

# Top Ten Changes to the



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The National Electrical Code (NEC) is updated every three years. Otherwise known as NFPA Chapter 70, the NEC has been published since 1897 and is responsible for continuously improving the safety of those who install electrical devices and the quality of work for those that use electricity (essentially, everyone).

NEC 2011, the latest edition, continues this tradition. This article is meant for electrical professionals, new and experienced alike, who are preparing for the inevitable transition away from NEC 2008 by the electrical industry. Using new NEC 2011 excerpts, my goal is to focus on the main areas of change and provide commentary for the changes involved..

The key to reading this article is to have your NEC 2011 Code book next to you. I have no interest in plagiarizing the entire Code so I simply have re-printed the areas of the Code where the changes occur so that you can flip to that page and see for yourself the entire context of the changes.

**Reading Key:**

 = Areas of the code that have been revised or are new from NEC 2008.

***My take:...*** = My analysis or interpretation of what the change is and/or why it was added.

***(No Change from NEC 2008)*** = This note is entered for reference only as the exact section specified is the same in the 2011 edition as it is in the 2008 edition. It does not literally say “No Change from NEC 2008”.

Take all the time you need to read this article as it contains the vast majority of the changes to NEC 2011 (the others are minor grammatical adjustments). Although most AHJ's (authority having jurisdiction) have not adopted the NEC 2011 yet, you will be better prepared for it after reading this article.

# 1. Grounding

***My take: Article 250 contains significant changes from the NEC 2008, with a heavy emphasis on grounding in separately derived systems. The Code tries to clarify throughout Article 250 that grounding and bonding are directly related and are not two different concepts. And with the numerous additions to section 690.47, the NEC 2011 is providing guidance for grounding on both the ac and dc side of the inverter for Solar PV systems.***

## **250.2 Definitions**

**Bonding Jumper, Supply-Side.** A conductor installed on the supply side of a service or within a service equipment enclosure(s), or for a separately derived system, that ensures the required electrical conductivity between metal parts required to be electrically connected.

## **250.30 Grounding Separately Derived Alternating-Current Systems**

In addition to complying with 250.30(A) for grounded systems, or as provided in 250.30(B) for ungrounded systems, separately derived systems shall comply with 250.20, 250.21, 250.22, and 250.26.

Informational Note No. 1: An alternate ac power source, such as an on-site generator, is not a separately derived system if the grounded conductor is solidly interconnected to a service-supplied system grounded conductor. An example of such a situation is where alternate source transfer equipment does not include a switching action in the grounded conductor and allows it to remain solidly connected to the service-supplied grounded conductor when the alternate source is operational and supply the load served.

Informational Note No. 2: See 445.13 for the minimum size of conductors that carry fault current.

***My take: The notes are added to clarify the requirements of grounding for separately derived systems. There's not much new except that the Code is clarifying code sections that apply to separately derived systems and that a solidly connected neutral means a generator is not a separately derived system.***

**(A) Grounded Systems.** A separately derived ac system that is grounded shall comply with 250.30(A) (1) through (A)(8). Except as otherwise permitted in this article, a grounded conductor shall not be connected to normally non-current-carrying metal parts of equipment, be connected to equipment grounding conductors, or be reconnected to ground on the load side of the system bonding jumper.

Informational Note: See 250.32 for connections at separate buildings or structures, and 250.142 for use of the grounded circuit conductor for grounding equipment.

*Exception: Impedance grounded neutral system grounding connections shall be made as specified in 250.36 or 250.186, as applicable.*

**(1) System Bonding Jumper.** An unspliced system bonding jumper shall comply with 250.28(A) through (D). This connection shall be made at any single point on the separately derived system from the source to the first system disconnecting means or overcurrent device, or it shall be made at the source of a separately derived system that has no disconnecting means or overcurrent devices, in accordance with 250.30(A)(1)(a) or (b). The system bonding jumper shall remain within the enclosure where it originates. If the source is located outside the building or structure supplied, a system bonding

jumper shall be installed at the grounding electrode connection in compliance with 250.30(C).

*Exception No. 1: For systems installed in accordance with 450.6, a single system bonding jumper connection to the tie point of the grounded circuit conductors from each power source shall be permitted.*

*Exception No. 2: A system bonding jumper at both the source and the first disconnecting means shall be permitted if doing so does not establish a parallel path for the grounded conductor. If a grounded conductor is used in this manner, it shall not be smaller than the size specified for the system bonding jumper but shall not be required to be larger than the ungrounded conductor(s). For the purposes of this exception, connection through the earth shall not be considered as providing a parallel path.*

*Exception No. 3: The size of the system bonding jumper for a system that supplies a Class 1, Class 2, or Class 3 circuit, and is derived from a transformer rated not more than 1000 volt-amperes, shall not be smaller than the derived ungrounded conductors and shall not be smaller than 14 AWG copper or 12 AWG aluminum.*

(a) *Installed at the Source.* The system bonding jumper shall connect the grounded conductor to the supply-side bonding jumper and the normally non-current-carrying metal enclosure.

