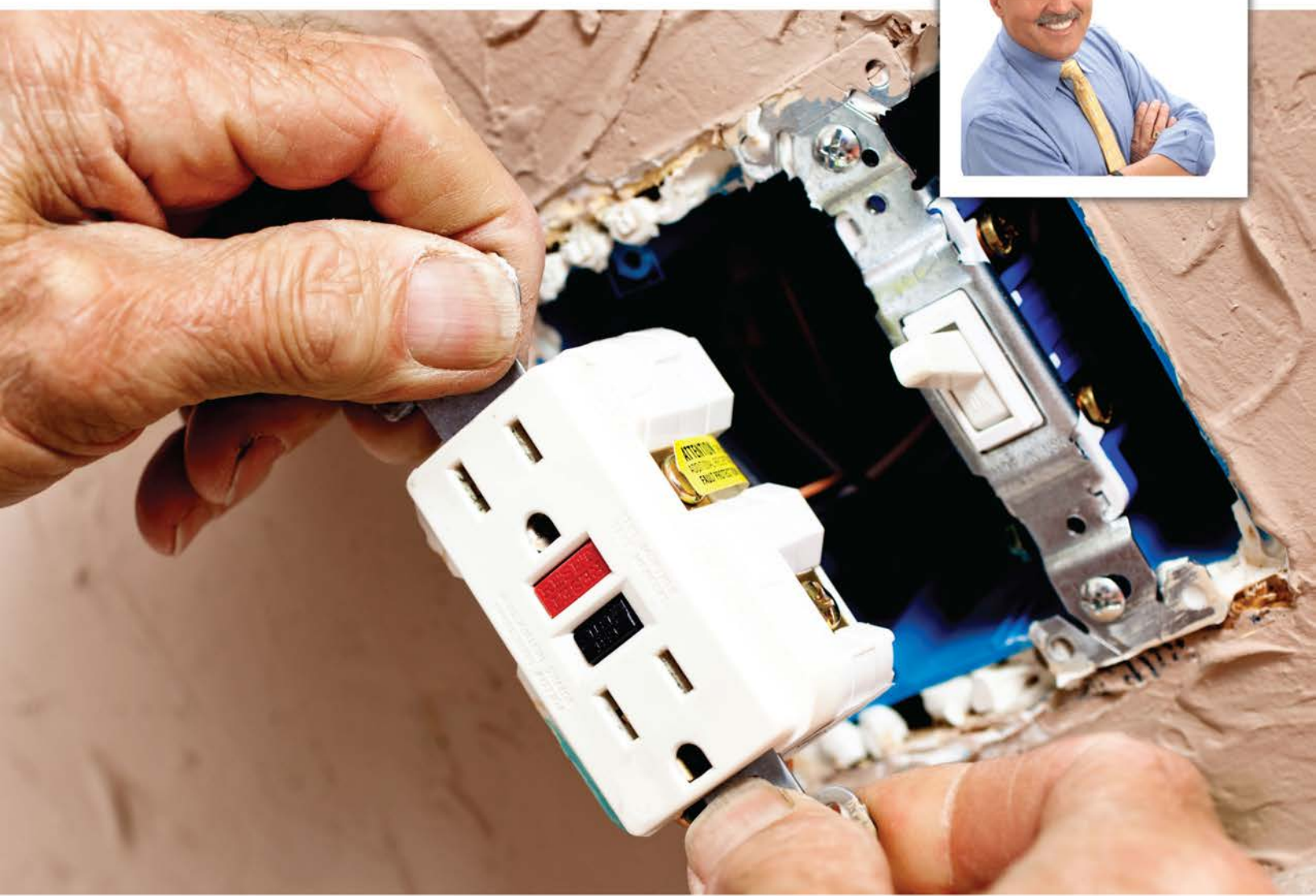




GFCI and AFCI Protection

210.8 and 210.12

Based on the 2017 NEC®



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ABOUT THE AUTHOR

Mike Holt worked his way up through the electrical trade. He began as an apprentice electrician and became one of the most recognized experts in the world as it relates to electrical power installations. He's worked as a journeyman electrician, master electrician, and electrical contractor. Mike's experience in the real world gives him a unique understanding of how the *NEC* relates to electrical installations from a practical standpoint.



You'll find his writing style to be direct, nontechnical, and powerful.

Did you know Mike didn't finish high school? So if you struggled in high school or didn't finish at all, don't let it get you down. However, realizing that success depends on one's continuing pursuit of education, Mike immediately attained his GED, and ultimately attended the University of Miami's Graduate School for a Master's degree in Business Administration.

