

GFCI, AFCI, Tamper Resistant Receptacles

2016 Winter UDC Electrical Code
Update



Ground-Fault Circuit Interrupter Protection for Personnel (Dwelling Units)



GFCI Breakers



1-Pole



2-Pole



1-Pole



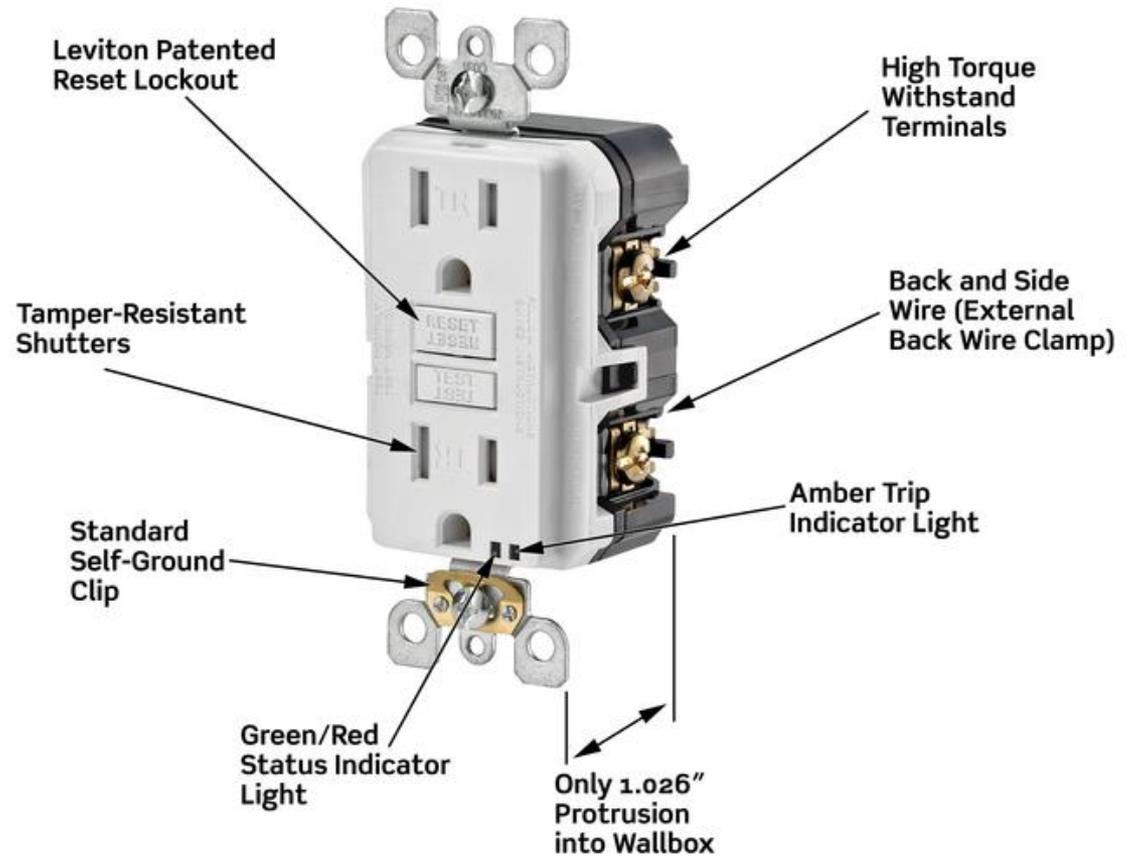
1-Pole

UL has issued major revisions to UL 943, the standard for safety for GFCI that take effect on June 29, 2015.

- **1.) Auto-Monitoring or Self-Test function:** This function allows for periodic, automatic testing of the ability of the GFCI to respond to a ground fault. If the Self-Test function detects a problem, the GFCI must deny power or provide visual and/or audible indication.
- **2.) Reverse line-load misfire function - repeated:** If the line cable is wired to the load terminals of a receptacle GFCI, power to the receptacle face will be denied. This requirement applies to the initial installation and any subsequent re-installations.

To maintain UL certification, all manufacturers must meet these revisions with GFCIs produced after June 28, 2015

Self-Test GFCI



Can I still install non self test GFCI's?

- YES.
- Non self GFCI's can still be installed and are code compliant per NEC requirements.
- The new self test GFCI's will replace the old style when supplies diminish

How Does a GFCI Function?

- A **ground fault circuit interrupter (GFCI)** is a device that shuts off an electric power circuit when it detects that current is flowing along an unintended path, such as through water or a person. It is used to reduce the risk of electric shock, which can cause the heart to stop or cause burns.
- A GFCI works by measuring the current leaving one side of a power source (the so-called "live" or "hot wire"), and comparing it to current returning on the other (the "neutral" side). If they are not equal, then some of the current must be leaking in an unwanted way, and the GFCI shuts the power off.

NEC Requirements for GFCI protection in Dwelling units are found in NEC 210.8(A): Ground-Fault Circuit-Interrupter Protection for Personnel.

- Ground-fault circuit-interruption for personnel shall be provided as required in 210.8(A) through (C) (**Page 50 2011 NEC**). The ground-fault circuit-interrupter shall be installed in a **readily accessible location**. Informational Note: See 215.9 for ground-fault circuit interrupter protection for personnel on feeders.
- **(A) Dwelling Units.** All 125-volt, single-phase, 15- and 20- ampere receptacles installed in the locations specified in 210.8(A)(1) through (8) shall have ground-fault circuit interrupter protection for personnel.

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 climb over or remove obstacles or to resort to portable ladders, and so forth.

210.8 Ground-Fault Circuit-Interrupters



- All GFCIs for personnel must be installed in a readily accessible location
- This applies to 210.8(A), (B), and (C)

