

# CHAPTER TWO

## WIRING and PROTECTION



**Article 210**



**210.8**



The GFCI requirements in Section 210.8 will be updated in 2023 as they have for the last several cycles. **GFCI protection** is required to be listed.

**210.8(A) Dwelling Units.**

- (1) Bathrooms
- (2) Garages and also accessory buildings that have a floor located at or below grade level not intended as habitable rooms and limited to storage areas, work areas, and areas of similar use.
- (3) Outdoors
- (4) Crawl spaces - at or below grade level
- (5) Basements
- (6) Kitchens
- (7) Areas with sinks and permanent provisions for food preparation, beverage preparation, or cooking**
- (8) Sinks - where receptacles are installed within 6 feet from the top inside edge of the bowl of the sink
- (9) Boathouses
- (10) Bathtub or shower stall
- (11) Laundry area
- (12) Indoor damp and wet locations

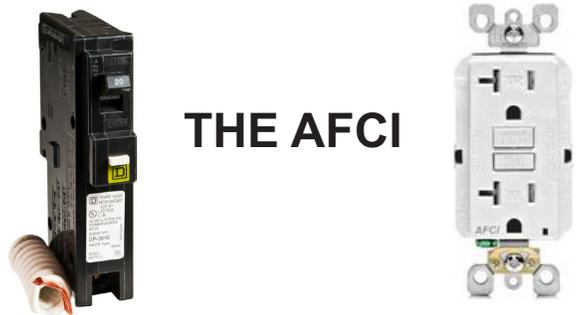


**210.8(B) Other Than Dwelling Units.**

- (1) Bathrooms
- (2) Kitchens**
- (3) Areas with sinks and permanent provisions for food preparation, beverage preparation, or cooking
- (4) Buffet serving areas with permanent provisions for food serving, beverage serving, or cooking**
- (5) Rooftops
- (6) Outdoors
- (7) Sinks **where receptacles or cord-and-plug-connected fixed or stationary appliances** are installed within 6 feet from the top inside edge of the bowl of the sink
- (8) Indoor damp or wet locations
- (9) Locker rooms with associated showering facilities
- (10) Garages, accessory buildings, service bays, and similar areas other than vehicle exhibition halls and showrooms
- (11) Crawl spaces at or below grade level
- (12) Unfinished areas of basements
- (13) Aquariums, bait wells, and similar open aquatic vessels or containers, such as tanks or bowls where receptacles are installed within 6 feet from the top inside edge or rim or from conductive support framing of the vessel or container**
- (14) Laundry areas
- (15) Bathtubs and shower stalls where receptacles are within 6' of the outside edge

**210.8(D) Specific Appliances.**

- (1) Automotive vacuum machines**
- (2) Drinking water coolers and bottle fill stations**
- (3) High-pressure spray washing machines**
- (4) Tire inflation machines**
- (5) Vending machines**
- (6) Sump pumps**
- (7) Dishwashers**
- (8) Electric ranges**
- (9) Wall-mounted ovens**
- (10) Counter-mounted cooking units**
- (11) Clothes dryers**
- (12) Microwave ovens**



**New Requirements 210.12(D):** AFCI for Fire Houses, Police Stations, Etc.



New requirements to require arc-fault circuit interrupter (AFCI) protection for sleeping quarters in firehouses, rescue squads, police departments, and similar locations. These locations present similar hazards regarding electrical fires on branch circuits as a dormitory unit. Even though these areas in a fire station, police departments, etc., are not defined as a dormitory, these locations present similar hazards regarding electrical fires on these circuits.

Dormitories were added requiring AFCI protection in the 2014 NEC revision cycle.

**New Requirements 210.17:** Guest Rooms and Guest Suites



210.17 was modified to include **assisted living facilities** that were provided with a permanent means for cooking requiring them to have their branch circuits installed per the requirements for dwelling unit.

**New Requirements 210.18 Branch Circuit Ratings**

The rating for other than individual branch circuits shall be **10**, 15, 20, 30, 40, and 50 amperes.

Exception 2: Branch circuits rated **10** amperes shall not supply receptacle outlets.

### New Requirements 210.19: Conductors - Minimum Ampacity and Size



Branch circuit conductors for circuits not exceeding 1000 volts ac or 1500 volts dc shall be sized in accordance with 210.19(A) through (D).

New Article 235 language was added at 210.19 stating that the section applies to not more than 1000 volts ac or 1500 volts dc and **Article 235 will apply to voltages over 1000 volts ac or 1500 volts dc.**

### New Requirements 210.23(A) **10** Ampere Branch Circuits.

(A) A **10** ampere branch circuits shall comply with the requirements of 210.23(A)(1) and (A)(2).