Mike resides in Central Florida, is the father of seven children, has five grandchildren, and enjoys many outside interests and activities. He's a nine-time National Barefoot Water-Ski Champion (1988, 1999, 2005–2009, 2012–2013). He's set many national records and continues to train year-round at a World competition level (www.barefootwaterskier.com).

What sets him apart from some is his commitment to living a balanced lifestyle; placing God first, family, career, then self.

*I dedicate this book to the
Lord Jesus Christ,
my mentor and teacher.
Proverbs 16:3*



ARTICLE 210

BRANCH CIRCUITS

Code Sections 210.8 and 210.12

Introduction to Article 210—Branch Circuits

This article contains the requirements for branch circuits, such as conductor sizing and identification, GFCI protection, and receptacle and lighting outlet requirements. It consists of three parts:

- [Part I. General Provisions](#)
- [Part II. Branch-Circuit Ratings](#)
- [Part III. Required Outlets](#)

Table 210.3 of this article identifies specific-purpose branch circuits. The provisions for branch circuits that supply equipment listed in Table 210.3 amend or supplement the provisions given in Article 210 for branch circuits, so it's important to be aware of the contents of this table.

Mastering the branch-circuit requirements in Article 210 will give you a jump-start toward completing installations that are free of *Code* violations.

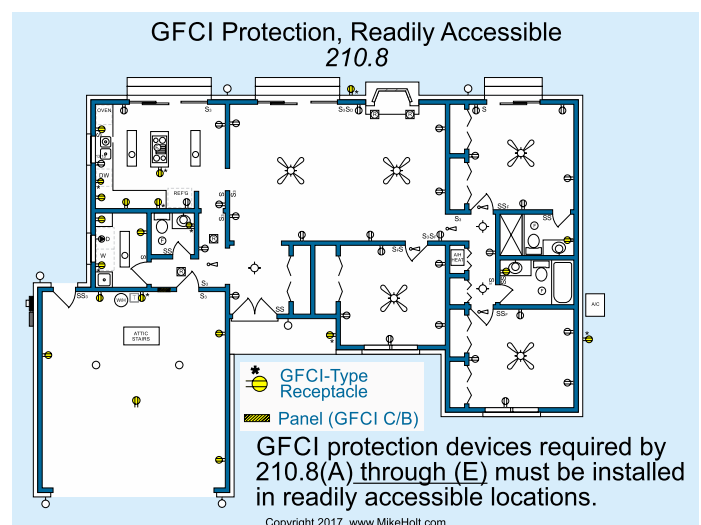
210.8 GFCI Protection

Ground-fault circuit interruption for personnel must be provided as required in 210.8(A) through (E). The GFCI device must be installed at a readily accessible location. ▶ [Figure 210–19](#)

Note 2: See 422.5 for GFCI requirements for automotive vacuum machines, drinking water coolers, high-pressure spray washing machines, tire inflation machines provided for public use, and vending machines.

Author's Comment:

- According to Article 100, “Readily Accessible” means capable of being reached quickly without having to climb over or remove obstacles, or resort to the use of portable ladders.



▶ [Figure 210–19](#)

For the application of 210.8(A)(7), 210.8(A)(9), and 210.8(B)(5), distance is measured as the shortest path the flexible cord would follow without piercing a floor, wall, ceiling, or fixed barrier, or passing through a door, doorway, or window. ▶Figure 210–20



▶Figure 210–20

(A) Dwelling Units. GFCI protection is required for 15A and 20A, 125V receptacles installed in the following locations:

Author's Comment:

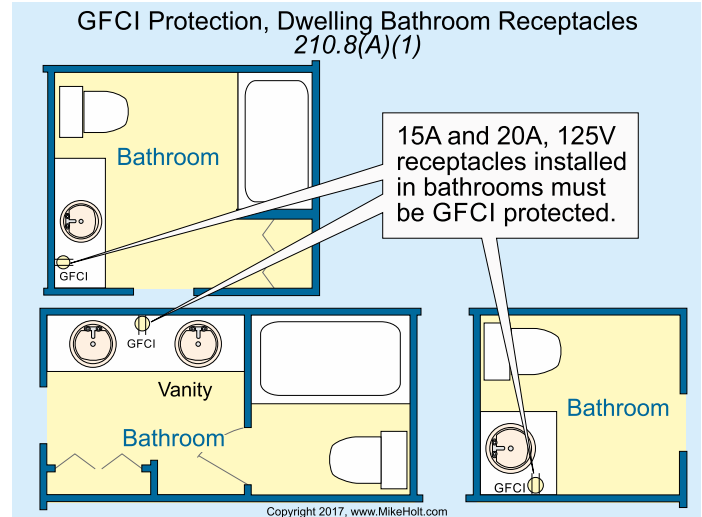
- See the definitions of “GFCI” and “Dwelling Unit” in Article 100.