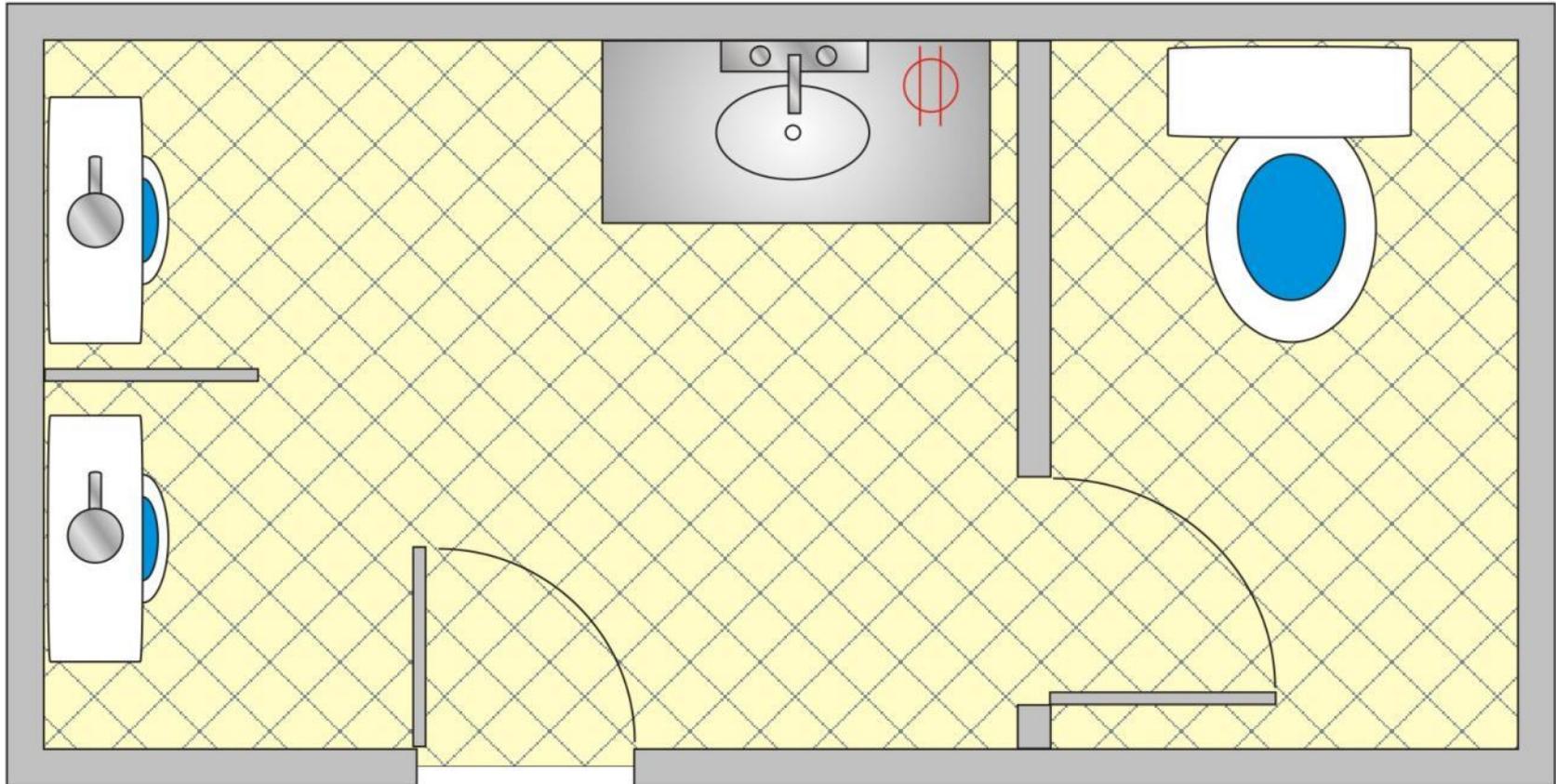
NEC 210.8(A)(1) Bathrooms



Article 100 Definitions: Bathroom



Bathroom - An area including a basin with one or more of the following: a toilet, a urinal, a tub, a shower, a bidet, or similar plumbing fixtures

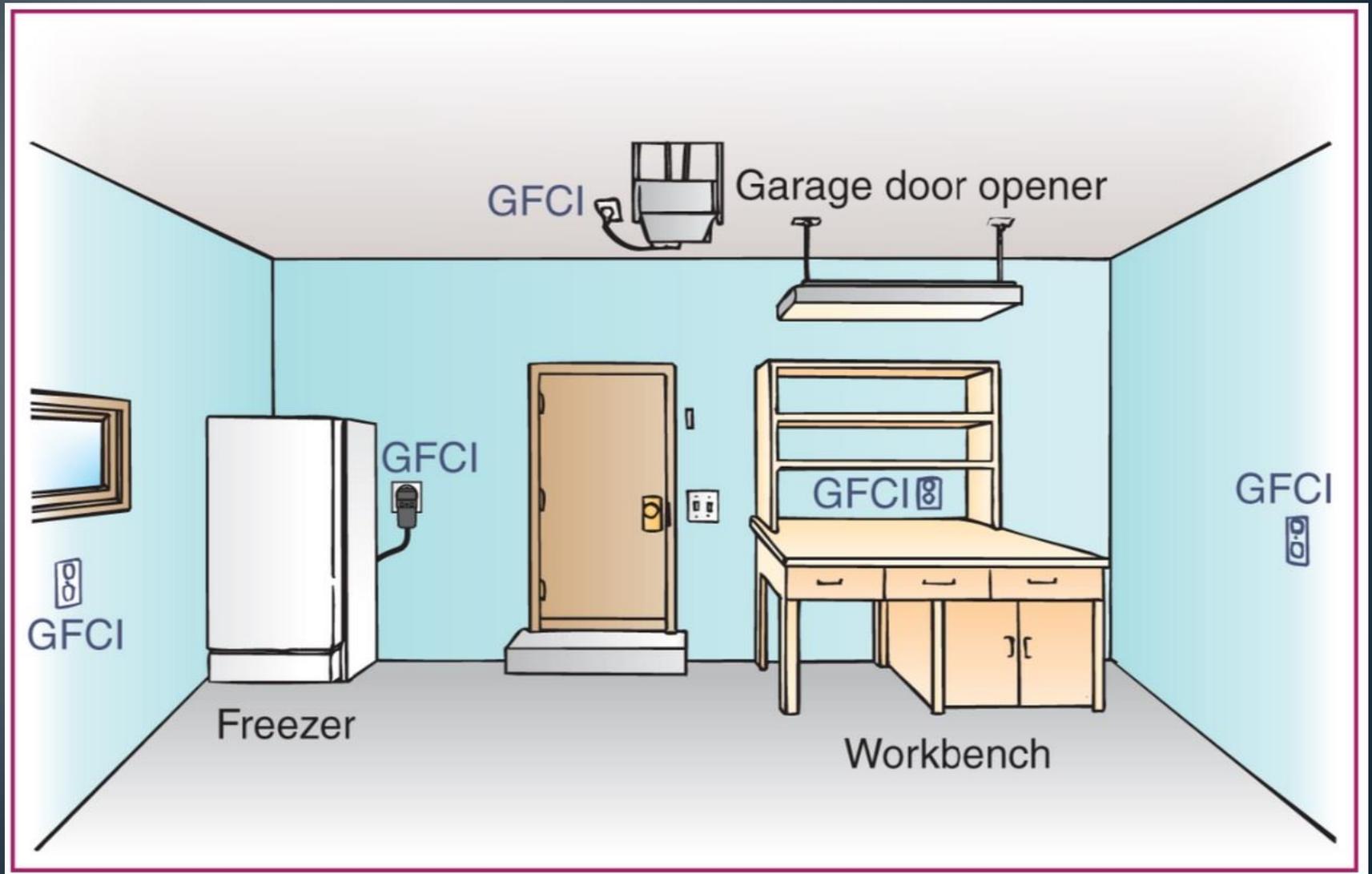


The definition of a bathroom has been revised to include areas with a basin and such things as a urinal

NEC 210.8(A)(2) Garages, and also accessory buildings



No GFCI Exceptions for Garages.



NEC 210.8(A)(3) Outdoors



NEC 210.8(A)(3) outdoor GFCI exception:
Receptacles that are not readily accessible and are supplied by a branch circuit dedicated to electric snow-melting, deicing, pipeline, or vessel heating equipment shall be permitted to be installed in accordance with 426.28 or 427.22 as applicable. (GFP Protection required)



Out of Reach

NEC 210.8(A)(4) Crawl Spaces



NEC 210.8(A)(5) Unfinished Basements

- Unfinished basements are defined for purposes of this section as portions or areas of the basement not intended as habitable rooms and limited to storage areas, work areas, and the like.



Unfinished Basement GFCI Exceptions:

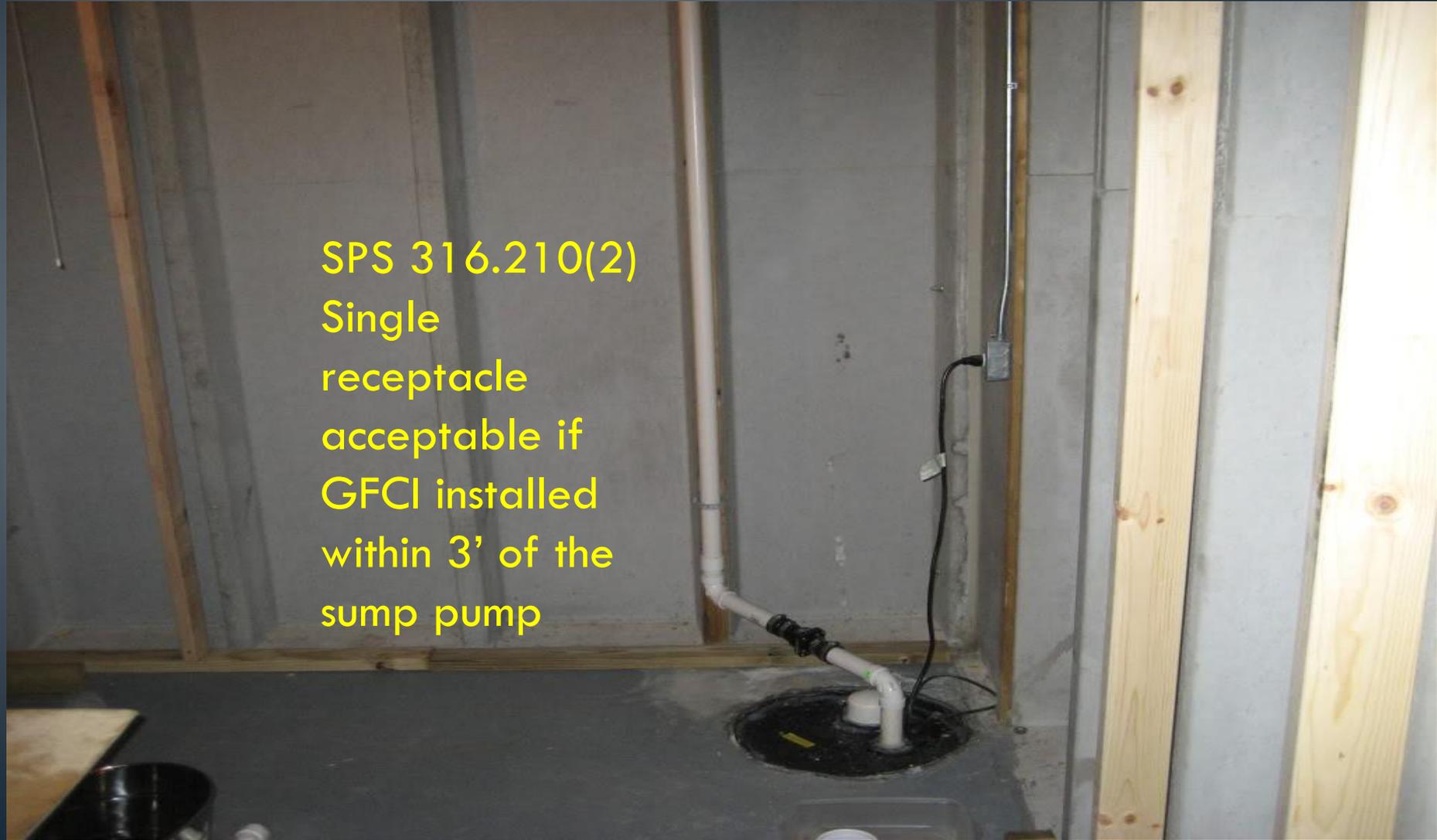
- **1. NEC 210.8(A)(5)(Exception): A receptacle supplying a permanently installed fire alarm or burglar alarm system shall not be required to have GFCI Protection.**
- **2. SPS 316.210(2) Exception: GFCI protection shall not be required for a single receptacle providing power for sump or sewage pumps where an accessible GFCI is located within 3' of the non-GFCI protected receptacle.**

GFCI not required NEC 210.8(A)(5) Exception

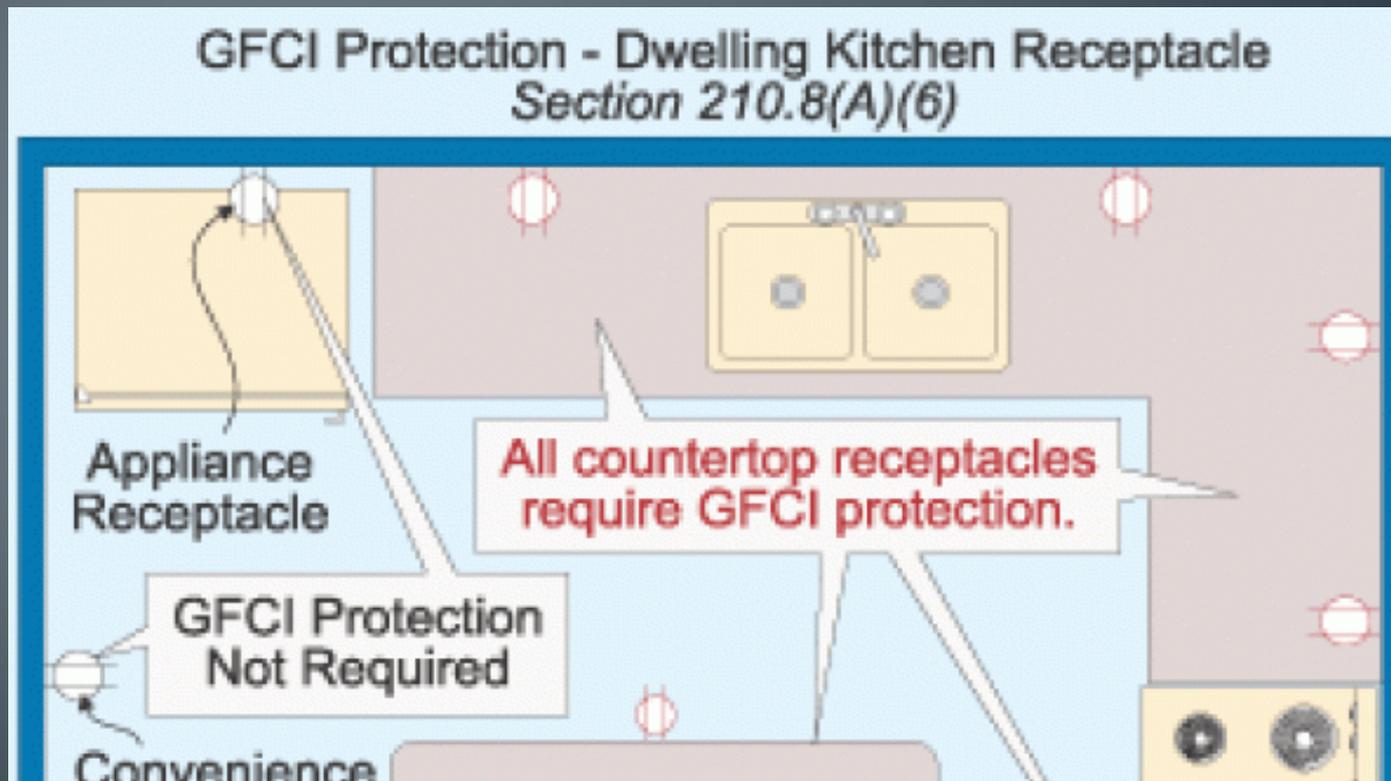


Wisconsin Sump Pump Receptacle requirements

SPS 316.210(2)
Single
receptacle
acceptable if
GFCI installed
within 3' of the
sump pump



NEC 210.8(A)(6) Kitchens: Where the receptacles are installed to serve the Countertop surfaces.



NEC 210.8(A)(7) Sinks: located in areas other than kitchens where receptacles are installed within 6' of the outside edge of the sink.

210.8(A)(7) GFCI - Dwelling Unit Sinks



GFCI is now 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 **(not just laundry, utility or wet bar sinks)**

