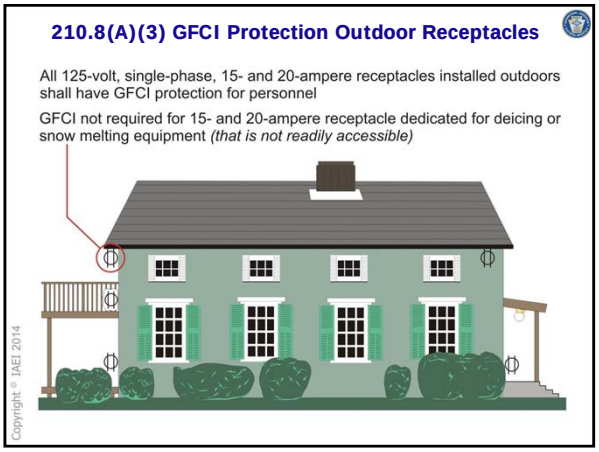
210.8(A)(3) GFCI Protection Outdoor Receptacles
All 125-volt, single-phase, 15- and 20-ampere receptacles installed outdoors shall have GFCI protection for personnel
GFCI not required for 15- and 20-ampere receptacle dedicated for deicing or snow melting equipment (that is not readily accessible)
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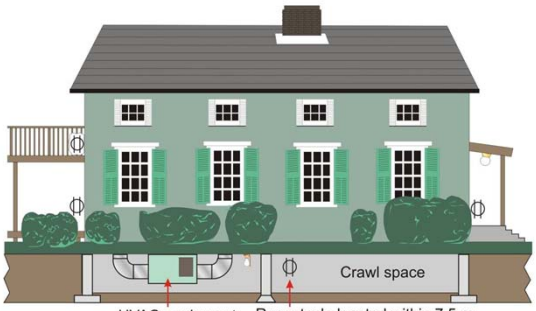
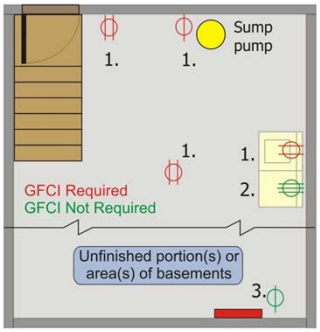
MultiMac
Weatherproof Cover
TEST MONTHLY
WR
RESET
TEST
SEE INSTRUCTIONS
MultiMac
Weatherproof Cover

210.8(A)(4) Crawl Spaces

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in crawl spaces *(at or below grade level)* shall have GFCI protection for personnel

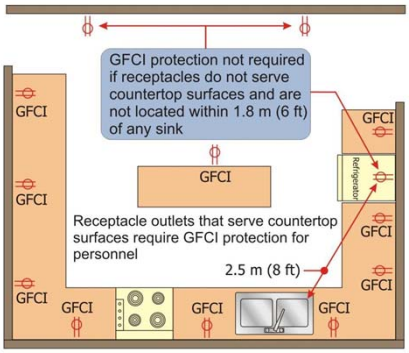


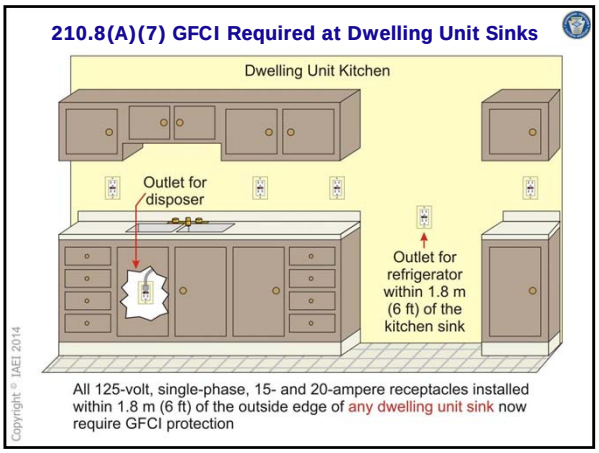
210.8(A)(5) GFCI Protection Unfinished Basements



1. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in unfinished basements require GFCI protection (one exception-see below)
2. Dryer receptacle would not require GFCI protection as this is typically rated at 240 -volt, 30-ampere
3. A single receptacle supplying a permanently installed burglar/fire alarm system is not required to have GFCI protection

210.8(A)(6) GFCI Kitchen Countertop Receptacles




210.8(A)(7) GFCI Required at Dwelling Unit Sinks
Dwelling Unit Kitchen
Outlet for disposer
Outlet for refrigerator within 1.8 m (6 ft) of the kitchen sink
All 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) of the outside edge of any dwelling unit sink now require GFCI protection
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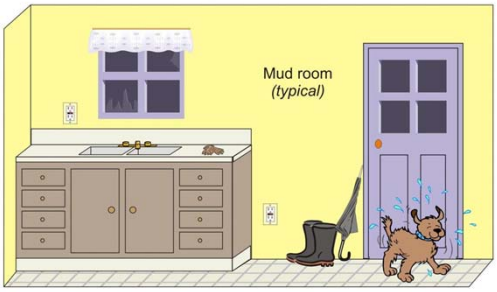
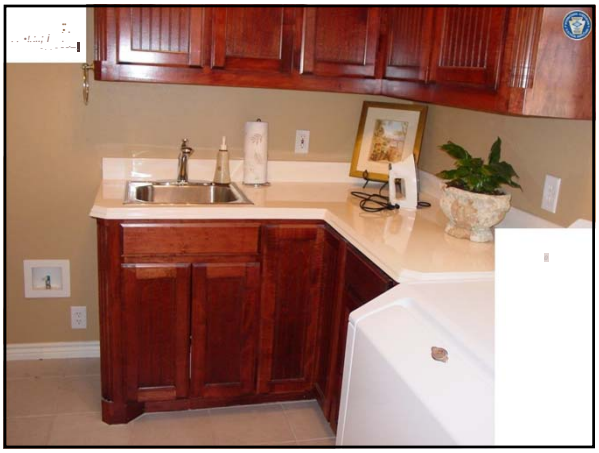
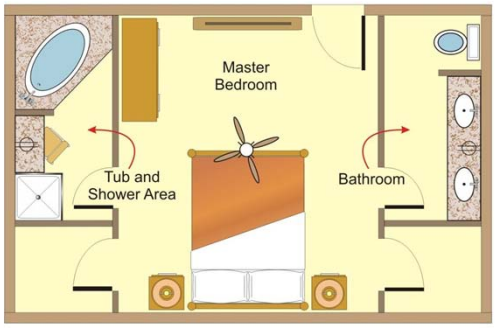
210.8(A)(7) GFCI Dwelling Unit Sinks



GFCI required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) of the outside edge of a dwelling unit sink *(laundry, utility, mud room, kitchen, wet bar, etc.)*