(1) Bathroom Area. GFCI protection is required for 15A and 20A, 125V receptacles in the bathroom area of a dwelling unit. ▶Figure 210–21

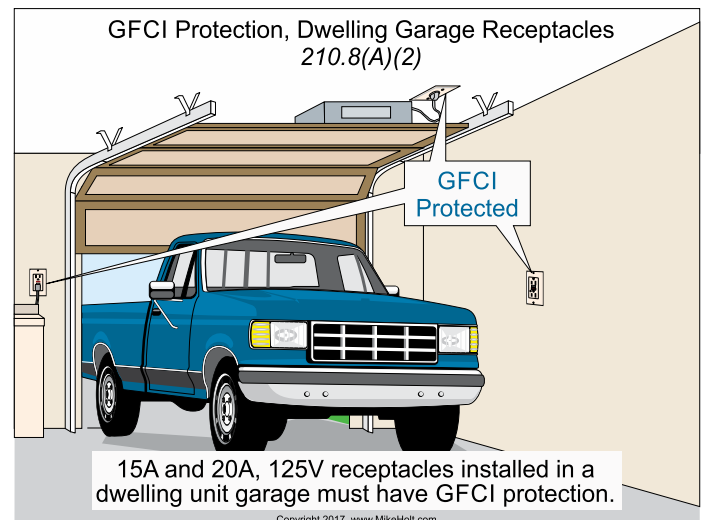
Author's Comment:

- A bathroom is an area that includes a basin as well as one or more of the following: a toilet, urinal, tub, shower, bidet, or similar plumbing fixture [Article 100].

(2) Garages and Accessory Buildings. GFCI protection is required for 15A and 20A, 125V receptacles in garages, and in grade-level portions of accessory buildings used for storage or work areas of a dwelling unit. ▶Figure 210–22



▶Figure 210–21



▶Figure 210–22

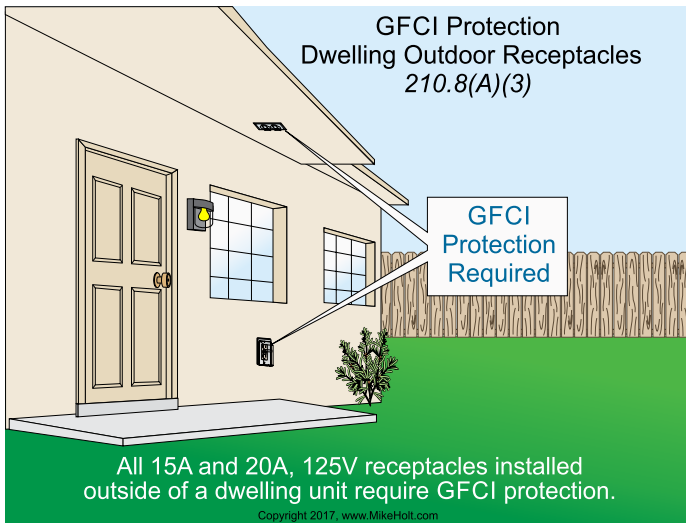
Author's Comment:

- See the definition of “Garage” in Article 100.
- A receptacle outlet is required in a dwelling unit attached garage [210.52(G)(1)], but a receptacle outlet isn't required in an accessory building or a detached garage without power. If a 15A or 20A, 125V receptacle is installed in an accessory building, it must be GFCI protected. ▶Figure 210–23

(3) Outdoors. GFCI protection is required for 15A and 20A, 125V receptacles located outdoors of dwelling units, including receptacles installed under the eaves of roofs. ▶Figure 210–24



►Figure 210-23

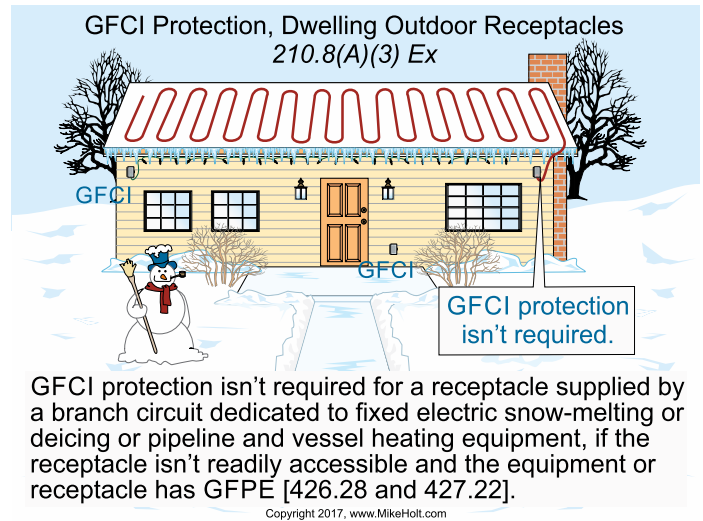


►Figure 210-24

Author's Comment:

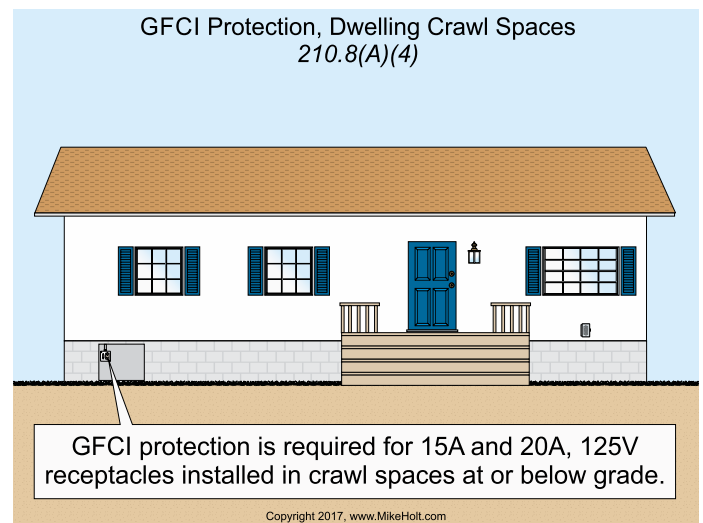
- Each dwelling unit of a multifamily dwelling that has an individual entrance at grade level must have at least one GFCI-protected receptacle outlet accessible from grade level located not more than 6½ ft above grade [210.52(E)(2)].
- Balconies, decks, and porches that are attached to the dwelling unit and are accessible from inside the dwelling must have at least one GFCI-protected receptacle outlet accessible from the balcony, deck, or porch [210.52(E)(3)].

Ex: GFCI protection isn't required for a receptacle that's supplied by a branch circuit dedicated to fixed electric snow-melting, deicing or pipeline and vessel heating equipment, if the receptacle isn't readily accessible and the equipment or receptacle has ground-fault protection of equipment (GFPE) [426.28 and 427.22]. ►Figure 210-25



►Figure 210-25

(4) Crawl Spaces at or Below Grade Level. GFCI protection is required for 15A and 20A, 125V receptacles installed in crawl spaces at or below grade. ►Figure 210-26

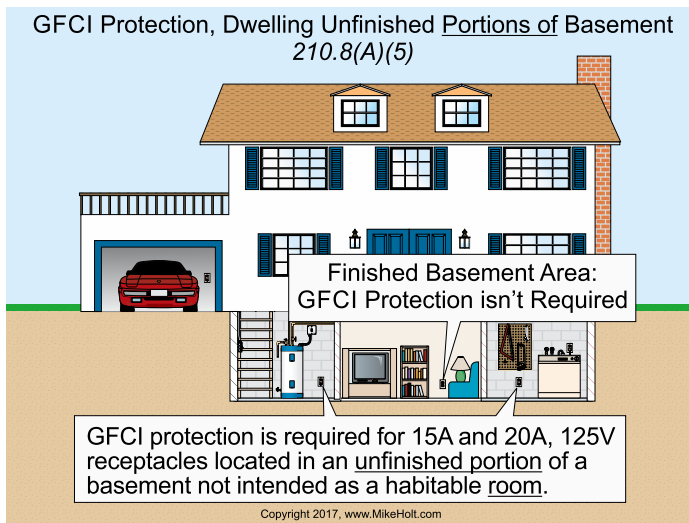


►Figure 210-26

Author's Comment:

- The *Code* doesn't require a receptacle to be installed in a crawl space, except when heating, air-conditioning and refrigeration equipment is installed there [210.63].

(5) Unfinished Portions of Basements. GFCI protection is required for 15A and 20A, 125V receptacles located in unfinished portions or areas of a basement not intended for habitable rooms. ▶[Figure 210-27](#)



▶[Figure 210-27](#)

Ex: A receptacle supplying only a permanently installed fire alarm or burglar alarm system isn't required to be GFCI protected [760.41(B) and 760.121(B)].