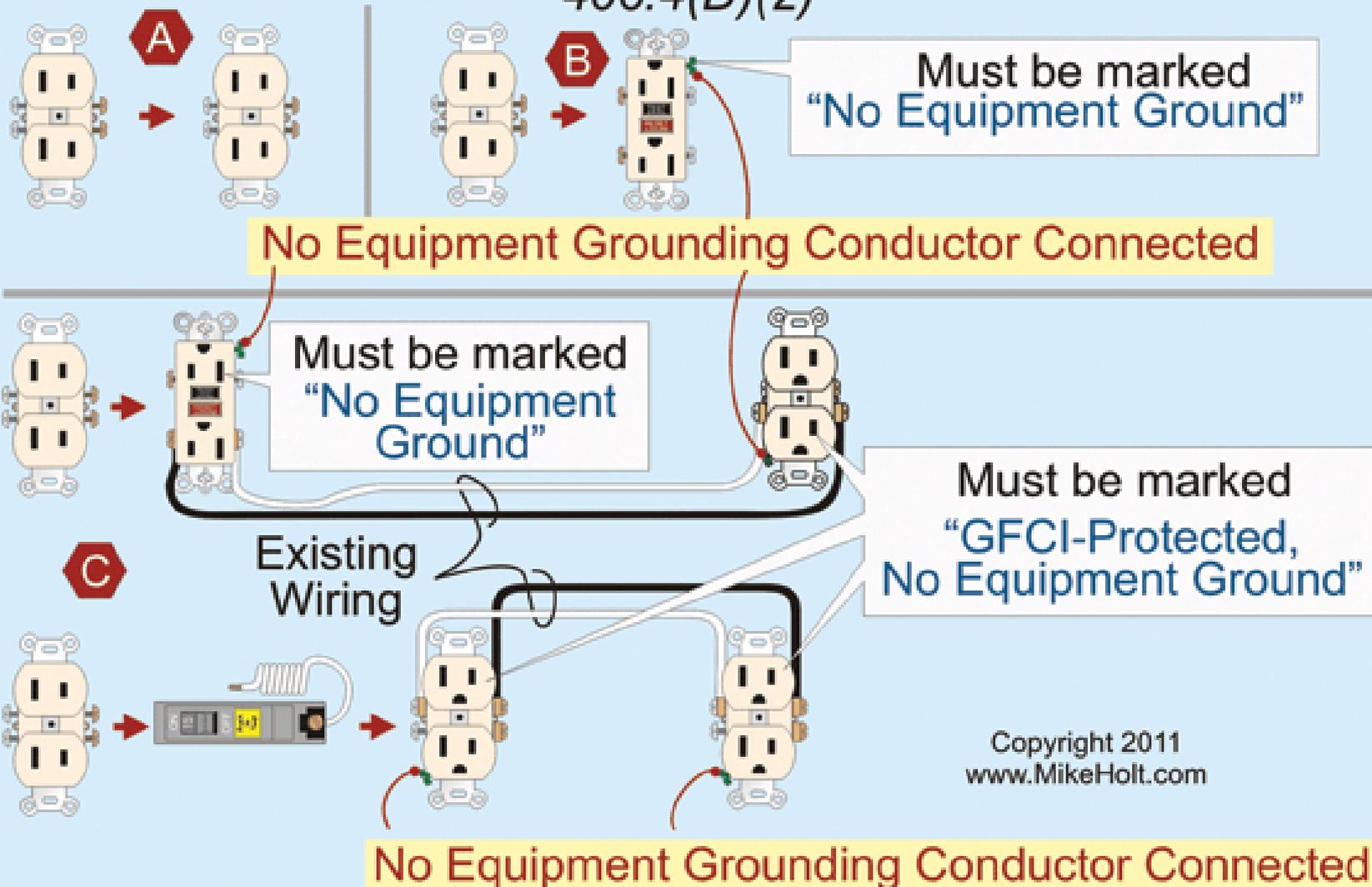
GFCI requirements for kitchen sinks still covered by 210.8(A)(6)

NEC 210.8(A)(8) Boathouses



GFCI Requirements for replacement receptacles

Replacing a Nongrounding-Type Receptacle No Equipment Grounding Conductor at Outlet Box 406.4(D)(2)



GFCI Requirements for replacement receptacles continued:

- NEC 406.4(D)(4) requires GFCI protected receptacles be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in the NEC

210.12(B) and 406.4(D)(4) Arc-Fault Circuit-Interrupter Protection



Listed Outlet Branch-Circuit Type AFCI Device

Courtesy of Pass & Seymour/Legrand

- An **Arc Fault Circuit Interrupter (AFCI)** is a type of duplex receptacle or circuit breaker that breaks the circuit when it detects a dangerous electrical arc, in order to prevent electrical fires. An AFCI distinguishes between a harmless arc that occurs incidental to normal operation of switches, plugs and brushed motors and an undesirable arc that can occur, for example, in a lamp cord that has a broken conductor in the cord.
- Arc faults in a home are one of the leading causes for electrical wiring fires. Each year in the United States, over 40,000 fires are attributed to home electrical wiring. These fires result in over 350 deaths and over 1,400 injuries each year.

- Conventional circuit breakers only respond to overloads and short circuits; so they do not protect against arcing conditions that produce erratic, and often reduced current. An AFCI is selective so that normal arcs do not cause it to trip. The AFCI circuitry continuously monitors the current and discriminates between normal and unwanted arcing conditions. Once an unwanted arcing condition is detected, the AFCI opens its internal contacts, thus de-energizing the circuit and reducing the potential for a fire to occur.

NEC 210.12(A): Dwelling Units AFCI Protection

- All 120-volt, single phase 15-20ampere **branch circuits** supplying **outlets** installed in the following locations require AFCI protection:
- Family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas

Is arc-fault protection required for branch circuits supplying the lighting and receptacle outlets in finished laundry rooms?

- **Answer: Yes.**
- **NEC 210.12 contains a non-exclusive list of rooms and similar areas. Branch-Circuits supplying such rooms or similar areas require AFCI protection. A laundry room that is “finished” is similar to a hallway or closet. Those areas are specifically identified in 210.12 and requires AFCI protection.**
- **NEC 210.12 does not apply to unfinished portions of basement laundry's.**
- **(The 2014 NEC, section 210.12 specifically includes laundry rooms.)**

Article 100 Definitions

- **Branch Circuit:** The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s)
- **Outlet:** A Point on the wiring system at which current is taken to supply utilization equipment.

Are outlets “receptacles” only? NO.

Outlet. A point on the wiring system at which current is taken to supply utilization equipment. (Article 100 definition)

Receptacle Outlet. An outlet where one or more receptacles are installed.

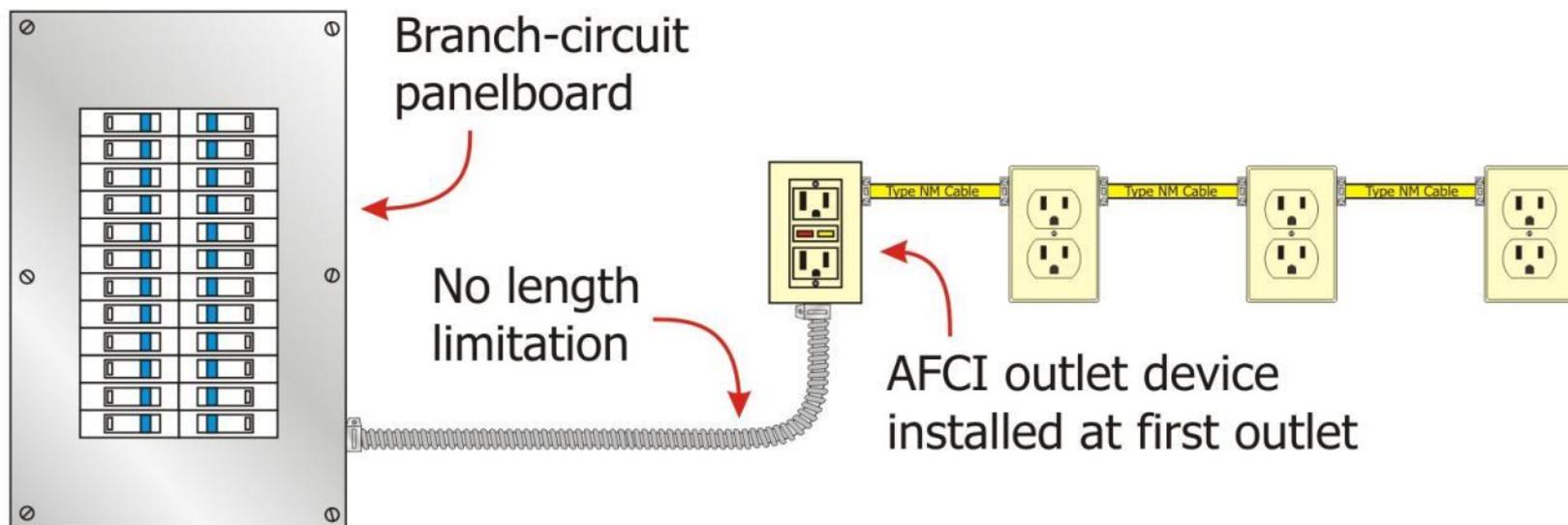
Lighting Outlet. An outlet intended for the direct connection of a lamp holder or luminaire.

Smoke detectors also considered outlets per definition.