#### (A)(1). **Loads Permitted for 10 Ampere Branch circuits.**

A **10** ampere branch circuit shall be permitted to supply one or more of the following:

- (1) Lighting outlets
- (2) Dwelling unit exhaust fans on bathroom or laundry lighting circuits
- (3) A gas fireplace unit supplied by an individual branch circuit

The substantiation for the change is the application of energy-efficient equipment, and the implementation of energy codes for modern construction, more options are available for reduced branch circuit loading.

### Technical Substantiation

#### Building Energy Codes



The application of energy efficient equipment and the implementation of Energy Codes for modern construction, provides more options for reduced branch circuit loading.

The result is that many branch circuits are capable of having a conductor current rating and overcurrent device rating of **10**-Amperes.

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These new requirements establish permission to allow **10**-ampere branch circuits for such things as lighting outlets and dwelling unit exhaust fans. Adopted energy code(s) and energy efficiencies, in general, are bringing forward the applications of **10**-ampere branch circuits for loads such as LED lighting and specific equipment. Loads not permitted on these **10**-ampere branch circuits would be receptacle outlets, fixed appliances (*except as permitted for individual branch circuits*), garage door openers, and laundry equipment.

### Technical Substantiation

The application of energy efficient equipment and the implementation of Energy Codes for modern construction, provides more options for reduced branch circuit loading. The result is that many branch circuits are capable of having a conductor current rating and overcurrent device rating of **10**-Amperes. For example, a typical 75-watt equivalent LED lamp has a load rating of 12 watts. At 120 volts, this is a load of 0.1 amps per lamp. A continuously loaded **10**-ampere branch circuit for fixed lighting would be allowed to have 8 amps of load current, which would equate to 80 of these LED lamps. This is more lamps than found in a typical 2000 square foot home. Other examples are specific limited loads such as fire or burglar alarm panels, kitchen instant hot water dispensers, attic exhaust fans, and others. These specific loads on individual branch circuits only need one or a few amperes and could safely be installed on a **10**-Ampere branch circuit. These lighting and specific appliance applications exist in both dwelling unit as well as commercial and industrial installations.



For example, a typical 75-watt equivalent LED lamp has a load rating of 12 watts. At 120 volts, this is a load of **0.1 amps** per lamp. A continuously loaded 10-ampere branch circuit for fixed lighting would be allowed to have 8 amps of load current, which would equate to 80 of these LED lamps.

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These specific loads on individual branch circuits only need one or a few amperes and could safely be installed on a **10**-Ampere branch circuit. These lighting and specific appliance applications exist in both dwelling units as well as commercial and industrial installations.

There are cases today where equipment is being protected by a 15-Ampere circuit breaker, whereas a **10**-Ampere overcurrent device and using 14 AWG Copper-Clad Aluminum conductors would provide a safe level of protection.

•The following are possible applications considered for 14 AWG copper-clad aluminum assuming an ampacity of 10 Amps at 60°C with a **10**-Amp branch circuit breaker or fuse as the OCPD.



\***Residential exhaust fans** on lighting circuit in bathroom, laundry or other room where **no receptacles are installed on the circuit**

••*The average bathroom fan uses right around 36 watts of energy. Thirty-six watts also translates to 120 volts and 0.3 amps, which is the average size and power usage of most residential bathroom fans.*



\***Gas fireplace igniter and fan** on **individual** branch circuit

••*Most blowers operate around .80-.90 amps or 100 watts.*



\***Gas furnace igniter and fan** on **individual** branch circuit

••*Typically, a standard blower fan needs on average 400 watts of electricity.*



\***Fire and/or burglar alarm** on **individual** branch circuit

••*Most alarm panels will use a 12 to 24 volt transformer rated for 40VA. Think of this as 40 watts.*

\***Maximum 1/3 horsepower sump pump** on **individual** branch circuit

••*A 1/3 hp sump pump has a running amperage of 3.7amp.*

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\***Maximum 1/3 horsepower whole house attic fan on individual branch circuit**

••*On average, an attic fan uses less than 300 watts of electricity.*



\***Septic tank ejector or habitable motor on individual branch circuit**

••*120VAC, 60 Hz, 1.4A, 86 Watts. So the pump is going to draw 86 watts in continuous operation.*

•Where there are possible applications, there are also needed **limitations**. The following are to be set as **limitations** elsewhere in the Code as uses not permitted except as specifically allowed in the list with stated conditions.