Author's Comment:

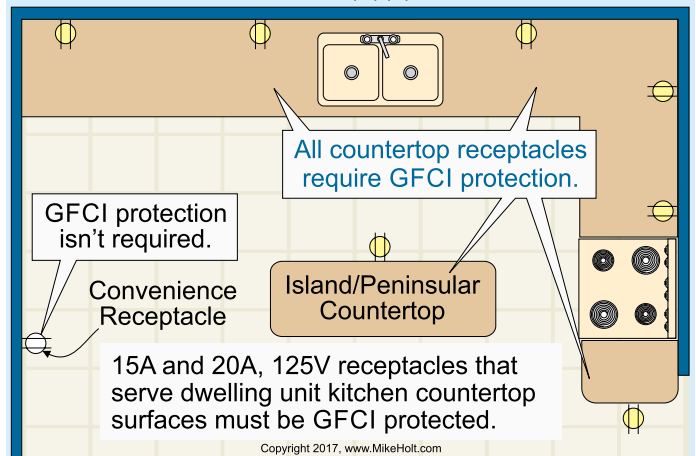
- A receptacle outlet is required in each unfinished portion of a dwelling unit basement [210.52(G)(3)].

(6) Kitchen Countertop Surfaces. GFCI protection is required for 15A and 20A, 125V receptacles that serve countertop surfaces. ▶[Figure 210-28](#)

Author's Comment:

- See 210.52(C) for the location requirements of countertop receptacles.

GFCI Protection, Dwelling Kitchen Countertop Surfaces 210.8(A)(6)



▶[Figure 210-28](#)

(7) Sinks. GFCI protection is required for 15A and 20A, 125V receptacles located within 6 ft from the top inside edge of the bowl of the sink. ▶[Figure 210-29](#)

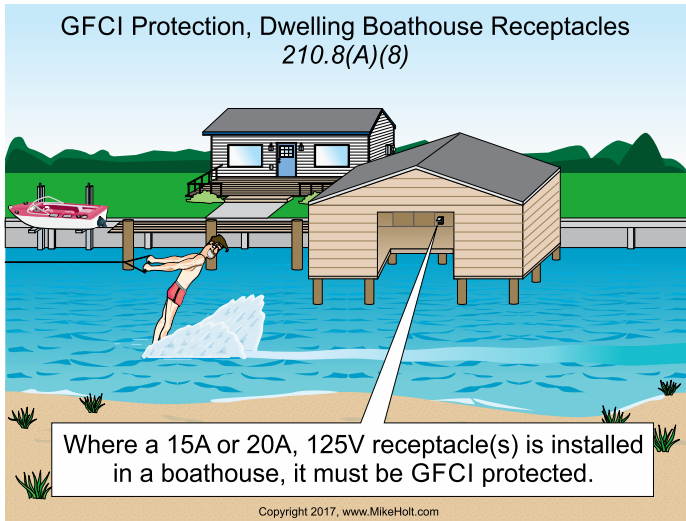


▶[Figure 210-29](#)

(8) Boathouses. GFCI protection is required for 15A and 20A, 125V receptacles located in a dwelling unit boathouse. ▶[Figure 210-30](#)

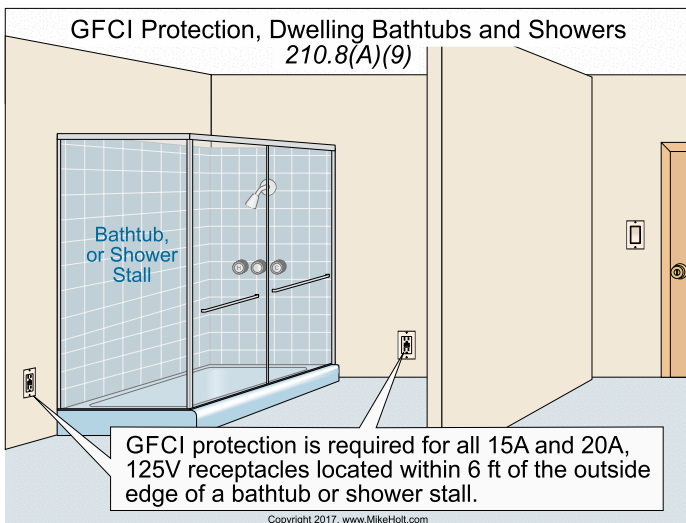
Author's Comment:

- The *Code* doesn't require a 15A or 20A, 125V receptacle to be installed in a boathouse, but if one is installed, it must be GFCI protected.