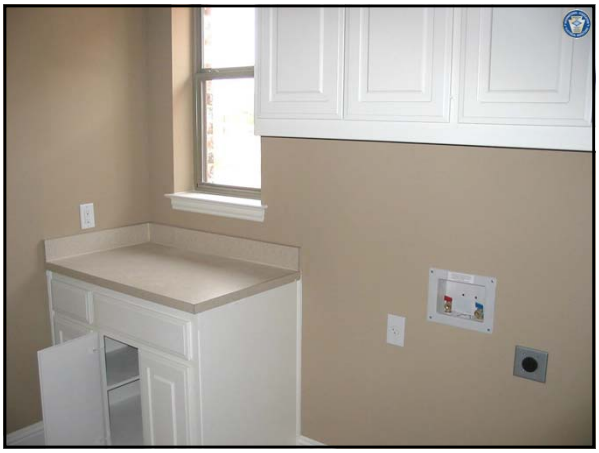
210.8(A)(9) GFCI Bathtub or Shower Stalls



All 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) of the outside edge of a dwelling unit bathtub or shower stall requires GFCI protection

210.8(A)(10) GFCI Dwelling Laundry Areas

GFCI protection required for all 125-volt, single-phase, 15- and 20-ampere receptacles located in a laundry room areas *(with or without a sink present)*



210.8(D) Dwelling Unit Kitchen Dishwasher Branch Circuit

- GFCI protection now required for all outlets that supply dishwashers installed in dwelling units.
  - Includes both receptacle and hard-wired outlet for dishwasher.
- Modern-day electronically controlled dishwashers can experience "end of life" failures that can result in increased risk of electrical shock.
- GFCI protection for outlets supplying dishwashers can mitigate these increased risk of electrical shock.

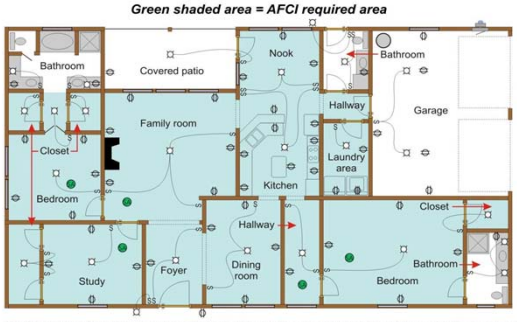
210.12 Arc-Fault Circuit-Interrupters

- AFCI is a device intended to provide protection from the effects of arcing type faults
- AFCI recognizes the characteristics that are unique to arcing
- The entire branch circuit is required to be protected
- Required for all 125-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets and devices installed in dwelling unit in the following locations:

kitchens	family rooms	dining rooms
living rooms	parlors	libraries
dens	bedrooms	sun rooms
recreation rooms	closets	hallways
laundry areas	similar rooms or areas	

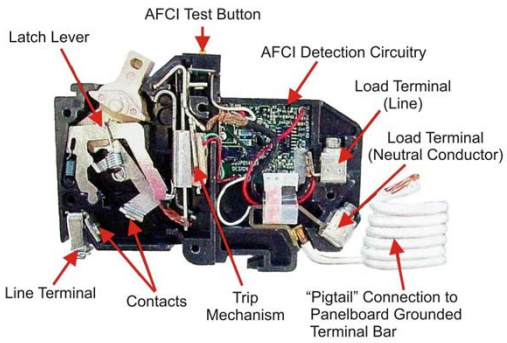
210.12(A) AFCI Protection Required

Green shaded area = AFCI required area



AFCI protection is required for all 125 volt, single-phase,15- and 20-ampere branch circuits supplying outlets and devices in several areas of a dwelling unit *(including 125 volt, single-station smoke alarms)*

AFCI Circuit Breaker – Cut-A-Way View



210.12(A) Arc-Fault Circuit-Interrupter Protection

Listed Outlet Branch-Circuit Type AFCI Devices

Listed Combination Overcurrent Protection Type AFCI Device

Courtesy of Pass & Seymour/Legrand

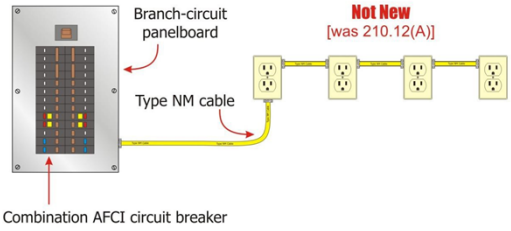
Courtesy of Eaton Corporation

Dual Function AFCI/GFCI Protection

- Square D QO™ and HomeLine™ Dual Function Circuit Breaker
- Dual-Function Arc Fault and Ground Fault protection, in a single, easy-to-install device

210.12(A) AFCI Protection

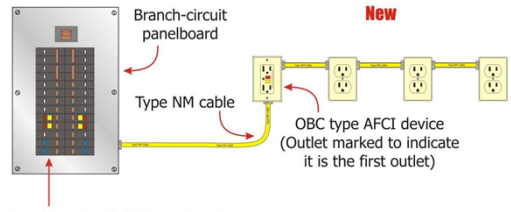
All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):



(1) A listed combination type arc-fault circuit interrupter, installed to provide protection of the entire branch circuit

210.12(A) AFCI Protection

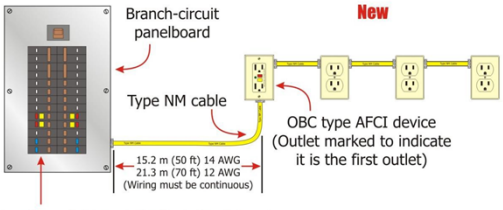
All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):



(2) A listed branch/feeder type AFCI installed at the origin of the branch circuit in combination with a listed outlet branch circuit type AFCI installed at the first outlet box on the branch circuit (first outlet marked to indicate that it is the first outlet)

210.12(A) AFCI Protection

All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):

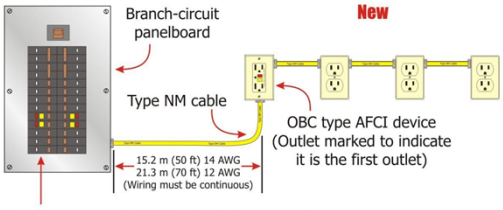


Supplemental arc protection circuit breaker

(3) A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed outlet branch circuit type AFCI installed at the first outlet box on the branch circuit (with three limiting conditions)

210.12(A) AFCI Protection

All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):

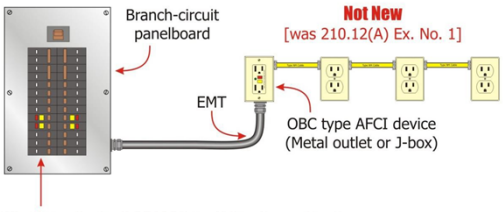


Listed branch circuit OCPD (circuit breaker or fuse)

(4) System Combination Type AFCI. A listed outlet branch circuit type AFCI installed at the first outlet in combination with a listed branch circuit over-current protective device (with four limiting conditions) (OCPD & OBC AFCI device must be identified and listed as "System Combination" type AFCI)

210.12(A) AFCI Protection

All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):

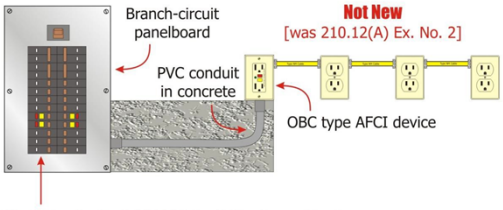


Listed branch circuit OCPD (circuit breaker or fuse)