(b) *Installed at the First Disconnecting Means.* The system bonding jumper shall connect the grounded conductor to the supply-side bonding jumper, the disconnecting means enclosure, and the equipment grounding conductor(s).

**(2) Supply-Side Bonding Jumper.** If the source of a separately derived system and the first disconnecting means are located in separate enclosures, a supply-side bonding jumper shall be installed with the circuit conductors from the source enclosure to the first disconnecting means. A supply-side bonding jumper shall not be required to be larger than the derived ungrounded conductors. The supply-side bonding jumper shall be permitted to be of nonflexible metal raceway type or of the wire or bus type as follows:

(a) A supply-side bonding jumper of the wire type shall comply with 250.102(C), based on the size of the derived ungrounded conductors.

(b) A supply-side bonding jumper of the bus type shall have a cross-sectional area not smaller than a supply-side bonding jumper of the wire type as determined in 250.102(C).

***My take: This entire section is new and provides clarification on sizing and installation of the supply-side bonding jumper. Both (a) and (b) point to 250.102 but that sections directs the reader to Table 250.66 which lists the Grounding Electrode Conductor Sizes based on the associated service entrance conductor size.***

**(3) Grounded Conductor.** If a grounded conductor is installed and the system bonding jumper connection is not located at the source, (250.30(A)(3)(a) through (A)(3)(d) shall apply.

(a) *Sizing for a Single Raceway.* The grounded conductor shall not be smaller than the required grounding electrode conductor specified in Table 250.66 but shall not be required to be larger than the largest derived ungrounded conductors larger than 100 kcmil copper or 1750 kcmil aluminum, the grounded conductor shall not be smaller than 12½ percent of the circular mil area of the largest set of derived ungrounded conductors.

(b) *Parallel Conductors in Two or More Raceways.* If the ungrounded conductors are installed in parallel in two or more raceways, the grounded conductor shall also be installed in parallel.

The size of the grounded conductor in each raceway shall be based on the total circular mil area of the parallel derived ungrounded conductors in the raceway as indicated in 250.30(A)(3)(a), but not smaller than 1/0 AWG.

Informational Note: See 310.10(H) for grounded conductors connected in parallel.

(c) *Delta-Connected System.* The grounded conductor of a 3-phase, 3-wire delta system shall have an ampacity not less than that of the ungrounded conductors.

(d) *Impedance Grounded System.* The grounded conductor of an impedance grounded neutral system shall be installed in accordance with 250.36 or 250.186, as applicable.

***My take: In this case, sizing and installation is given for the Grounded Conductor. Most people refer to this as a "neutral", though a neutral conductor and grounded conductor are not always the same thing. In any regards, this section is added to clarify the ground-fault return to the power source.***

(4) **Grounding Electrode.** The grounding electrode shall be as near as practicable to, and preferably in the same area as, the grounding electrode conductor connection to the system. The grounding electrode shall be the nearest of one of the following:

(1) Metal water pipe grounding electrode as specified in 250.52(A)(1).

(2) Structural metal grounding electrode as specified in 250.52(A)(2).

*Exception No. 1: Any of the other electrodes identified in 250.52(A) shall be used if the electrodes specified by 250.30(A)(4) are not available.*

*Exception No. 2 to (1) and (2): If a separately derived system originates in listed equipment suitable for use as service equipment, the grounding electrode used for the service or feeder equipment shall be permitted as the grounding electrode for the separately derived system.*

Informational Note No. 1: See 250.104(D) for bonding requirements for interior metal water piping in the area served by separately derived systems.

Informational Note No. 2: See 250.50 and 250.58 for requirements for bonding all electrodes together if located at the same building or structure.

***My take: This section is added to state that the Grounding Electrode (the main connection to earth) is required to be located in close proximity to the connection point of the grounding electrode conductor for a separately derived system. This can occur at the power source or the first means of disconnect.***

(5) **Grounding Electrode Conductor, Single Separately Derived System.** A grounding electrode conductor for a single separately derived system shall be sized in accordance with 250.66 for the derived ungrounded conductors. It shall be used to connect the grounded conductor of the derived system to the grounding electrode as specified in 250.30(A)(4). This connection shall be made at the same point on the separately derived system where the system bonding jumper is connected.

**(6) Grounding Electrode Conductor, Multiple Separately Derived Systems.** A common grounding electrode conductor for multiple separately derive systems shall be permitted. If installed, the common grounding electrode conductor shall be used to connect the grounded conductor of the separately derived systems to the grounding electrode as specified in 250.30(A)(4). A grounding electrode conductor tap shall then be installed from each separately derived system to the common grounding electrode conductor. Each tap conductor shall connect the grounded conductor of the separately derived system to the common grounding electrode conductor. This connection shall be made at the same point on the separately derived system where the system bonding jumper is connected.

**(a) Common Grounding Electrode Conductor .** The common grounding electrode conductor shall be permitted to be one of the following:

(1) A conductor of the wire type not smaller than 3/0 AWG copper or 250 kcmil aluminum.

(2) The metal frame of the building or structure that complies with 250.52(A)(2) or is connected to the grounding electrode system by a conductor that shall not be smaller than 3/0 AWG copper or 250 kcmil aluminum.

