



Mike Holt's Illustrated Guide to

Understanding the NEC® Requirements for GFCI and AFCI

*Extracted from Mike Holt's Illustrated Guide to
Understanding the National Electrical Code, Volume 1*



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GFCI Protection

(A) Dwelling Units. GFCI protection is required for all 15A and 20A, 125V receptacles located in the following locations of a dwelling unit:

Author's Comment: See the definitions of GFCI and Dwelling Unit in Article 100.

(1) Bathroom Area. GFCI protection is required for all 15A and 20A, 125V receptacles in the bathroom area of a dwelling unit. **Figure 210-11**

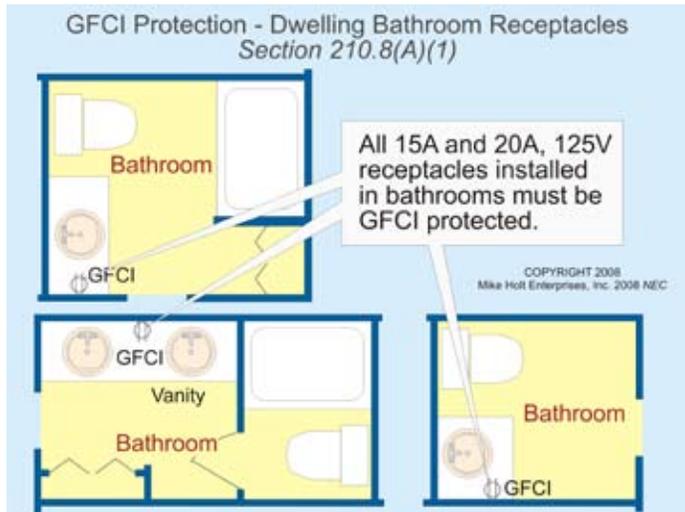


Figure 210-11

Author's Comments:

- See the definition of "Bathroom" in Article 100.
- In the continued interests of safety, proposals to allow receptacles for dedicated equipment in the bathroom area to be exempted from the GFCI protection requirements have been rejected.

(2) Garages and Accessory Buildings. GFCI protection is required for all 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 210-12**

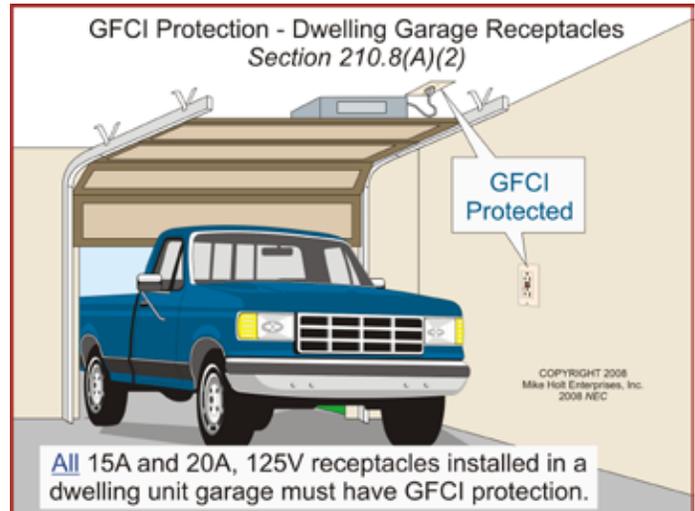


Figure 210-12

Author's Comments:

- See the definition of "Garage" in Article 100.
- A receptacle outlet is required in a dwelling unit attached garage [210.52(G)], 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 210-13**



Figure 210-13

(3) Outdoors. All 15A and 20A, 125V receptacles located outdoors of dwelling units, including receptacles installed under the eaves of roofs, must be GFCI protected. **Figure 210-14**



Figure 210-14

Author's Comments:

- 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 over 20 sq ft 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)].

Exception: GFCI protection isn't required for a fixed electric snow-melting or deicing equipment receptacle supplied by a dedicated branch circuit, if the receptacle isn't readily accessible and the equipment or receptacle has ground-fault protection of equipment (GFPE) [426.28]. **Figure 210-15**

(4) Crawl Spaces. All 15A and 20A, 125V receptacles installed in crawl spaces at or below grade of a dwelling unit must be GFCI protected.