(5) A listed outlet branch-circuit type AFCI device (first outlet) is permitted with RMC, IMC, EMT, Type MC, steel armored Type AC cables, metal wireways, or metal auxiliary gutters and metal outlet and junction boxes installed for the portion of the branch circuit between the OCPD and the first outlet

210.12(A) AFCI Protection

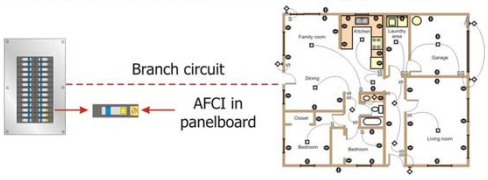
All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):



(6) Where a listed metal or nonmetallic conduit or tubing or Type MC cable is encased in not less than 50mm (2 in.) of concrete for the portion of the branch circuit between the OCPD and the first outlet, it shall be permitted to install an a listed outlet branch circuit type AFCI at the first outlet

210.12(A)(1) Combination AFCI Protection

All 120 volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in dwelling unit bedrooms and other areas of the dwelling are required to be protected by a listed combination arc-fault circuit interrupter device when 210.12(A)(1) is employed



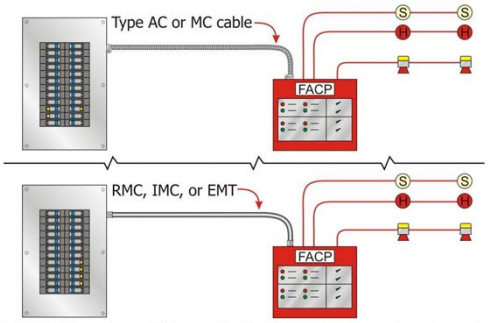
AFCI protection required to be of the combination type

Combination type AFCI detects both parallel and series arc faults

Parallel Arc Fault = Direct contact of two opposite polarities

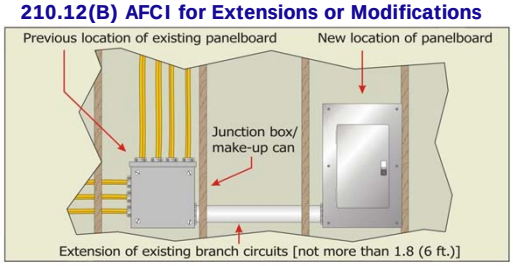
Series Arc Fault = An arc across a break in a conductor

210.12(A) Exception Fire Alarm System



Individual branch circuit is permitted without AFCI protection where it is installed using metal outlet boxes and RMC, IMC, EMT, Type MC or steel armored Type AC cable for permanently installed fire alarm systems

210.12(B) AFCI for Extensions or Modifications



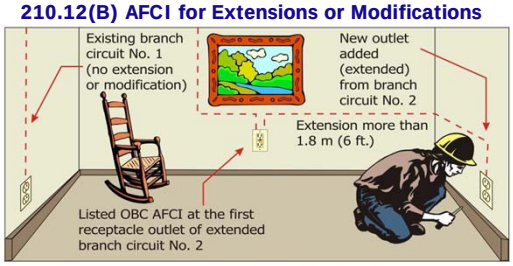
In any of the areas specified in 210.12(A), where branch-circuit wiring is modified, replaced or extended, the branch circuit shall be protected by:

(1) A listed combination AFCI located at the origin of the branch circuit, or

(2) A listed outlet branch-circuit AFCI located at the first receptacle outlet of the existing branch circuit

Exception: *AFCI protection is not required where the extension is not more than 1.8 m (6 ft.) and does not include any additional outlets or devices*

210.12(B) AFCI for Extensions or Modifications



In any of the areas specified in 210.12(A), where branch-circuit wiring is modified, replaced or extended, the branch circuit shall be protected by:

(1) A listed combination AFCI located at the origin of the branch circuit, or

(2) A listed outlet branch-circuit AFCI located at the first receptacle outlet of the existing branch circuit

Exception: *AFCI protection is not required where the extension is not more than 1.8 m (6 ft.) and does not include any additional outlets or devices*

120-Volt Single-Station Smoke Alarm

AFCI Protection Required? – YES (210.12)


Power-Limited Fire Alarm (PLFA) Circuits
BRYANT SECURITY
SYSTEMS
(972)
238-0863
DSC
AFCI Protection Required? - NO (760.41)

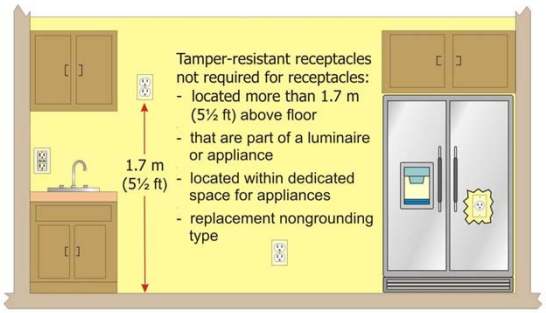

Combination Type AFCI
TYPE HOM
HOM115CAFI
120/240 V
LISTED
C.B.
ALSO LISTED AS
COMBINATION
AFCI
ISSUE NO.
AD-8232
HACR Type
AI/Cu
60/75 C
60Hz
15
I/ON
O/OFF


Branch Circuit/Feeder Type AFCI
TYPE QO
QO115AFI
LISTED
C.B.
ALSO LISTED AS
BRANCH/FEEDER
AFCI
ISSUE NO.
N-5880
HACR Type
SWD
AI/Cu
60/75 C
60Hz
10 kA
120V~
15
I/ON
O/OFF

406.12(A) Tamper-Resistant Receptacles

- All nonlocking 125-volt, 15- and 20-ampere receptacles in areas of a dwelling unit referred to in 210.52 are required to be listed tamper-resistant receptacles
- Receptacles in the following locations shall not be required to be tamper-resistant:
  - Receptacles located more than 1.7 m (5½ ft) above the floor
  - Receptacles part of a luminaire or appliance
  - Single or duplex receptacle for appliances located within dedicated appliance space *(not easily moved)*
  - Nongrounding receptacles used for replacement of nongrounding-type receptacles

406.12 Tamper-Resistant Receptacles



In all areas specified in 210.52, all nonlocking type 125-volt, 15- and 20-ampere receptacles required to be listed tamper-resistant receptacles

406.12(A) Tamper-Resistant Receptacles

- The following areas of the dwelling are specifically referenced in 210.52 and require tamper-resistant receptacles:

Kitchens	Recreation rooms
Family rooms	Bathrooms
Dining rooms	Outdoors
Living rooms	Laundry areas
Parlors	Basements
Libraries	Garages
Dens	Accessory buildings
Sunrooms	Hallways
Bedrooms	Foyer