210.12(A) Ex. No. 1 Outlet Type AFCI



Main rule at 210.12(A) requires AFCI combination-type protection installed to provide protection of the entire branch circuit

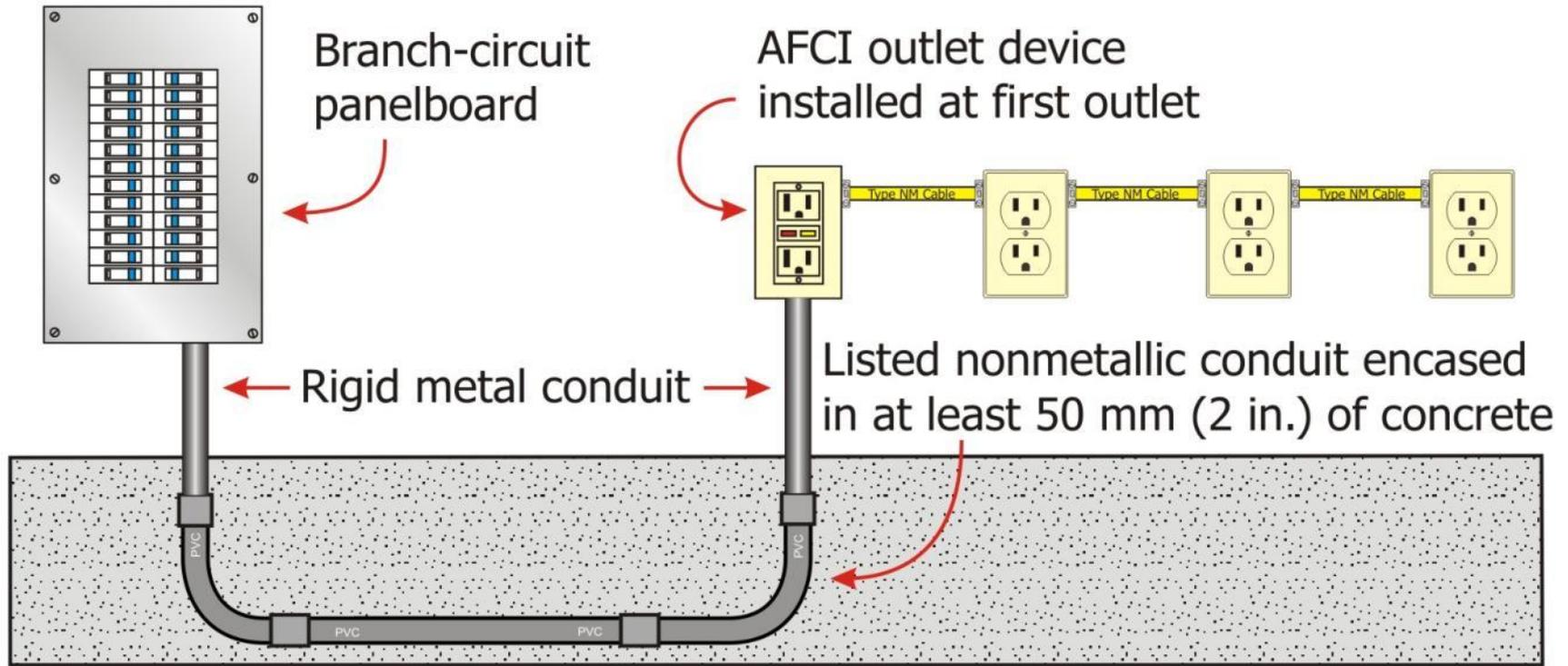


Ex. No. 1: If RMC, IMC, EMT, **Type MC** or steel armored Type AC cables meeting the requirements of 250.118 and metal outlet and junction boxes are installed for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a **outlet branch-circuit Type AFCI** at the first outlet to provide protection for the remaining portion of the branch circuit.

210.12(A) Ex. No. 2 Outlet Type AFCI

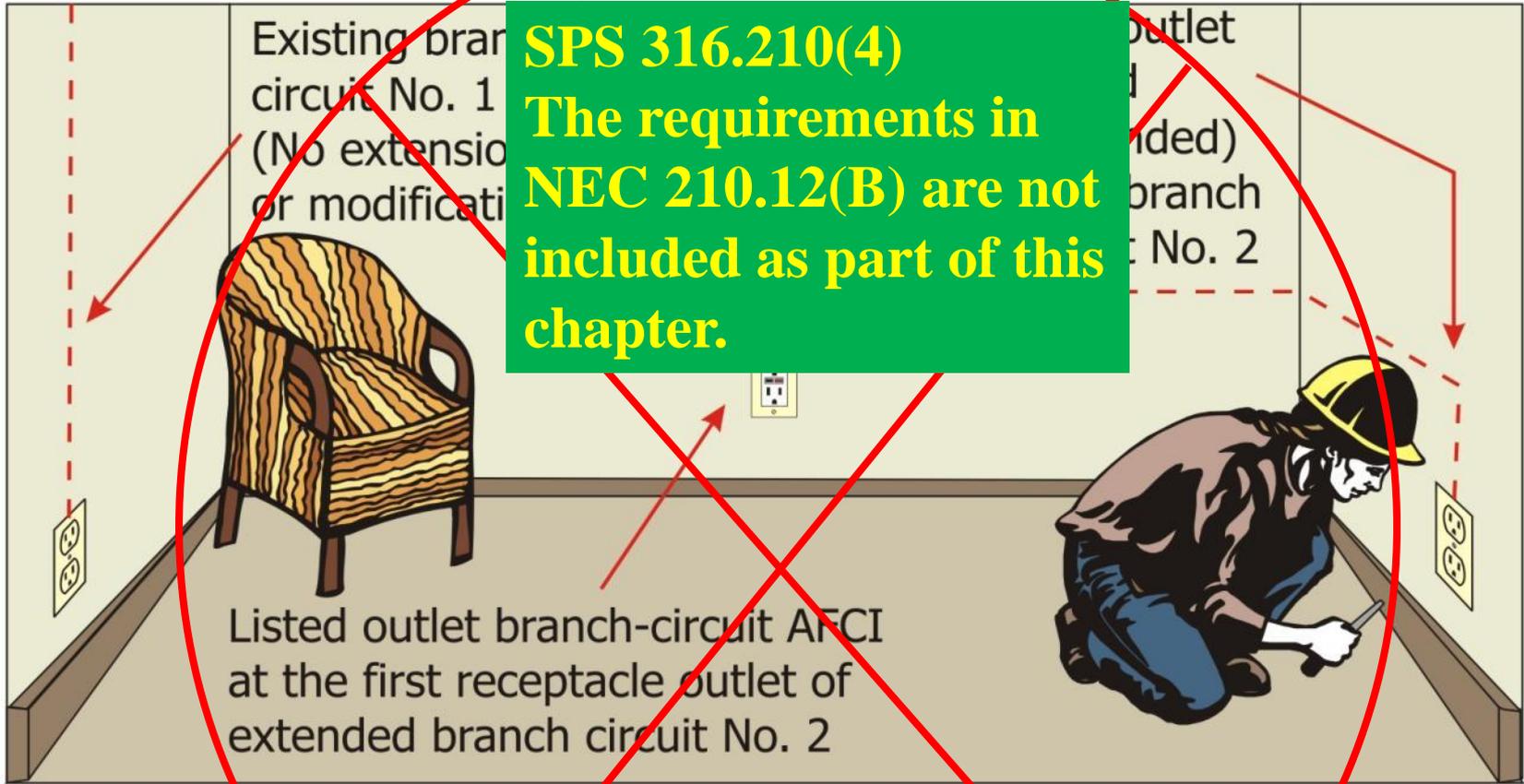


Main rule at 210.12(A) requires AFCI combination-type protection installed to provide protection of the entire branch circuit



Ex. No. 2: Where a listed metal or nonmetallic conduit or tubing is encased in not less than 50 mm (2 in.) of concrete (that portion of the branch circuit between the overcurrent device and the first outlet), it shall be permitted to install a outlet branch-circuit AFCI at the first outlet to provide AFCI protection for the remaining portion of the branch circuit