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 Basements. GFCI protection is required for all 15A and 20A, 125V receptacles located in the unfinished portion of a basement not intended as a habitable room and limited to storage and work areas. **Figure 210-16**



Figure 210-15

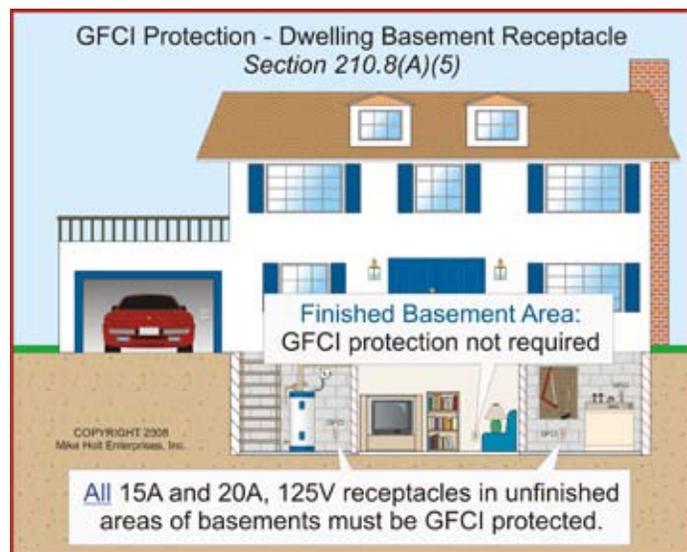


Figure 210-16

Exception: A receptacle supplying only a permanently installed fire alarm or burglar alarm system is not 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)].

(6) Kitchen Countertop Surfaces. GFCI protection is required for all 15A and 20A, 125V receptacles that serve countertop surfaces in a dwelling unit. **Figure 210-17**

Author's Comments:

- GFCI protection is required for all receptacles that serve countertop surfaces. But GFCI protection isn't required for

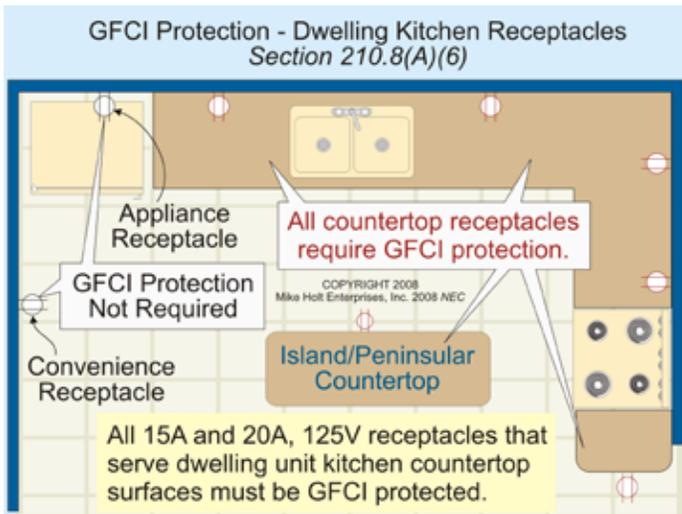


Figure 210-17

receptacles that serve built-in appliances, such as dishwashers or kitchen waste disposals.

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

(7) Laundry, Utility, and Wet Bar Sinks. GFCI protection is required for all 15A and 20A, 125V receptacles located within an arc measurement of 6 ft from the sink. **Figures 210-18 and 210-19**