\*Prohibited for any circuits with multiple receptacles. Receptacles permitted only on individual branch circuits to specified loads



\*Supplying fixed appliances



\*Supplying garage door opener



\*Supplying laundry equipment

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•Applications in **other than dwelling** branch circuits using 14 AWG THHN/THWN individual conductors with applicable ampacities from Table 310.16, in raceway, wireway, gutter, or in cable; MC, NMB, AC, TC cable assemblies.



\*Small motors 1-phase or 3-phase less than 8 Amp FLA by motor tables



\*Small motors 1-phase or 3-phase less than 12 Amp FLA by motor tables and all terminals identified for 75°C



\* Lighting circuits with LED – store window, display, and general lighting



\*Control and signaling limited to 10 Amps. This is already allowed with a change to the 2020 NEC for TC and MC cables, but did not include any ampacity ratings to be applied

### Summary

#### Building Energy Codes



New Building Codes Initiative will boost resilience to the impacts of climate change, lower utility bills for homes and businesses.

Instituting updated energy codes allows new construction to better align with current energy efficiency and climate priorities.

Energy codes are just one of many building codes, such as fire, electrical, structural, or plumbing. Energy codes are different than appliance and equipment standards. Energy codes cover the building itself—for example, the walls/floors/ceiling insulation, windows, air leakage, and duct leakage.

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Modern building energy codes are critical to lowering energy bills for homes and businesses, reducing greenhouse gas emissions. States and local governments adopt and enforce these energy codes.

- \*Residential exhaust fans **on lighting circuit in bathroom, laundry or other room** where **no receptacles are installed on the circuit**
- \*Gas fireplace igniter and fan on **individual** branch circuit
- \*Gas furnace igniter and fan on **individual** branch circuit
- \*Maximum 1/3 horsepower sump pump on **individual** branch circuit
- \*Maximum 1/3 horsepower whole house attic fan on **individual** branch circuit
- \*Septic tank ejector or habitable motor on **individual** branch circuit

The home doesn't have septic tank, attic fan, sump pump, or a gas furnace. It will have an alarm system, a kitchen instant hot water dispenser @ 750-watt, 1/2-gallon tank will produce up to 60 cups of hot water per hour and a ceiling fan that consume less than 26 watts.



- \*Alarm system on **individual** branch circuit



- \*Kitchen instant hot water dispenser on **individual** branch circuit



- \*Low wattage ceiling fan on **individual** branch circuit

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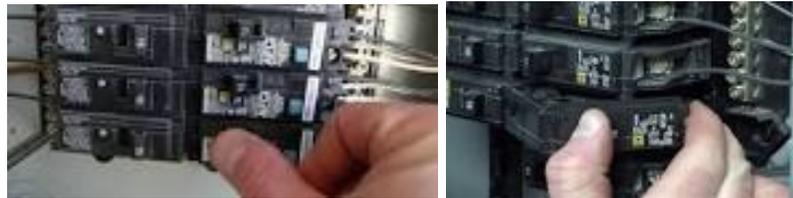
If the home had a septic tank, attic fan, sump pump, and a gas furnace, 8 additional **individual 10** amp circuits with AFCI circuit breakers and **no receptacles** on any circuit would add to the panel.



Arc fault breakers are similar in size to regular circuit breakers.

Can you replace an arc fault breaker with a regular breaker?

Yes, you can. The regular circuit breaker can fit the panel of your old Arc fault breaker.



The AFCI breaker costs around \$29, the regular breaker around \$7.

A 30 amp regular circuit breaker can fit into the slot where the 10 amp breaker was so there is no means of safeguarding against inserting the wrong breaker sized at 30 amps to replace a 10 amp breaker connected to a #14 AWG conductor.



The electrical inspector would be required to check each *new energy efficient circuit* to make sure **no receptacles** are in the wiring to follow the NEC rules.



### Incorrect Alterations

Another cause of a residential wiring fire is incorrect alterations or changes to the electrical system. This may occur when a non-professional is **installing or altering** the electrical system in a residence.

Oftentimes, the work completed by a non-professional does not meet the safety code requirements of the National Electrical Code



This happens **everyday** as the do-it-yourself hardware stores encourage a person to do their own paddle fan, wire, light fixture, receptacle, etc. installation. You can turn your home into a horror chamber in less than an hour.

The **store clerk will even teach you** to become an electrician in 20 minutes. And no one will ever know (which includes the company holding your homeowner's insurance policy) until the fire department comes and an investigation is started and guess what? Now, the jury will decide.

### New Requirements 210.70(A)(1)



**210.70(A)(1).** At least one lighting outlet controlled by a listed wall-mounted control device shall be installed in every habitable room, kitchen, **laundry area**, and bathroom.