210.12(B) AFCI - Extensions or Modifications



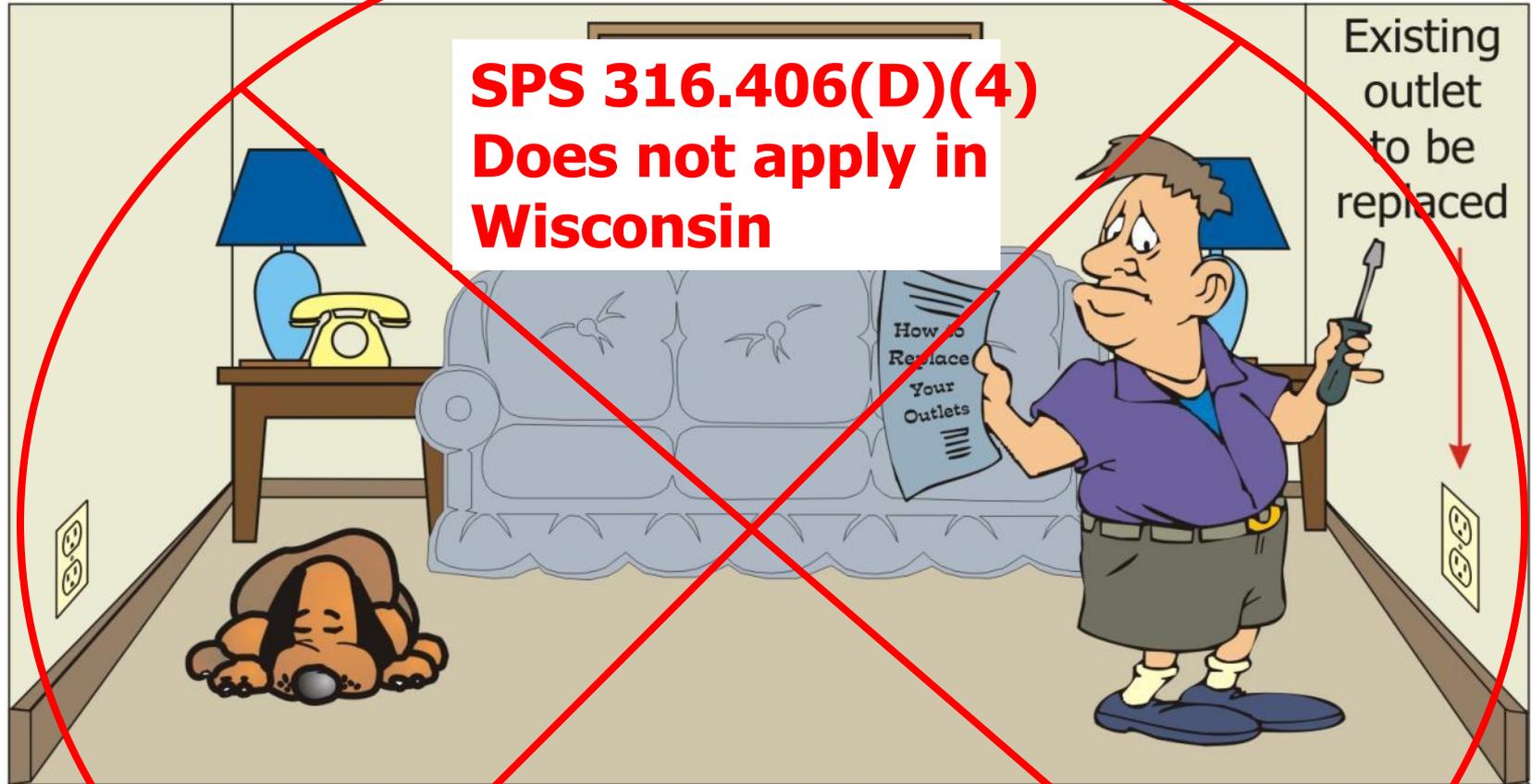
In any of the areas specified in 210.12(A), where branch-circuit wiring is modified, replaced or extended, the branch circuit shall be protected by:

- (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

406.4(D)(4) Receptacle Replacement (AFCI)



**SPS 316.406(D)(4)
Does not apply in
Wisconsin**



Arc-fault circuit-interrupter protection is required for replacement receptacle outlets where a receptacle outlet is supplied by a branch circuit that requires AFCI protection elsewhere in the Code (effective date January 1, 2014)

Replacement receptacle outlet can be protected by a listed outlet branch circuit type AFCI receptacle or a listed combination type AFCI circuit breaker

406.12 Tamper-Resistant Receptacles



What are tamper-resistant electrical receptacles and what is the new requirement?

TR receptacles have spring-loaded shutters that close off the contact openings, or slots, of the receptacles. When a plug is inserted into the receptacle, both springs are compressed and the shutters then open, allowing for the metal prongs to make contact to create an electrical circuit. Because both springs must be compressed at the same time, the shutters do not open when a child attempts to insert an object into only one contact opening, and there is no contact with electricity. Tamper-resistant receptacles are an important next step to making the home a safer place for children.

Why require tamper-resistant Electrical Receptacles?

Each year, approximately 2,400 children suffer severe shock and burns when they stick items into the slots of electrical receptacles. It is estimated that there are six to 12 child fatalities a year related to this.

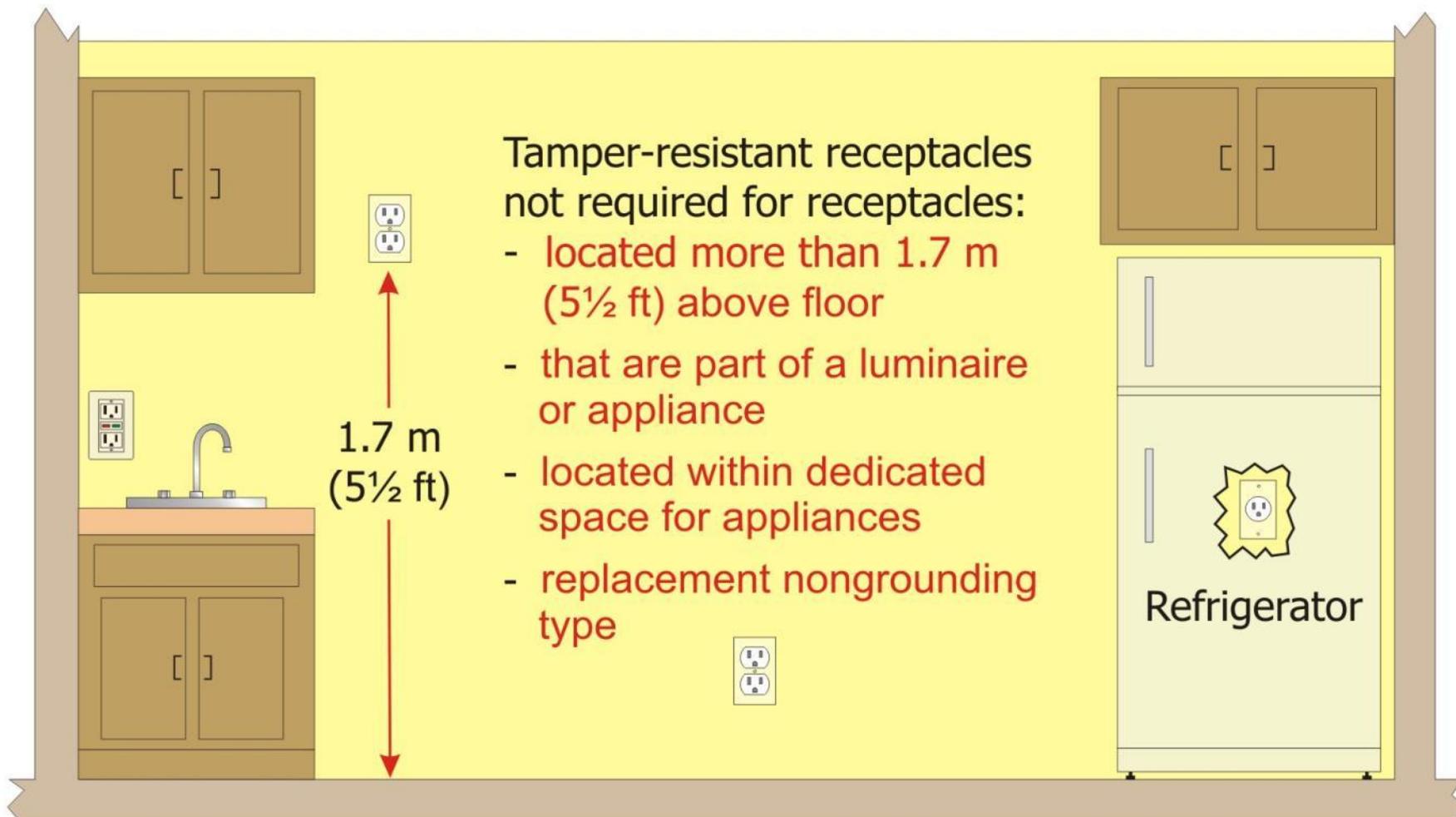
- **If homeowners do not have children, are TR receptacles required?**

Yes. Owners or tenants of homes and apartments change frequently. In addition, exposure to electrical shock and burn accidents are not limited to a child's own home. Children visit homes of relatives and friends who don't have children of their own. This requirement ensures all new homes and apartments are safe for children, whether the home is their own or they are there on a temporary basis.