*Similar rooms or areas of dwelling unit

406.12(A) Tamper-Resistant Receptacles

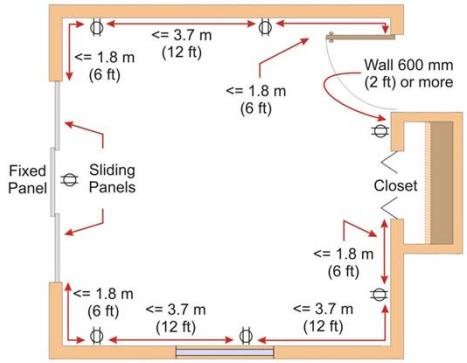
Courtesy of Pass & Seymour/Legrand

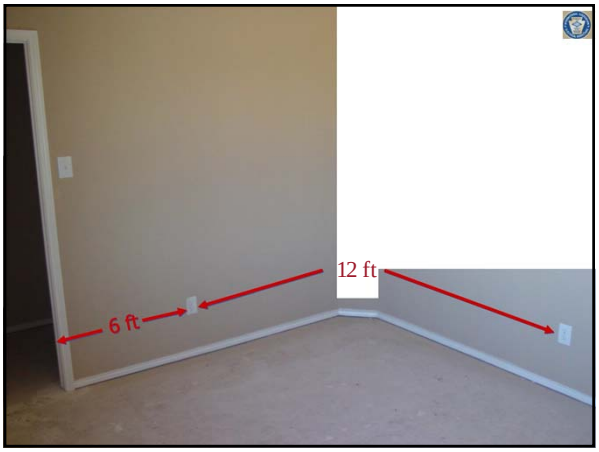
Tamper-resistant receptacles are available in a wide variety of models for various applications

210.52(A) Dwelling Unit Receptacle Outlets

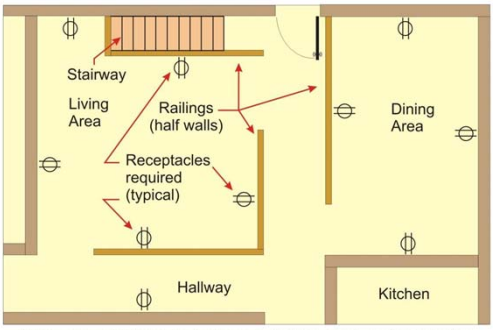
- Spacing rules call for installation of receptacle outlets so that no point along the floor line in any wall space is more than 1.8 m (6 ft) measured horizontally from an outlet in that space
- Includes 600 mm (2 ft) wall space and wall space occupied by fixed panels in exterior or interior walls
- Does not include sliding panels in exterior or interior walls
- Fixed room dividers are included in the 1.8 m (6 ft) measurement

210.52(A) Receptacle Locations and Spacing



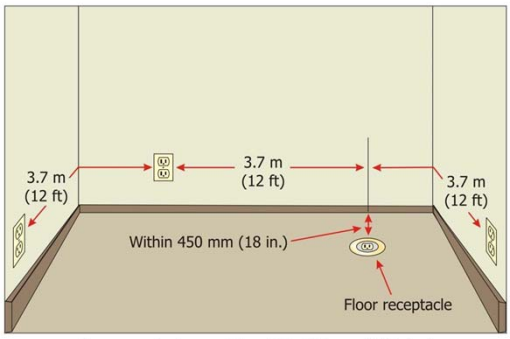


210.52(A)(2) Receptacle Location and Spacing



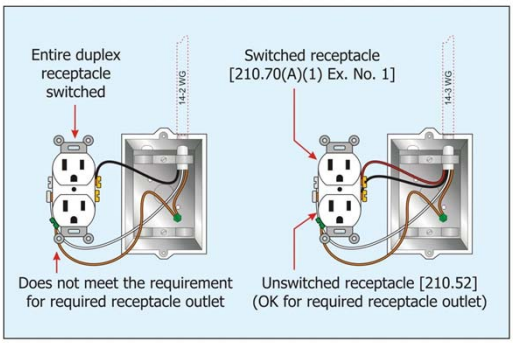
Wall space shall include fixed room dividers, such as freestanding bar-type counters or railings

210.52(A)(3) Floor Receptacles



Floor receptacles must be within 450 mm (18 in.) of the wall to be counted as required receptacle

210.52 Dwelling Unit Receptacle Outlets



Switched receptacles do not count as receptacle outlets required by 210.52

210.52(B) Small Appliance Receptacles

- Two or more 20-ampere small appliance branch circuits required to serve all receptacle outlets only in the kitchen, pantry, breakfast room, dining room or similar area of a dwelling unit
- The 20-ampere small appliance branch circuits are required to supply refrigeration equipment located in these areas as well
  - Exception permits an individual 15- or 20-ampere branch circuit for refrigeration equipment only
- Generally, the two or more small appliance branch circuits cannot have other outlets *(outdoor, bedroom, etc.)*

(cont. on next slide)

210.52(B) Small Appliance Receptacles *(cont.)*

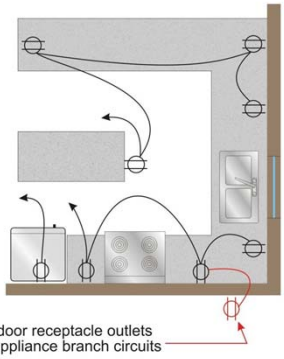
- At least two of the 20-ampere small appliance branch circuits are required to serve the countertop surfaces in the kitchen
- Either or both of these two small appliance branch circuits can also supply other receptacle outlets in the same room or adjacent permitted areas such as a dining room or pantry receptacle outlets
- No small appliance branch circuit can serve more than one kitchen

210.52(B) Small Appliance Receptacles

Minimum of two small appliance branch circuits limited to receptacle outlets only in kitchens, dining rooms, and similar areas

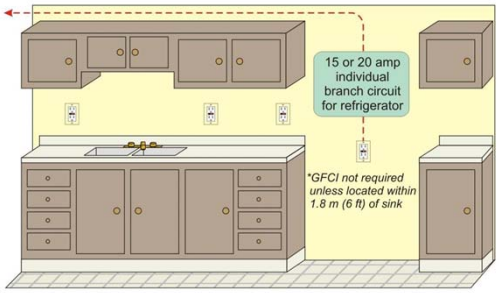
(See exceptions for clock outlet and gas appliances)

An additional dedicated 15-ampere or greater branch circuit permitted for refrigeration equipment



Other outlets such as outdoor receptacle outlets NOT permitted on small appliance branch circuits

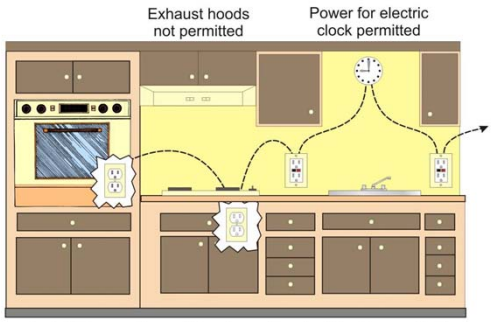
210.52(B)(1) Ex. No. 2 Refrigerator Branch Circuit



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

The receptacle outlet for refrigeration equipment is permitted to be supplied from an individual branch circuit rated 15 amperes or greater

210.52(B)(2) Ex. No. 1 & 2 No Other Outlets



Receptacle(s) for supplemental equipment and lighting for gas-fired ranges, ovens or counter-mounted units permitted on small appliance branch circuits

210.52(C) Kitchen Countertop Receptacles

- Base or Wall Mounted Countertops
  - Receptacle outlets shall be installed so that no point along the wall line is more than 600 mm (24 in.) measured horizontally from a receptacle outlet in that space
  - A receptacle outlet must be installed at each wall countertop space that is 300 mm (12 in.) or wider
  - *[See 210.52(C)(1) and Exception]*
  - Countertop spaces separated by rangetops, refrigerators, or sinks shall be considered as separate countertop spaces *[210.52(C)(4)]*