►Figure 210-30

(9) Bathtubs or Shower Stalls. GFCI protection is required for 15A and 20A, 125V receptacles located within 6 ft of the outside edge of a bathtub or shower stall. ►Figure 210-31



►Figure 210-31

(10) Laundry Areas. GFCI protection is required for 15A and 20A, 125V receptacles installed in laundry areas. ►Figure 210-32

(B) Other than Dwelling Units. GFCI protection is required for single-phase receptacles rated 50A or less not exceeding 150V to ground and three-phase receptacles rated 100A or less not exceeding 150V to ground installed in the following locations:



►Figure 210-32

(1) Bathrooms. GFCI protection is required for receptacles installed in bathrooms. ►Figure 210-33

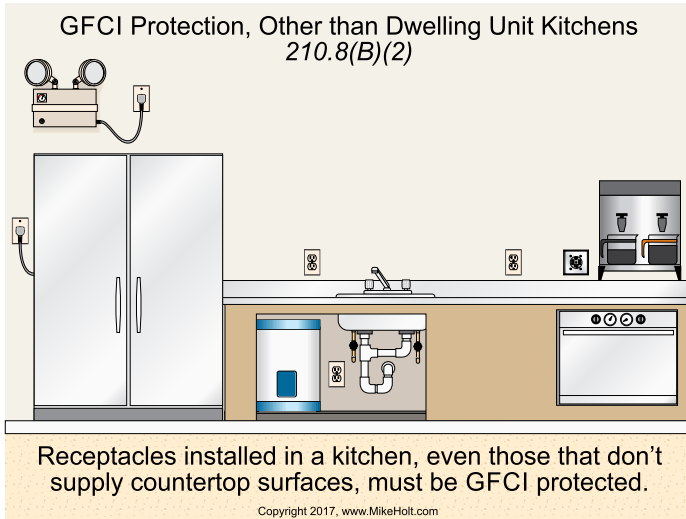


►Figure 210-33

Author's Comment:

- A bathroom is an area that includes a basin as well as one or more of the following: a toilet, urinal, tub, shower, bidet, or similar plumbing fixture [Article 100].

(2) Kitchens. GFCI protection is required for receptacles installed in a kitchen. ►Figure 210-34

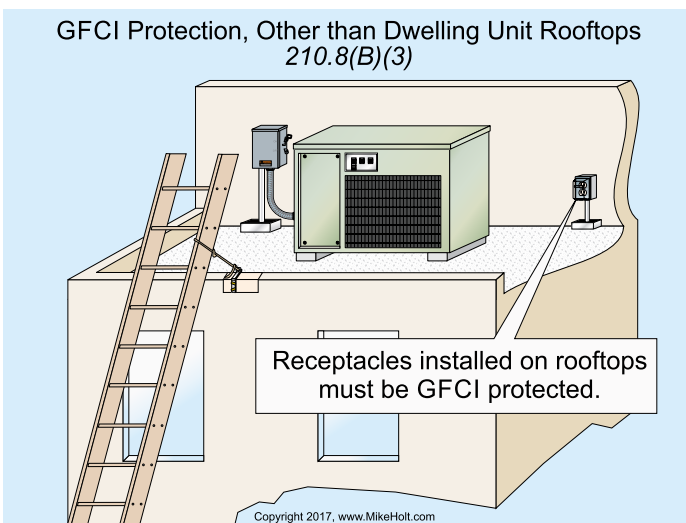


►Figure 210-34

Author's Comment:

- A kitchen is an area with a sink and permanent provisions for food preparation and cooking [Article 100].

(3) Rooftops. GFCI protection is required for receptacles installed on rooftops. ►Figure 210-35

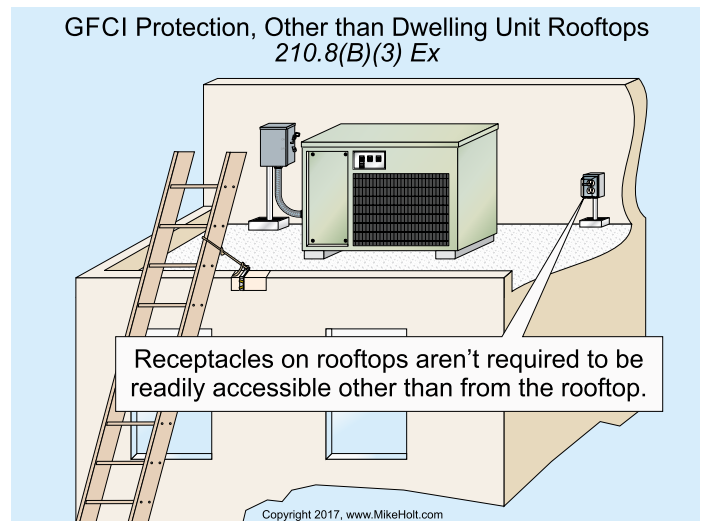


►Figure 210-35

Author's Comment:

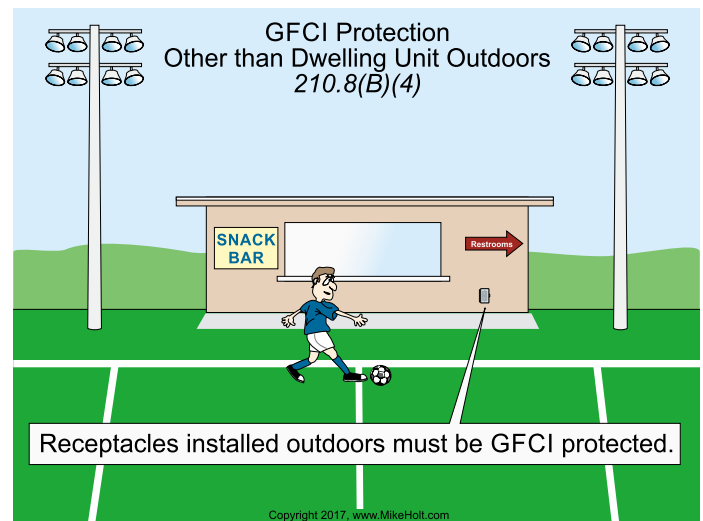
- A 15A or 20A, 125V receptacle outlet must be installed within 25 ft of heating, air-conditioning and refrigeration equipment [210.63].

Ex: Rooftop receptacles are required to be readily accessible from the rooftop surface area. ►Figure 210-36



►Figure 210-36

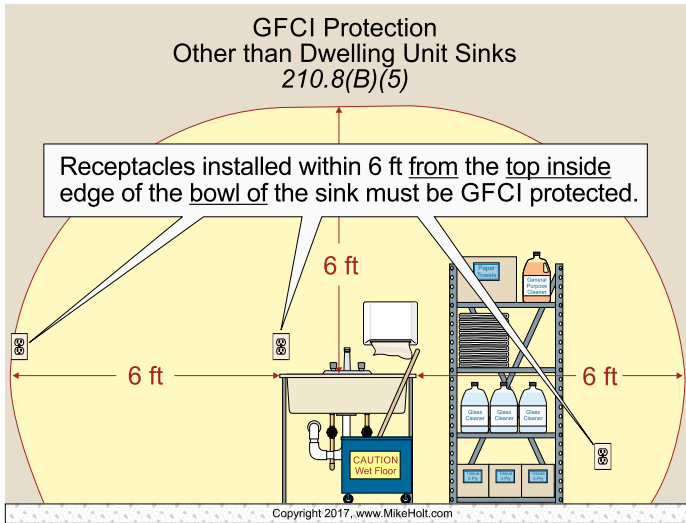
(4) Outdoors. GFCI protection is required for receptacles installed outdoors. ►Figure 210-37



►Figure 210-37

(5) Sinks. GFCI protection is required for receptacles installed within 6 ft from the top inside edge of the bowl of the sink. ►Figure 210-38

Ex 1: In industrial laboratories, receptacles used to supply equipment where removal of power would introduce a greater hazard aren't required to be GFCI protected.



►Figure 210–38

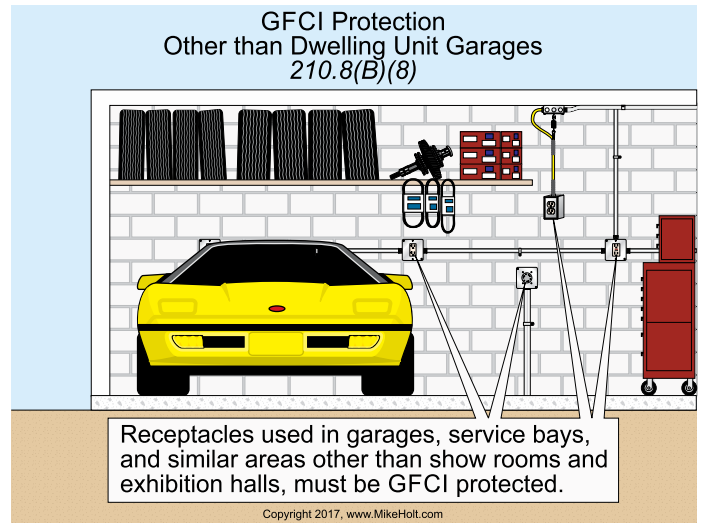
(6) Indoor Wet Locations. GFCI protection is required for receptacles installed indoors in wet locations.

