Instructor: L. Keith Lofland

- IAEI - Director of Education, Codes & Standards
- Former Chief Electrical Inspector- Garland, TX
- Member: NEC CMP 9
- Member: UL Electrical Council
- Principal Author – IAEI’s One- and Two-Family Dwelling Electrical Systems
- Certified Electrical Inspector- IAEI, ICC, IAEI/NFPA
- Master and Journeyman Electrician
- Former Secretary/Treasurer- Texas Chapter IAEI
- International Instructor – IAEI

Presentation based on IAEI’s One- and Two-Family Dwelling Electrical Systems, 9th edition textbook

This textbook is based on the requirements contained in 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.

- **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.”
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)

Feeder or sub-panelboard

Feeder not required to be larger than SE conductors

Typical loads to swimming pool, outbuildings, water pumps, etc.

Service equipment

50% of SE Conductors

Air-conditioner or heat pump

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

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

Service-entrance conductors

Main power feeder

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

Service disconnect

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 2/0 AWG Al meets this rating at 75°C (167°F)

Reproduction of Example D7 of Informational Annex D of the NEC
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

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
250.50 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

13 mm (1/2 in.) reinforcing bars (typical)

Minimum 6.0 m (20 ft)

Side View

Clamp suitable for concrete encasement or exothermic weld

4 AWG copper conductor
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

Bathrooms
Garages and Accessory Buildings
Outdoors
Crawl Spaces
Unfinished Basements
Kitchens
Sinks
Boathouses
Bathtub and Shower Stalls
Laundry Areas
Boat Hoists
Dishwashers
Swimming Pools and Similar Installations

(Note: See Chapter 14 for additional information)
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
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
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**: 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 fixture"
210.8(A)(2) GFCI Protection in Garages

1. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in dwelling unit garages require GFCI protection.

2. Dryer receptacles would not require GFCI protection (typically rated at 240-volt, 30-ampere).

Garage and grade-level portions of accessory buildings.

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).
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

GFCI protection not required if receptacles do not serve countertop surfaces and are not located within 1.8 m (6 ft) of any sink.

Receptacle outlets that serve countertop surfaces require GFCI protection for personnel.
210.8(A)(7) GFCI Required at 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)(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 area (with or without a sink present).
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.

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
  - living rooms
  - dens
  - recreation rooms
  - laundry areas
  - family rooms
  - parlors
  - bedrooms
  - closets
  - similar rooms or areas
  - dining rooms
  - libraries
  - sun rooms
  - hallways
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-family smoke alarms).

AFCI Circuit Breaker – Cut-A-Way View

Latch Lever
AFCI Test Button
AFCI Detection Circuitry
Load Terminal (Line)
Load Terminal (Neutral Conductor)
Line Terminal
Contacts
Trip Mechanism
"Pigtails" Connection to Panelboard Grounded Terminal Bar

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/Leviton
Courtesy of Eaton Corporation
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. **Branch-circuit panelboard**
   - Type NM cable
   - Combination AFCI circuit breaker
   - **Not Now** [was 210.12(A)]

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

---

2. **Branch-circuit panelboard**
   - Type NM cable
   - **Now**

   - OBC type AFCI device
   - (Outlet marked to indicate it is the first outlet)

   (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):

1. Branch-circuit panelboard
2. Type NM cable
3. OBC type AFCI device (Outlet marked to indicate it is the first outlet)
4. Listed branch circuit OCPD (circuit breaker or fuse)
5. Listed branch circuit OCPD (circuit breaker or fuse)
6. (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.

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).

(4) System Combination Type AFCI. A listed outlet branch circuit type AFCI installed at the first outlet in combination with a listed branch circuit overcurrent 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 OCPO (circuit breaker or fuse)
- Combination AFCI detects both parallel and series arc faults

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 OCPO 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

Type AC or MC cable
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.
Power-Limited Fire Alarm (PLFA) Circuits

AFCI Protection Required? - NO (760.41)

Combination Type AFCI

Branch Circuit/Feeder Type AFCI
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
  - Family rooms
  - Dining rooms
  - Living rooms
  - Parlor
  - Libraries
  - Dens
  - Sunrooms
  - Bedroms
  - Recreation rooms
  - Bathrooms
  - Outdoors
  - Laundry areas
  - Basements
  - Garages
  - Accessory buildings
  - Hallways
  - Foyer

*Similar rooms or areas of dwelling units*
Tamper-resistant receptacles are available in a wide variety of models for various applications.

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)(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)
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.

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

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.

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

Exhaust hoods not permitted

Power for electric clock permitted

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)]

**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.)
- Outlet within 600 mm (24 in. if X ≤ 300 mm (12 in.)
- Outlet not required

Sink or range extending from face of counter
210.52(C)(5) Receptacle Outlet Locations

Receptacle outlets shall be installed on or above the countertop. Not permitted face-up in work surface or countertop. Receptacle outlet assemblies listed for the application shall be permitted to be installed in countertops.

20 in.

> 6 in.
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)

One receptacle centered between the basins and within 900 mm (3 ft) of each basin (sink) is permitted as well.
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)(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.
Outlet no longer required to be installed "within the perimeter of the balcony, deck or porch."

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)

Diagram showing the placement of outlets and circuits related to laundry equipment.
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.

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 separate 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.

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.
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.

Doors, 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

Stairway lighting controlled by switch at each level for stairways with six risers or more.

Switch required at landing levels that include an entry at the landing level.
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)
Wiring Methods

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

Nail plates listed and marked

Nail plates less than 1.6 mm (1/16 in.) permitted if listed and marked

300.4(A)(1) and (A)(2) Cable Protection

Protective steel plates to cover the entire area of the wiring

Less than 32 mm (1/4 in.)

Bored holes in wood
Notches in wood
Protective plates

Appropriate length and width protection required
Need Metal Nail Protectors?

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 caulkling 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

Note: 310.15(A)(2) Exception is not applicable
Table 310.15(B)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors

<table>
<thead>
<tr>
<th>Number of Conductors</th>
<th>Percent of Values in Tables 310.15(B)(15) through 310.15(B)(19) as Adjusted for Ambient Temperature if Necessary</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-6</td>
<td>80</td>
</tr>
<tr>
<td>7-9</td>
<td>70</td>
</tr>
<tr>
<td>10-20</td>
<td>50</td>
</tr>
<tr>
<td>21-30</td>
<td>45</td>
</tr>
<tr>
<td>31-40</td>
<td>40</td>
</tr>
<tr>
<td>41 and above</td>
<td>35</td>
</tr>
</tbody>
</table>

1Number 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

Cable ties permitted for securing cable

Protection for cable if less than 32 mm (1½ in.)

Maintain minimum radius at bends in Type NM cables (not less than five times the diameter of the cable)

Cables considered to be supported by holes through wooden joists, rafter, or studs