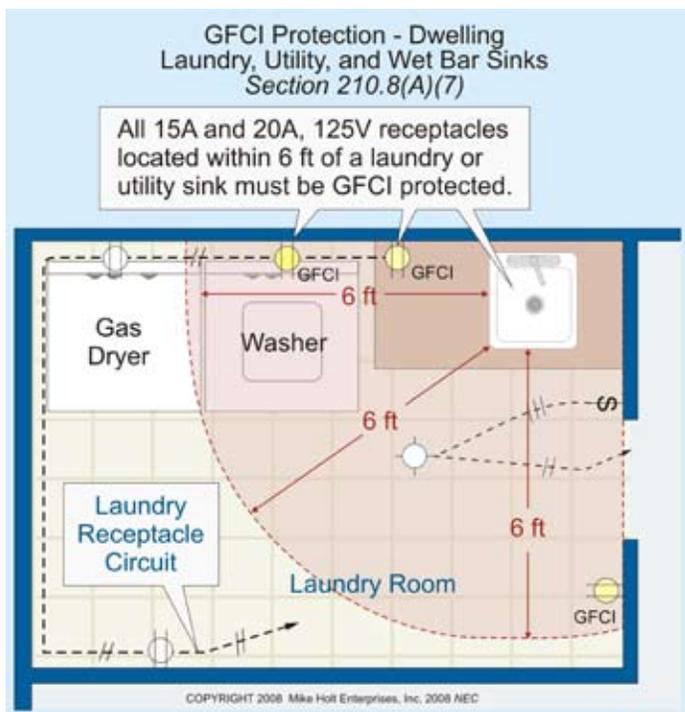


Figure 210-18

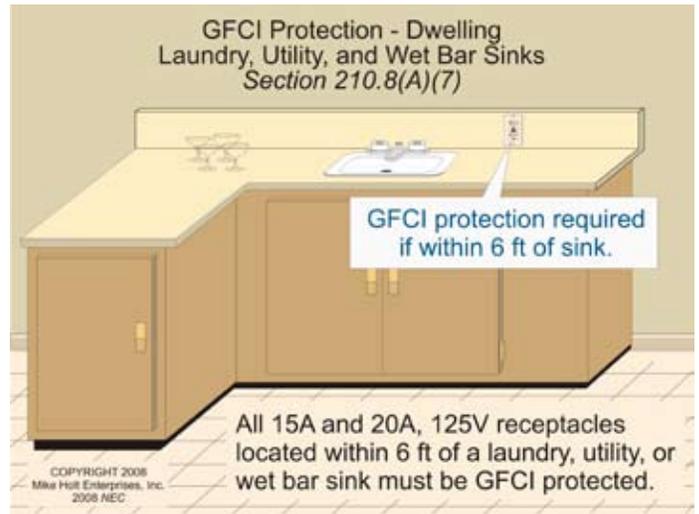


Figure 210-19

(8) Boathouses. GFCI protection is required for all 15A and 20A, 125V receptacles located in a dwelling unit boathouse. **Figure 210-20**



Figure 210-20

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.

(B) Other than Dwelling Units. GFCI protection is required for all 15A and 20A, 125V receptacles installed in the following commercial/industrial locations:

(1) Bathrooms. All 15A and 20A, 125V receptacles installed in commercial or industrial bathrooms must be GFCI protected. **Figure 210-21**



Figure 210-21

Author's Comments:

- See the definition of a “Bathroom” in Article 100.
- A 15A or 20A, 125V receptacle isn't required in a commercial or industrial bathroom, but if one is installed, it must be GFCI protected.

(2) Kitchens. All 15A and 20A, 125V receptacles installed in an area with a sink and permanent facilities for food preparation and cooking [Article 100], even those that don't supply the countertop surface, must be GFCI protected. **Figure 210-22**

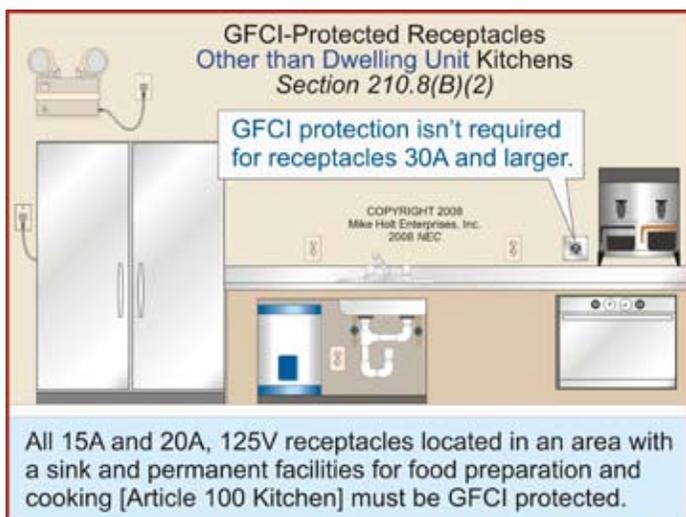


Figure 210-22

Author's Comments:

- GFCI protection is not required for receptacles rated other than 15A and 20A, 125V in these locations.
- GFCI protection is not required for hard-wired equipment in these locations.