210.52(C) Kitchen Countertop Receptacles

- Island and Peninsular Countertops
  - At least one receptacle shall be installed at each island or peninsular countertop space with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater *[210.52(C)(2) & (C)(3)]*
  - A peninsular countertop is measured from the connecting edge *(of the base countertops)*
  - Where a range or sink is installed in an island or peninsular countertop and the width of the countertop behind the range or sink is less than 300 mm (12 in.), the range or sink is considered to divide the countertop space into two separate countertop spaces

210.52(C)(5) Kitchen Countertop Receptacles

- All Kitchen Countertops
  - Receptacle outlets shall be located on or above, but not more than 500 mm (20 in.) above, the countertop
  - Receptacle outlet assemblies listed for the application shall be permitted to be installed in countertops
  - Receptacle outlets rendered not readily accessible by appliances fastened in place, appliance garages, sinks, rangetops, or appliances occupying dedicated space are not considered as these required outlets

(cont. on next slide)

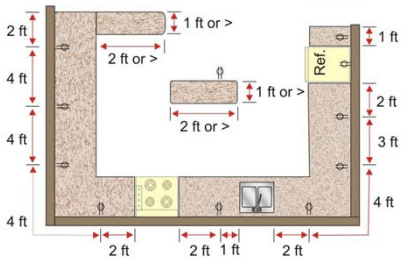
210.52(C)(5) Kitchen Countertop Receptacles

- All Kitchen Countertops
  - Receptacle outlets permitted to be mounted not more than 300 mm (12 in.) below the countertop under one of two conditions:
    - Construction for the physically impaired
    - On island and peninsular countertops where the countertop is flat across its entire surface *(no backsplashes, dividers, etc.)* with no means to mount a receptacle within 500 mm (20 in.) above the countertop

210.52(C) Kitchen Receptacles at Counter Spaces

No point on wall countertop spaces more than 600 mm (24 in.) from a receptacle outlet (measured along the backsplash)

Receptacle outlet required for wall space 300 mm (12 in.) or greater



Counter spaces separated by range tops, refrigerators or sinks are considered as a separate counter space *(receptacle outlet(s) required for each space)*

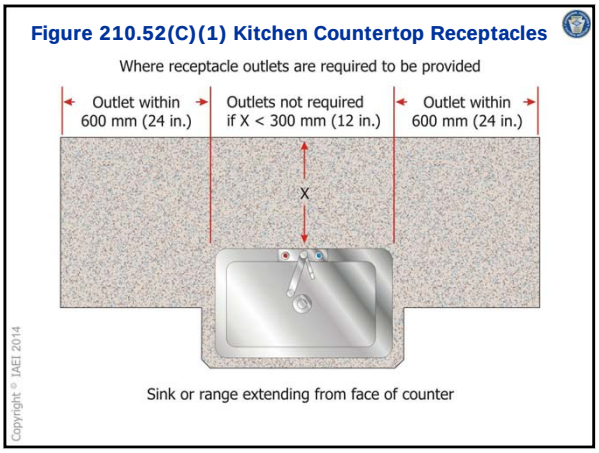


Figure 210.52(C)(1) Kitchen Countertop Receptacles
Where receptacle outlets are required to be provided
Outlet within 600 mm (24 in.)
Outlets not required if X < 300 mm (12 in.)
Outlet within 600 mm (24 in.)
X
Sink or range extending from face of counter
Copyright © IAEI 2014

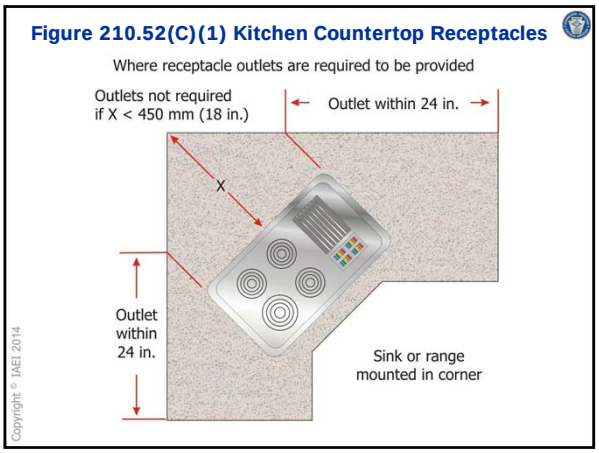
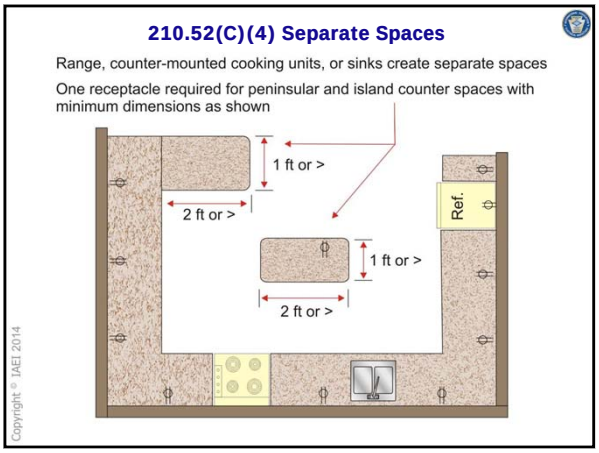


Figure 210.52(C)(1) Kitchen Countertop Receptacles
Where receptacle outlets are required to be provided
Outlets not required if X < 450 mm (18 in.)
Outlet within 24 in.
X
Outlet within 24 in.
Sink or range mounted in corner
Copyright © IAEI 2014


210.52(C)(4) Separate Spaces
Range, counter-mounted cooking units, or sinks create separate spaces
One receptacle required for peninsular and island counter spaces with minimum dimensions as shown
1 ft or >
2 ft or >
Ref.
1 ft or >
2 ft or >
Copyright © IAEI 2014

210.52(C)(5) Receptacle Outlet Locations

Maximum 500 mm (20 in.) above counter-top surface in order to serve countertop

Not permitted face-up in work surface or countertop

Receptacles NOT to be located below countertop where countertop extends beyond the support base more than 150 mm (6 in.)

Maximum 300 mm (12 in.) below countertop only for:

(1) Construction for the physically impaired

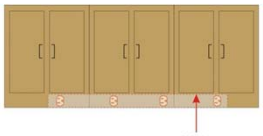
(2) Where island or peninsular countertop is flat across entire surface (no backsplash) and no means for mounting receptacle above countertop within 500 mm (20 in.)