406.12 Tamper-Resistant Receptacles

- All 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*)
 - Non-grounding receptacles used for replacements

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 Tamper-Resistant Receptacles

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

Kitchens

Family rooms

Dining rooms

Living rooms

Parlors

Libraries

Dens

Sunrooms

Bedrooms

Recreation rooms

Bathrooms

Outdoors

Laundry areas

Basements

Garages

Accessory buildings

Hallways

Foyer

*Similar rooms or areas of dwelling unit

406.4(D)(5) Receptacle Replacement Tamper-Resistant Receptacles



Listed tamper-resistant receptacles are required for replacement receptacle outlets where a receptacle outlet is required to be tamper-resistant elsewhere in the Code

See 406.12, 406.13, and 406.14 for tamper-resistant receptacle requirements

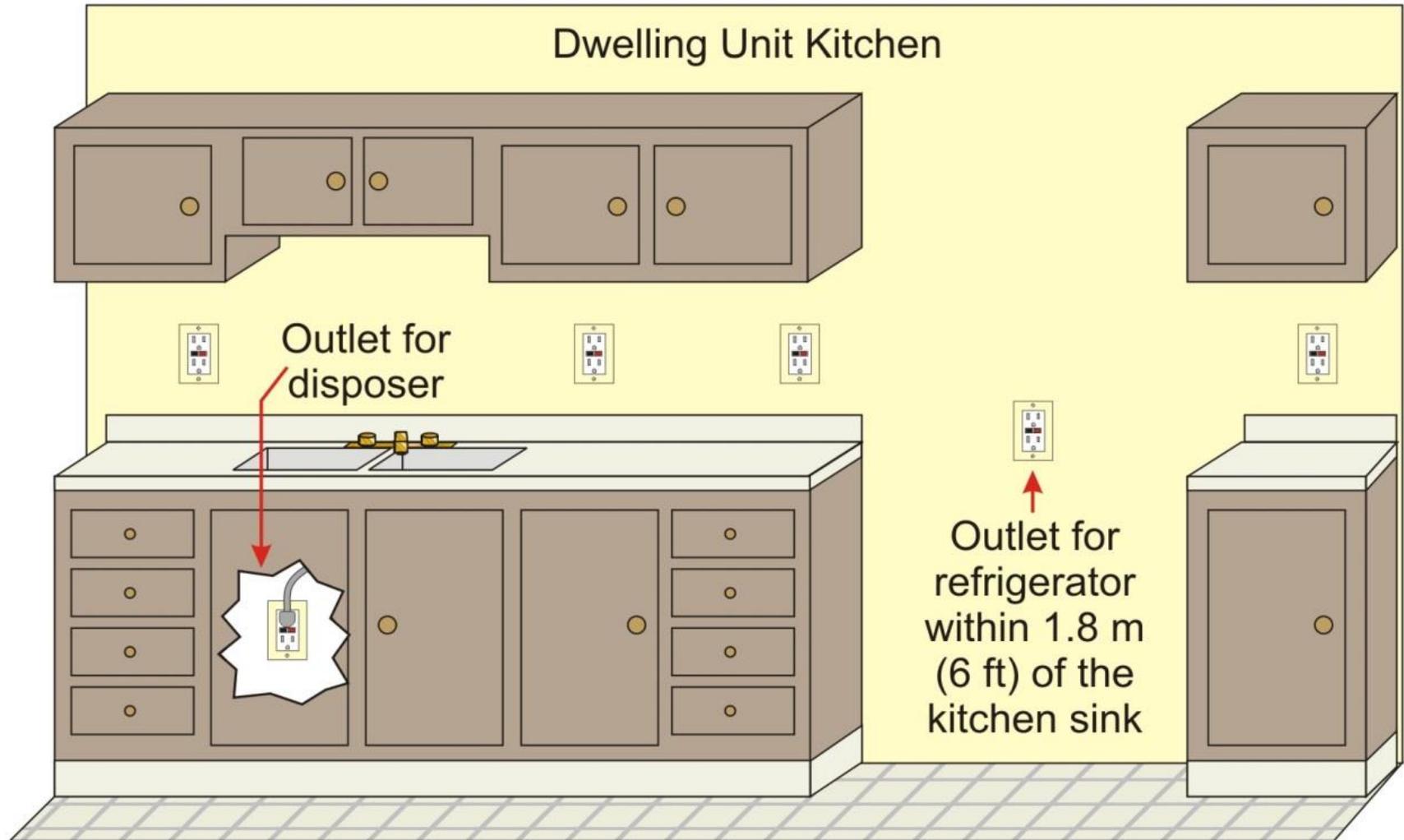
Analysis of Changes-2014 NEC



210.8(A)(7) GFCI: Dwelling Unit Sinks

- GFCI protection required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) of all dwelling unit sinks (*including kitchen sinks*).
- Revision removes the term “located in areas other than kitchens.”
- Rule will now include the garbage disposal receptacle located in the cabinet under a kitchen sink, receptacle located behind a refrigerator, or a general lighting branch circuit living room receptacle located on the back side of a kitchen sink bar area if they are located within 1.8 m (6 ft) of the kitchen sink.