(3) Rooftops. All 15A and 20A, 125V receptacles installed on rooftops must be GFCI protected. **Figure 210-23**



Figure 210-23

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].

Exception: GFCI protection isn't required for a fixed electric snow-melting or deicing equipment receptacle that isn't readily accessible [426.28].

(4) Outdoors. All 15A and 20A, 125V receptacles installed outdoors must be GFCI protected. **Figure 210-24**

Exception No. 1 to (3) and (4): GFCI protection isn't required for a fixed electric snow-melting or deicing equipment receptacle supplied by a dedicated branch circuit, if the receptacle isn't readily accessible and the equipment or receptacle has ground-fault protection of equipment (GFPE) [426.28].

(5) Sinks. All 15A and 20A, 125V receptacles installed within 6 ft of the outside edge of a sink must be GFCI protected. **Figure 210-25**

(C) Boat Hoists. GFCI protection is required for outlets not exceeding 240 volts that supply boat hoists in dwelling unit locations. **Figure 210-26**

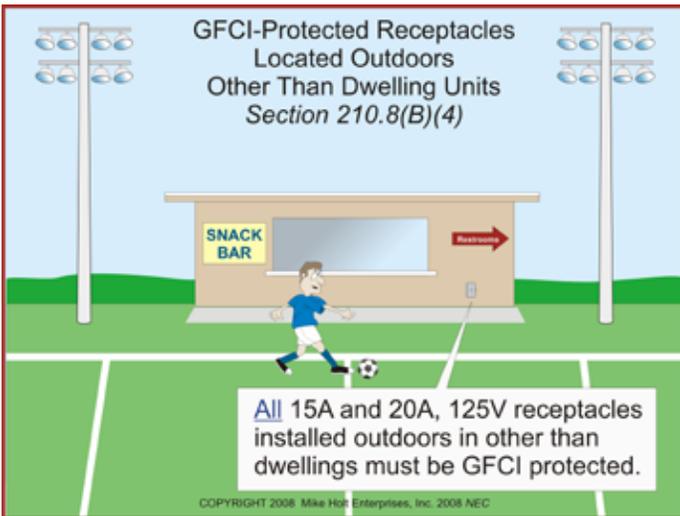


Figure 210-24

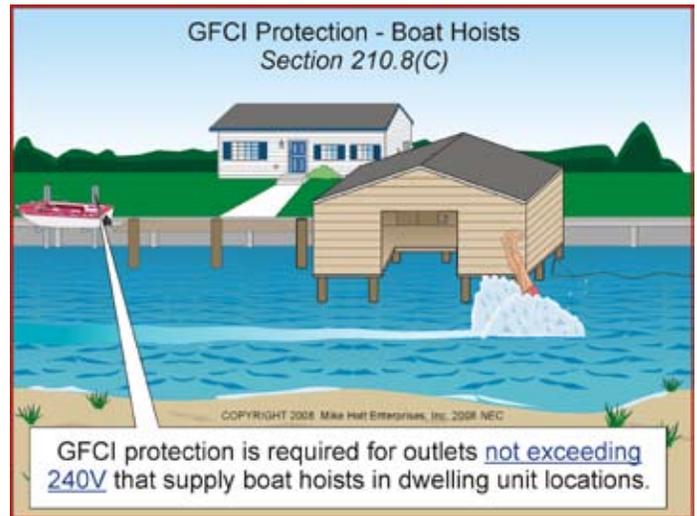


Figure 210-26

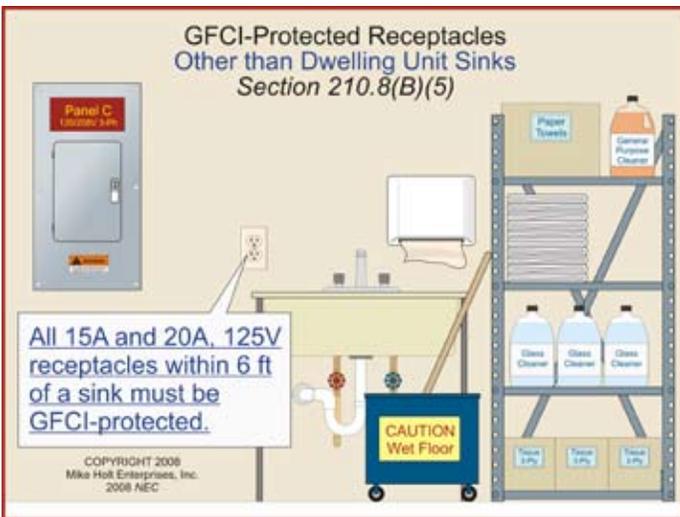


Figure 210-25

Author's Comments:

- See the definition of "Outlet" in Article 100.
- This ensures GFCI protection regardless of whether the boat hoist is cord-and-plug-connected or hard-wired.

AFCI Protection

(A) AFCI Definition. An arc-fault circuit interrupter is a device intended to de-energize the circuit when it detects the current waveform characteristics unique to an arcing fault.

Figures 210–34 and 210–35

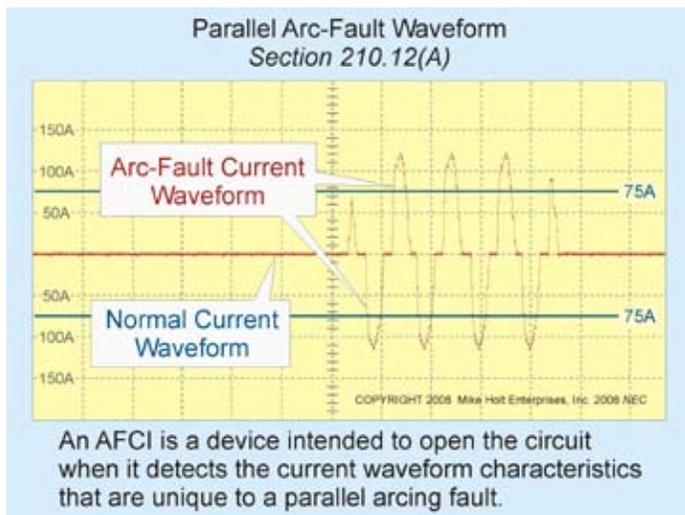


Figure 210–34

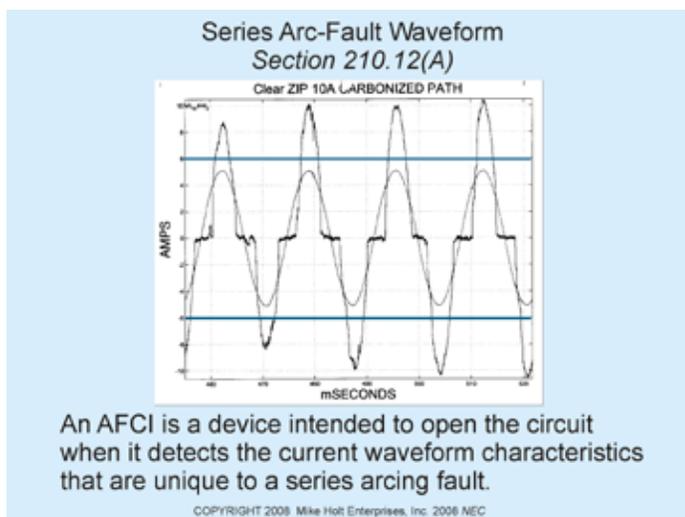


Figure 210–35

(B) Dwelling Unit Circuits. All 15A or 20A, 120V branch circuits in dwelling units supplying outlets in family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas must be protected by a listed AFCI device of the combination type. Figure 210–36