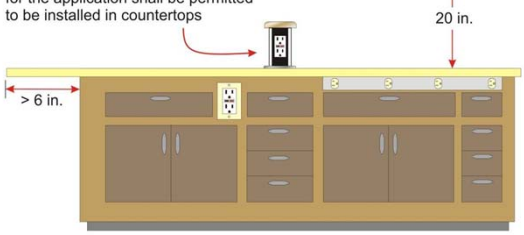
210.52(C)(5) Receptacle Outlet Locations

Receptacle outlets shall be installed on or above the countertops

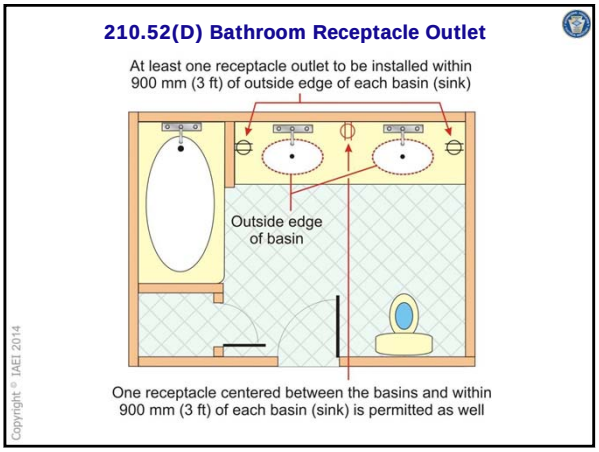
Not permitted face-up in work surface or countertop

Receptacle outlet assemblies listed for the application shall be permitted to be installed in countertops






Photos courtesy
of Thomas & Betts
Corporation


210.52(D) Bathroom Receptacle Outlet
At least one receptacle outlet to be installed within
900 mm (3 ft) of outside edge of each basin (sink)
Outside edge
of basin
One receptacle centered between the basins and within
900 mm (3 ft) of each basin (sink) is permitted as well
Copyright © IAEI 2014

210.52(D) Bathroom Receptacle Outlet

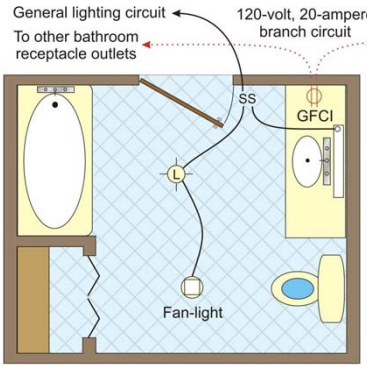
Receptacle outlet must be located within 900 mm (3 ft) of the outside edge of the basin (sink)

Receptacle outlet permitted on wall or partition adjacent to basin

Receptacle outlet mounted on front or side of vanity can serve as required receptacle outlet if not more than 300 mm (12 in.) below the top of basin

Receptacle outlet assemblies permitted to be installed in the countertop

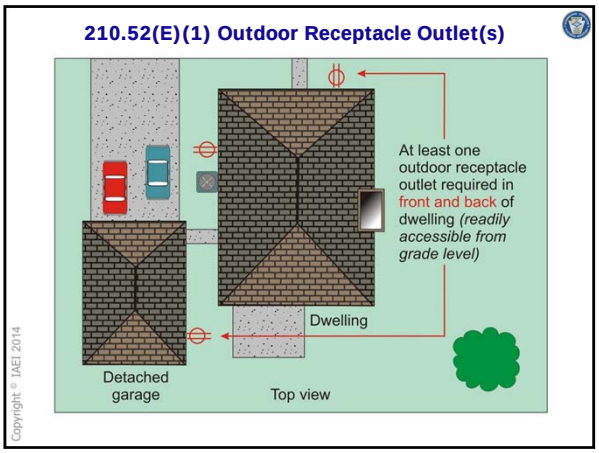
210.11(C)(3) Bathroom Branch Circuit

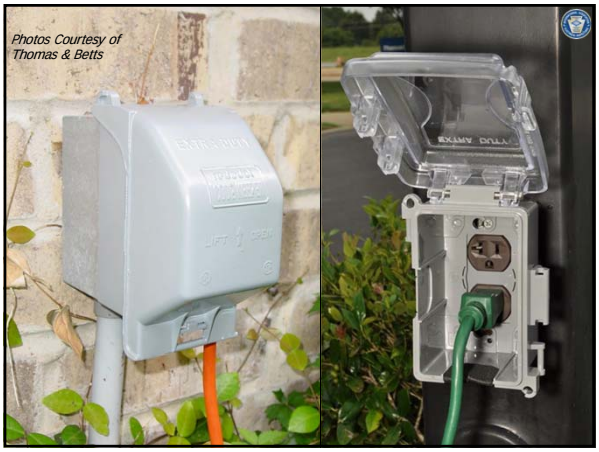


One 120-volt, 20-ampere branch circuit to supply bathroom receptacles

Other outlets not permitted on 20-ampere bathroom receptacle circuit

Exception permits other equipment within the same bathroom to be supplied by the 20-ampere branch circuit where it supplies one bathroom only


210.52(E)(1) Outdoor Receptacle Outlet(s)
At least one outdoor receptacle outlet required in front and back of dwelling (readily accessible from grade level)
Dwelling
Detached garage
Top view
Copyright © IAEI 2014


Photos Courtesy of Thomas & Betts


Product Courtesy of Arlington Industries

210.52(E)(3) Balconies, Decks, and Porches

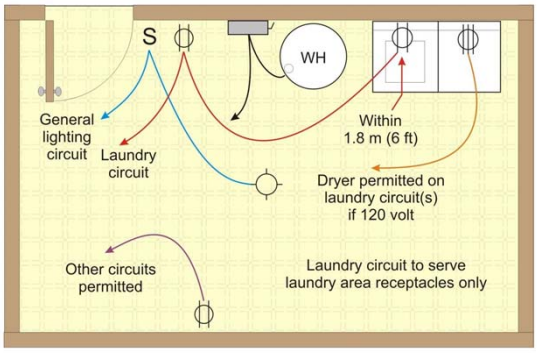
At least one 125-volt, 15- or 20-ampere receptacle outlet must be installed at every attached balcony, deck, or porch that is accessible from inside the dwelling unit

The receptacle outlet(s) must be accessible from the balcony, deck, or porch and shall not be located more than 2.0 m (6½ ft) above the walking surface

Laundry Circuit and Outlet(s)

- At least one receptacle outlet shall be installed in areas designated for the installation of laundry equipment *(exception for multifamily dwellings with laundry facilities)* [210.52(F)]
- A 20-ampere branch circuit shall be provided to supply the laundry receptacle outlet(s) required by 210.52(F)
- This circuit shall have no other outlets [210.11(C)(2)]
- Appliance receptacle outlet(s) installed for specific appliances *(such as laundry equipment)* must be installed within 1.8 m (6 ft) of the intended location of the appliance [210.50(C)]

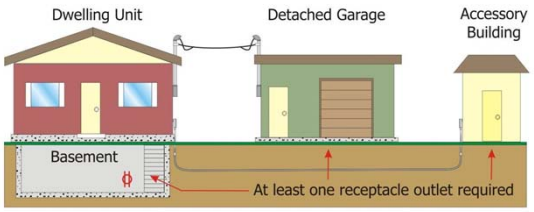
210.52(F), 210.50(C) Laundry Receptacle Outlet(s)