210.8(A)(7) GFCI - Dwelling Unit Sinks

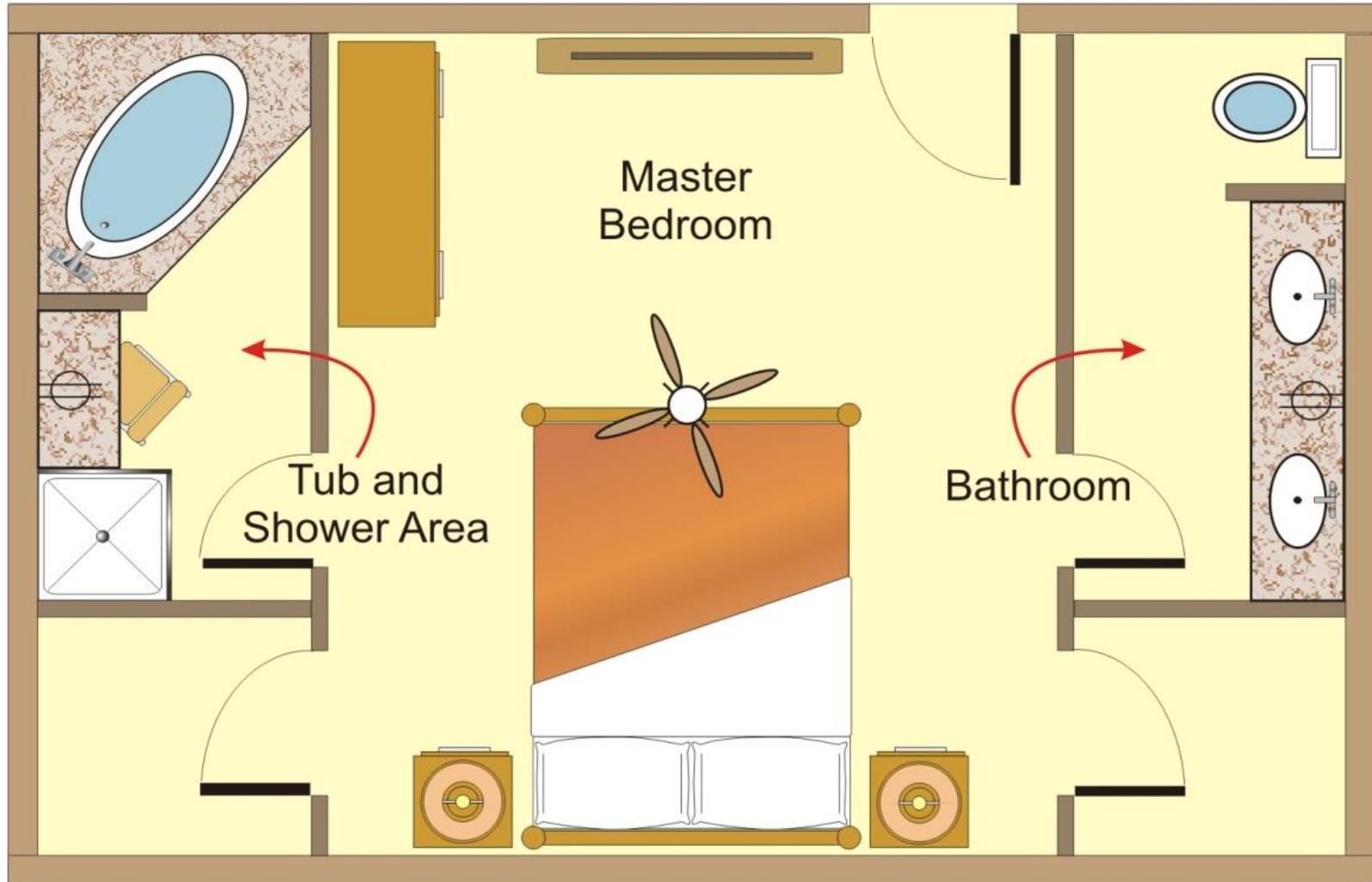


All 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) of the outside edge of **any dwelling unit sink** now require GFCI protection

210.8(A)(9) Dwelling Unit Bathtubs or Shower Stalls

- GFCI protection now required where receptacles are installed within 1.8 m (6 ft) of the outside edge of dwelling unit “Bathtubs or Shower Stalls.”
- Bathtubs or shower stalls are not always located in an area that meets the Article 100 definition of a “bathroom.”
- Bathroom is “an area including a basin with one or more of the following: a toilet, a urinal, a tub, a shower, a bidet, or similar plumbing fixtures.”
- Example: a room or area connected to a dwelling unit bedroom with a bathtub or shower stall as the only plumbing fixture in that particular room or area with a basin sink and toilet provided in another common area of the dwelling.

210.8(A)(9) GFCI: Bathtubs 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: Laundry Areas

- All dwelling unit “Laundry Areas” now require GFCI protection for 125-volt, single phase, 15-and 20-ampere receptacles (*regardless of presence of a sink or distance from same*).
- A laundry room sink is no longer the driving factor whether GFCI protection is required or not.
- GFCI protection in laundry areas addresses increased shock hazard risk and is consistent with other *NEC* requirements for GFCI protection of receptacles in areas in close proximity of water.
- Increased usage of GFCI protection for personnel at receptacles of residential homes is a highly effective means of further reducing the potential for electrical shock hazards.



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.



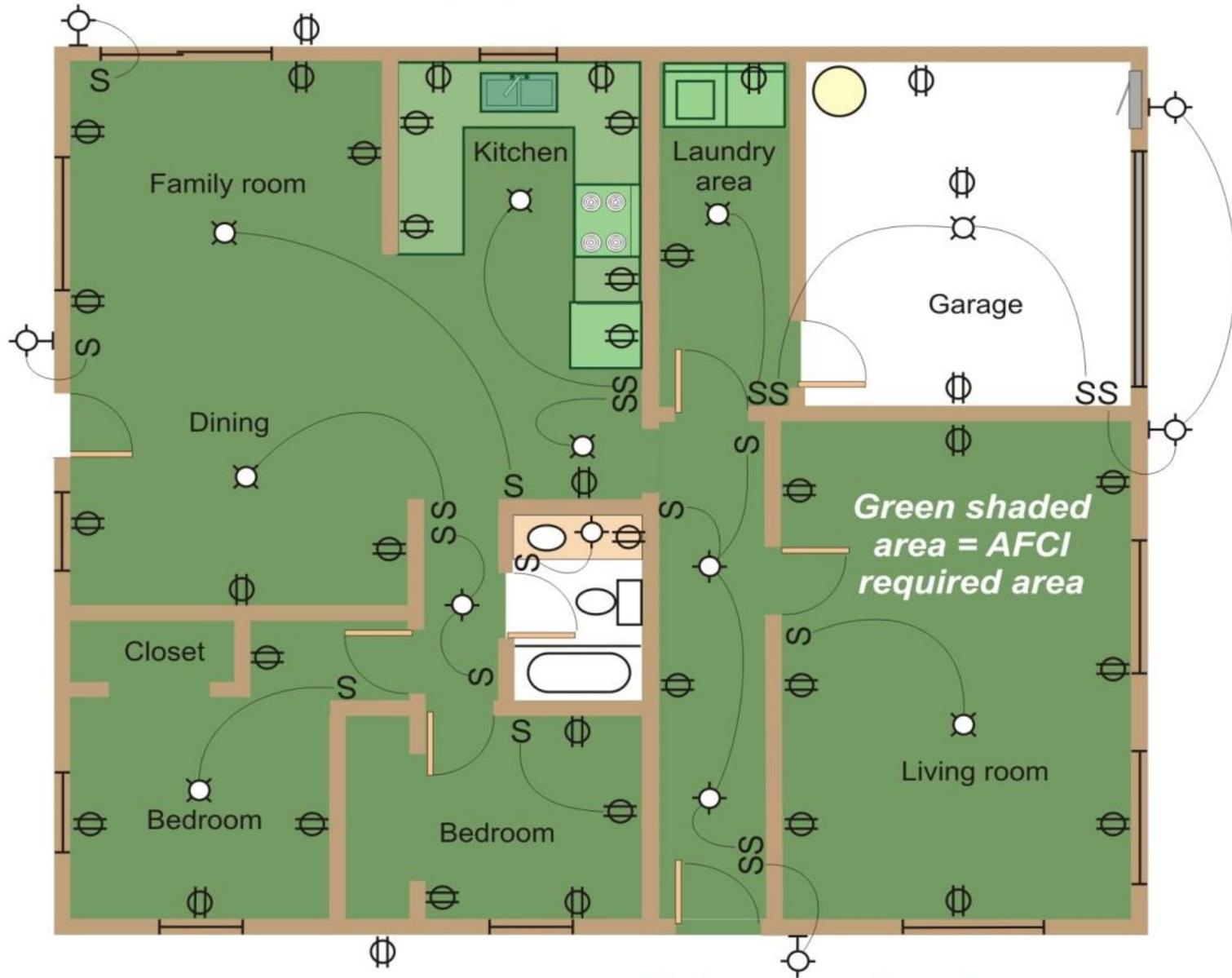
210.12 AFCI Protection

- New provision added to require all AFCI devices required by 210.12 to be installed in a readily accessible location.
- Aligns with the “readily accessible” requirements for GFCI devices covered at 210.8.
- Primarily related to occupant or user accessibility to the monthly testing and reset features of AFCI devices.
- Will aid and facilitate the ability to reset the AFCI device in the event the AFCI detects an arcing event.

210.12(A) AFCI Protection

- “Kitchens” and “laundry areas” were added to list of areas requiring AFCI protection.
- This expansion into the kitchens and laundry areas is another step in the incremental approach for AFCI protection at dwelling units.
- AFCI protection was also expanded to include 15 or 20 ampere branch circuits supplying outlets or “devices” which would now include switches, etc.
- AFCI protection is now required to be installed in dwelling unit kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas.

210.12(A) AFCI Protection



AFCI protection expanded to **kitchen** and **laundry areas**

NEC 2017 Proposal “Whole House” AFCI Protection

- **Revision: 210.12(A) – Whole-House AFCI Protection**
- The continual expansion for arc-fault circuit-interrupter (AFCI) protection appears to be complete with the proposed revisions to 210.12(A), which would require AFCI protection for all 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in dwelling units. The “laundry list” of rooms or areas requiring AFCI protection was removed, leaving AFCI protection required for the entire dwelling unit

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Thank You.
Any Questions?