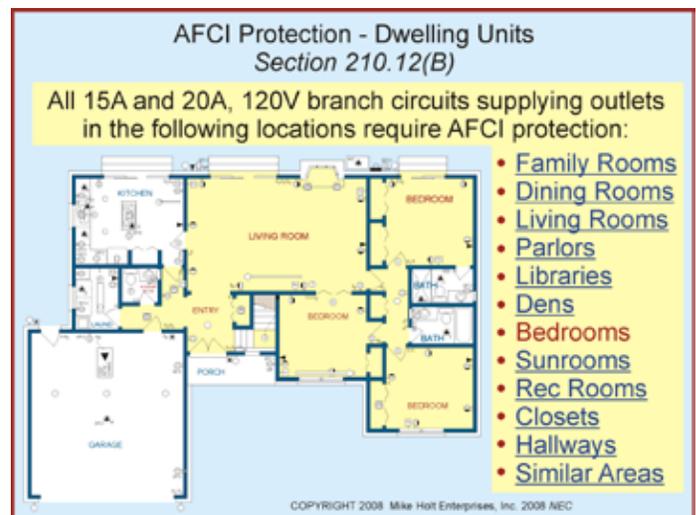


Figure 210–36

Author's Comment: The 120V circuit limitation means AFCI protection isn't required for equipment rated 230V, such as a baseboard heater or room air conditioner. For more information, visit www.MikeHolt.com, click on the "Search" link, and search for "AFCI."

FPN No. 3: See 760.41(B) and 760.121(B) for power-supply requirements for fire alarm systems.

Author's Comment: Smoke alarms connected to a 15A or 20A circuit of a dwelling unit must be AFCI protected if the smoke alarm is located in one of the areas specified in 210.12(B). The exemption from AFCI protection for the "fire alarm circuit" contained in 760.41(B) and 760.121(B) doesn't apply to the single- or multiple-station smoke alarm circuit typically installed in

dwelling unit bedroom areas. This is because a smoke alarm circuit isn't a fire alarm circuit as defined in NFPA 72, *National Fire Alarm Code*. Unlike single- or multiple-station smoke alarms, fire alarm systems are managed by a fire alarm control panel.

Figure 210-37

Exception No. 1: The AFCI protection can be located at the first outlet if the circuit conductors are installed in RMC, IMC, EMT or steel armored Type AC cable, and the AFCI device is contained in a metal outlet or junction box.

Exception No. 2: AFCI protection can be omitted for branch-circuit wiring to a fire alarm system in accordance with 760.41(B) and 760.121(B), if the circuit conductors are installed in RMC, IMC, EMT, or steel armored Type AC cable.

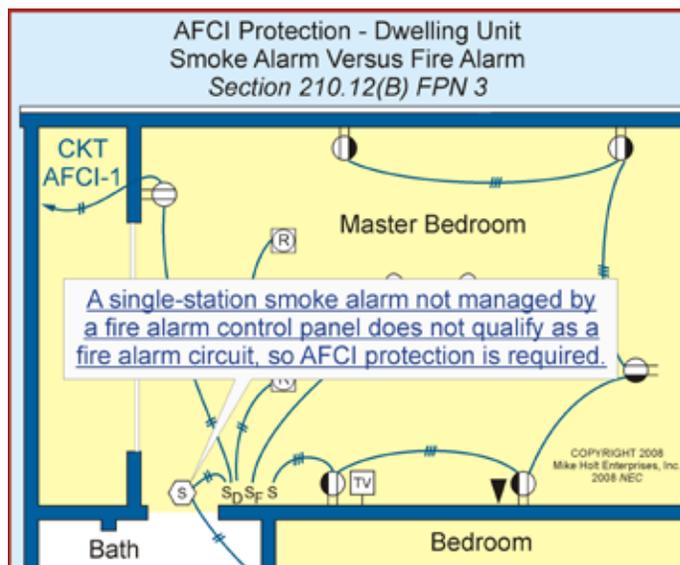


Figure 210-37