210.52(G) Basements, Garages, and Accessory Buildings

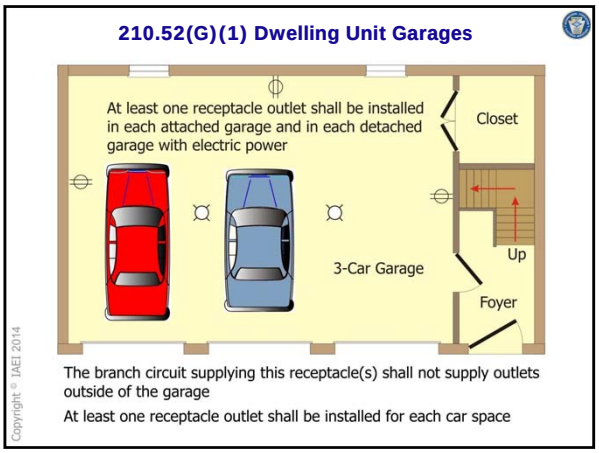
- At least one receptacle outlet shall be installed in the areas specified in 210.52(G)(1) through (3)
  - 210.52(G)(1) Garages
  - 210.52(G)(2) Accessory Buildings
  - 201.52(G)(3) Basements
- These receptacles shall be in addition to receptacles required for specific equipment
- Branch circuit supplying garage receptacle(s) shall not supply outlets outside the garage
- Receptacle required for each car space in a garage
- This is an effort to recognize the possibility of electric vehicle (EV) and plug-in hybrid electric vehicle (PHEV) charging in these garages

210.52(G) Basements, Garages, and Accessory Buildings (with Power)



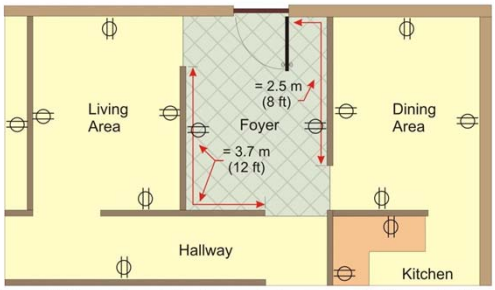
At least one 125-volt, 15- or 20-ampere receptacle outlet, in addition to those for specific equipment, shall be installed in areas specified below:

- Attached garages and in each detached garage with electric power *(see specifics for garages on next slide)*
- Accessory buildings with electric power
- Unfinished basements - each seperate portion of the basement


210.52(G)(1) Dwelling Unit Garages
At least one receptacle outlet shall be installed in each attached garage and in each detached garage with electric power
Closet
3-Car Garage
Up
Foyer
The branch circuit supplying this receptacle(s) shall not supply outlets outside of the garage
At least one receptacle outlet shall be installed for each car space
Copyright © IAEI 2014


Hallway
Receptacle Outlet(s)

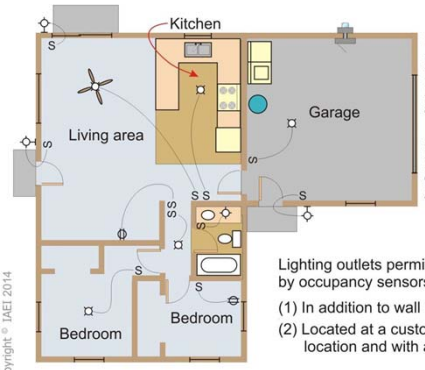
210.52(I) Foyers



Foyers that are not part of a hallway having an area that is greater than 5.6 m² (60 ft²) are required to have a receptacle(s) located in each wall space 900 mm (3 ft) or more in width

Doorways, door-side windows that extend to the floor, and similar openings shall not be considered wall space

210.70(A)(1) Lighting Outlets Required



Lighting outlets required to be installed in every habitable room and bathroom

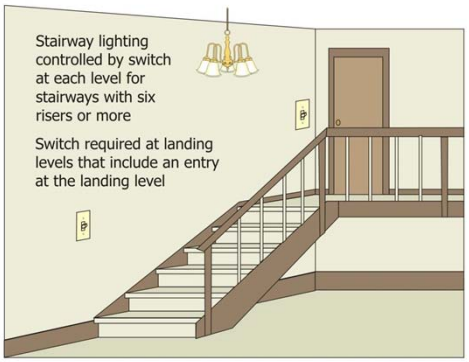
Switched receptacles permitted in rooms other than kitchens and bathrooms

Lighting outlets permitted to be controlled by occupancy sensors that are:

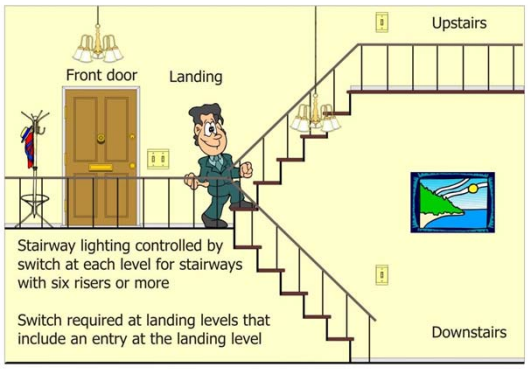
(1) In addition to wall switches

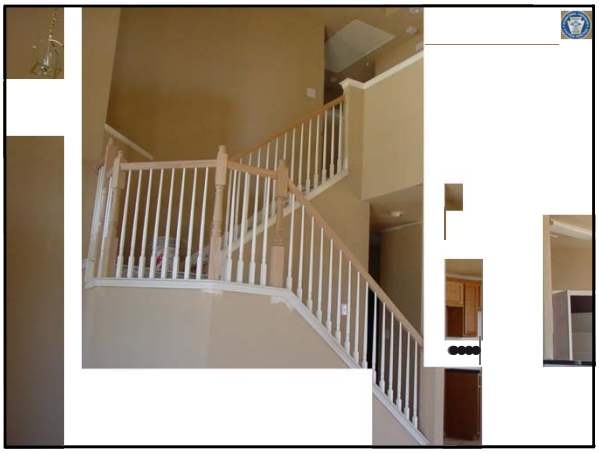
(2) Located at a customary wall switch location and with a manual override

210.70(A)(2)(c) Switches at Stairways and Landings



210.70(A)(2)(c) Switches at Stairways and Landings

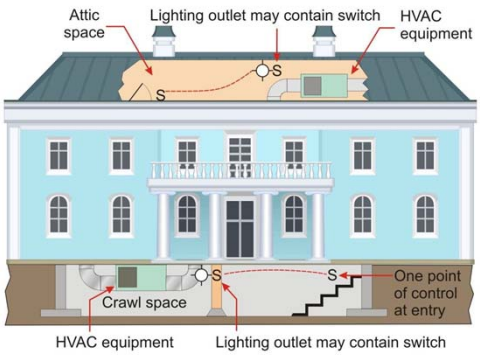


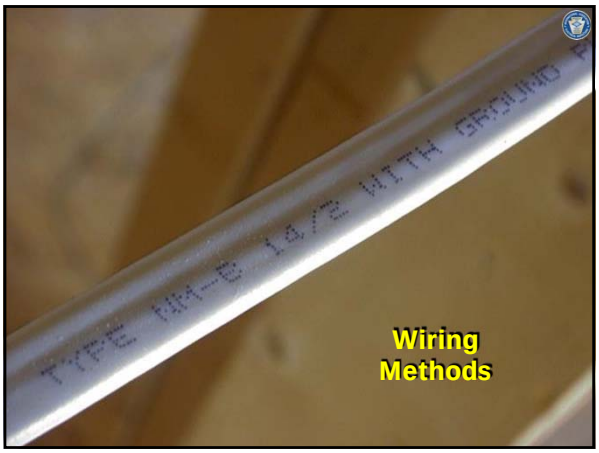


Lighting in Storage or Equipment Spaces

- At least one lighting outlet controlled by a wall switch *(or containing a switch)* shall be installed where the following spaces are used for storage or contain equipment requiring servicing:
  - Attics, underfloor spaces, utility rooms, and basements
- At least one point of control *(wall switch)* shall be located at the usual point of entry to these spaces
- The lighting outlet shall be provided at or near the equipment requiring servicing
- See 210.70(A)(3)