(7) Locker Rooms. GFCI protection is required for receptacles installed in locker rooms with associated showering facilities. ►Figure 210–39



►Figure 210–39

(8) Garages. GFCI protection is required for receptacles installed in garages, service bays, and similar areas, other than show rooms and exhibition halls. ►Figure 210–40



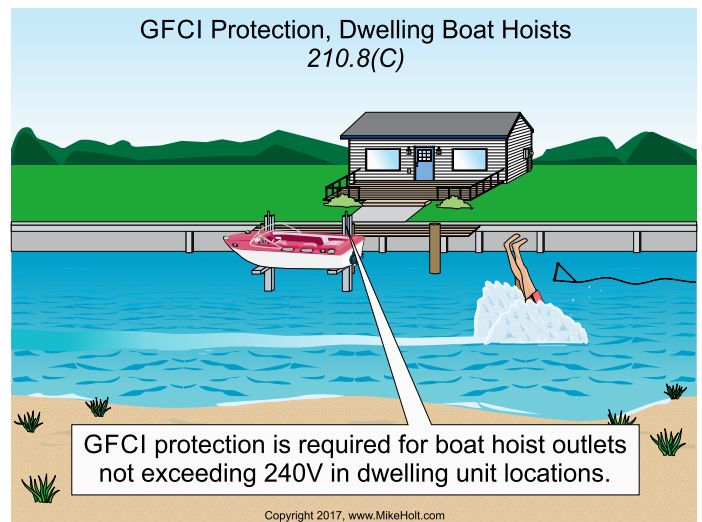
►Figure 210–40

Author's Comment:

- A garage is defined in article 100 as building or portion of a building in which one or more self-propelled vehicles can be kept for use, sale, storage, rental, repair, exhibition, or demonstration.

(10) Unfinished Portions of Basements. GFCI protection is required for receptacles located in the unfinished portions of a basement.

(C) Boat Hoist—Dwelling Unit. GFCI protection is required for boat hoist outlets not exceeding 240V in dwelling unit locations. ►Figure 210–41



►Figure 210–41

(D) Dishwasher—Dwelling Unit. GFCI protection is required for outlets supplying dishwashers in a dwelling unit. ▶Figure 210–42



▶Figure 210–42

(E) Crawl Space Lighting Outlets—Dwelling. GFCI protection is required for 120V lighting outlets in crawl spaces in dwelling units.

210.12 Arc-Fault Circuit-Interrupter Protection

Arc-fault circuit-interrupter protection must be provided in accordance with 210.12(A), (B), (C), and (D). AFCI devices must be installed in readily accessible locations.

(A) Required Locations. A listed combination AFCI breaker is required for all 15A or 20A, 120V branch circuits in dwelling units supplying outlets or devices in kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas. ▶Figure 210–53

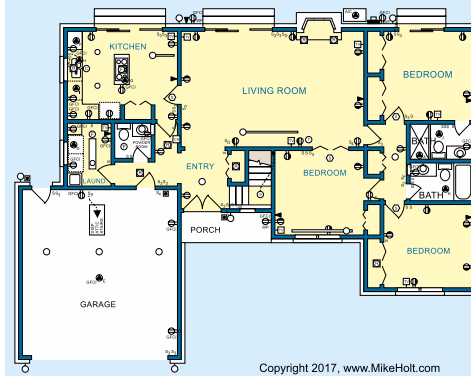
(B) Dormitory Units. A listed combination AFCI breaker is required for all 15A or 20A, 120V branch circuits for outlets and devices in dormitory unit bedrooms, living rooms, hallways, closets, bathrooms, and similar rooms in accordance with 210.12(A).

(C) Guest Rooms and Guest Suites. A listed combination AFCI breaker is required for all 15A or 20A, 120V branch circuits supplying outlets and devices in guest rooms and guest suites of hotels and motels.

▶Figure 210–54

AFCI Protection for Dwelling Units, Where Required 210.12(A)

15A and 20A, 120V branch circuits supplying outlets or devices in the following locations require AFCI protection:



- Bedrooms
- Closets
- Dens
- Dining Rooms
- Family Rooms
- Hallways
- Kitchens
- Laundry Areas
- Libraries
- Living Rooms
- Parlors
- Rec Rooms
- Sunrooms
- Similar Areas

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▶Figure 210–53

AFCI Protection, Guest Rooms and Guest Suites 210.12(C)



▶Figure 210–54

(D) Branch-Circuit Extensions or Modifications in Dwelling Units and Dormitory Units. Where 15A or 20A, 120V branch-circuit wiring is modified, replaced, or extended in a dwelling unit or dormitory where AFCI protection is required [210.12(A)], the modified, replaced, or extended branch-circuit wiring must be AFCI protected by one of the following methods:

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

Ex: AFCI protection isn't required for extension wiring that's less than 6 ft in length if no outlets or devices are added.

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