210.70(A)(3) Storage or Equipment Spaces

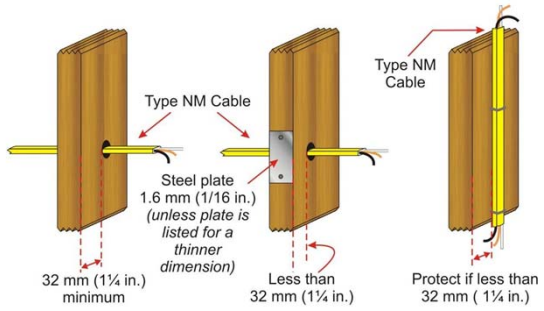




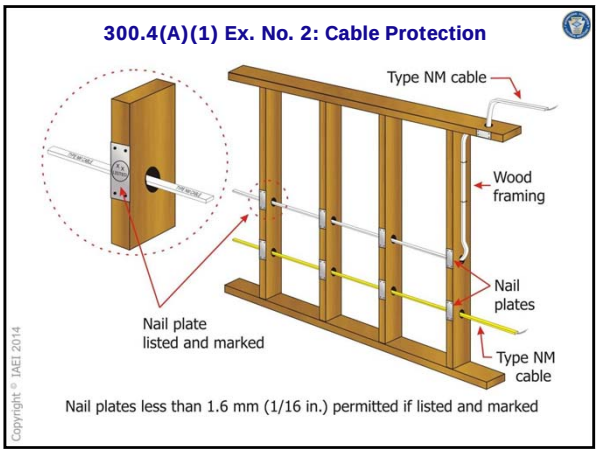
Ampacity of Type NM Cables

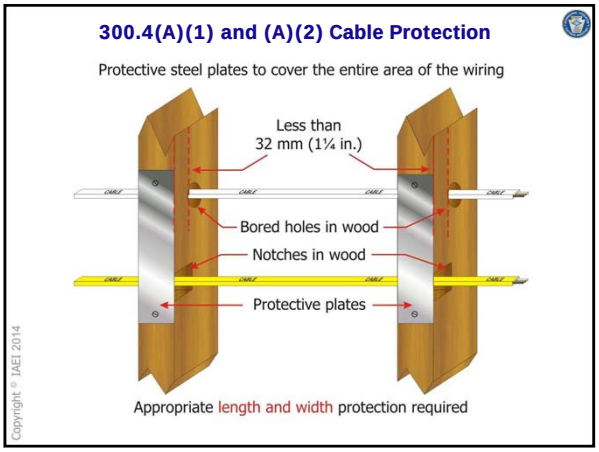
- Conductors insulation required to be rated at ~~90ºC~~ [334.112]
  - Cables that meet this requirement are marked NM-B, NMC-B or NMS-B
- Ampacity of cable required to be that of ~~60ºC~~ conductor temperature rating [334.80]
- Derating for high ambient temperatures or for bundling of conductors longer than 600 mm (24 in.) permitted from 90ºC ampacity column [334.80]
- Equipment grounding conductor of cable sized per Table 250.122

300.4(A) Cable Protection Requirements

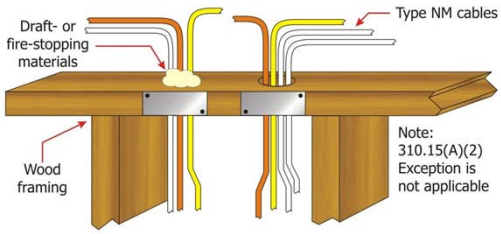


Where run through or parallel with framing members or furring strips protect wiring against physical damage


300.4(A)(1) Ex. No. 2: Cable Protection
Type NM cable
Wood framing
Nail plates
Type NM cable
Nail plate listed and marked
Nail plates less than 1.6 mm (1/16 in.) permitted if listed and marked
Copyright © IAEI 2014


300.4(A)(1) and (A)(2) Cable Protection
Protective steel plates to cover the entire area of the wiring
Less than 32 mm (1¼ in.)
Bored holes in wood
Notches in wood
Protective plates
Appropriate length and width protection required
Copyright © IAEI 2014

334.80 Ampacity of Type NM Cable



Ampacity adjustment factors in Table 310.15(B)(3)(a) apply to the following:

(1) Where more than two cables with two or more current-carrying conductors pass through wood framing *(without maintaining spacing)* and the wood framing is sealed with thermal insulation, sealing foam, or caulking material

(2) Where more than two cables with two or more current-carrying conductors are installed in thermal insulation without maintaining spacing between the cables

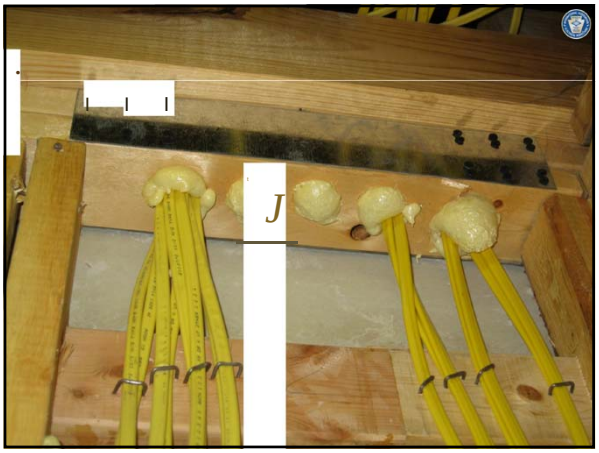
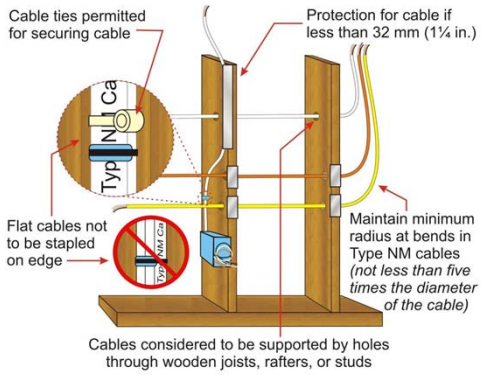


Table 310.15(B)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors

Number of Conductors[1]	Percent of Values in Tables 310.15(B)(16) through 310.15(B)(19) as Adjusted for Ambient Temperature if Necessary
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35

[1]Number of conductors is the total number of conductors in the raceway or cable, including spare conductors. The count shall be adjusted in accordance with 310.15(B)(5) and (6), and shall not include conductors that are connected to electrical components but that cannot be simultaneously energized.

300.4, 334.30 Cable Protection and Supports



One- and Two Family Dwelling Electrical Systems – 2014 *NEC*

End of Part One of Two

Training Presentation by:
International Association of Electrical Inspectors