**(b) Tap Conductor Size.** Each tap conductor shall be sized in accordance with 250.66 based on the derived ungrounded conductors of the separately derived system it serves.

**(c) (1) A connector listed as grounding and bonding equipment.**

(2) Listed connections to aluminum or copper busbars not smaller than 6mm x 50mm (1/4in. X 2in.). If aluminum busbars are used, the installation shall comply with 250.64(A).

***My take: This new section gives guidelines for connecting multiple grounding electrode conductor taps of separately dervided systems to a common grounding electrode conductor. Sub-section (a) then gives the sizing requirements for the common grounding electrode conductor.***

**(8) Bonding, (B) Ungrounded Systems.** The equipment of an ungrounded separately derived system shall be grounded and bonded as specified in 250.30(B)(1) through (B)(3).

**(1) Grounding Electrode Conductor.** A grounding electrode conductor, sized in accordance with 250.66 for the largest derived ungrounded conductor(s) or set of derived ungrounded conductors, shall be used to connect the metal enclosures of the derived system to the grounding electrode as specified in 250.30(A)(5) or (6), as applicable. This connection shall be made at any point on the separately derived system from the source to the first system disconnecting means. If the source is located outside the building or structure supplied, a grounding electrode connection shall be made in compliance with 250.30(C).

**(2) (No Change from NEC 2008)**

**(3) Bonding Path and Conductor.** A supply-side bonding jumper shall be installed from the source of a separately derived system to the first disconnecting means in compliance with 250.30(A)(2).

***My take: For any electrical design professional, this section clarifies and adds the obvious: Any and all separately derived systems needs to be grounded and bonded.***

**(C) Outdoor Source.** If the source of the separately derived system is located outside the building or structure supplied, a grounding electrode connection shall be made at the source location to one or more grounding electrodes in compliance with 250.50. In addition, the installation shall comply with 250.30(A) for grounded systems or with 250.30(B) for ungrounded systems.

*Exception: The grounding electrode conductor connection for impedance grounded neutral systems shall comply with 250.36 or 250.186, as applicable.*

**My take: This clarification is added to the Code for generators, transformers, photovoltaic solar systems, batteries or other motors that are located outside and need to be grounded.**

### **250.32 Buildings or Structures Supplied by a Feeder(s) or Branch Circuit(s)**

**(A) (No Change from NEC 2008)**

**(B) Grounded Systems**

**(1) Supplied by a Feeder or Branch Circuit. (No Change from NEC 2008)**

*Exception: For installations made in compliance with previous editions of this Code that permitted such connection, the grounded conductor run with the supply to the building or structure shall be permitted to serve as the ground-fault return path if all of the following requirements continue to be met:*

**My take: Revisions have been made to this section's Exception to clarify "previous editions of this Code" and "ground-fault return path".**

**(2) Supplied by Separately Derived System.**

**(a) With Overcurrent Protection.** If overcurrent protection is provided where the conductors originate, the installation shall comply with 250.32(B)(1).

**My take: This is a new section, which somewhat states the obvious. If a system for an adjacent building has overcurrent protection, then it complies with 250.32(B).**

### **250.52 Grounding Electrodes**

**(A) Electrodes Permitted for Grounding.**

**(1) Metal Underground Water Pipe.** A metal underground water pipe in direct contact with the earth for 3.0m (10 ft) or more (including any metal well casing bonded to the pipe) and electrically continuous (or made electrically continuous by bonding around insulating joints or insulating pipe) to the points of connection of the grounding electrode conductor and the bonding conductor(s) or jumper(s), if installed.

**(2) Metal Frame of the Building or Structure.** The metal frame of the building or structure that is connected to the earth by one or more of the following methods:

**(1)** At least one structural metal member that is in direct contact with the earth 3.0m (10 ft) or more, with or without concrete encasement.

**(2)** Hold-down bolts securing the structural steel column that are connected to a concrete-encased electrode that complies with 250.52(A)(3) and is located in the support footing

or foundation. The hold-down bolts shall be connected to the concrete-encased electrode by welding, exothermic welding, the usual steel tie wires, or other approved means.

***My take: This section clarifies when the metal frame of a building can act as the Grounding Electrode.***

**(3) Concrete-Encased Electrode.** A concrete-encased electrode shall consist of at least 6.0m (20 ft) of either (1) or (2):

- (1) One or more bare or zinc galvanized or other electrically conductive coated steel reinforcing bars or rods of not less than 13mm (1/2in.) in diameter, installed in one continuous 6.0m (20 ft) length, or if in multiple pieces connected together by the usual steel tie wires, exothermic welding, welding, or other effective means to create 6.0m (20 ft) or greater length; or
- (2) Bare copper conductor not smaller than 4 AWG.

Metallic components shall be encased by at least 50 mm (2 in.) of concrete and shall be located horizontally within that portion of a concrete foundation or footing that is in direct contact with the earth or within vertical foundations or structural components or members that are in direct contact with the earth. If multiple concrete-encased electrodes are present at a building or structure, it shall be permissible to bond only one into the grounding electrode system.

Informational Note: Concrete installed with insulation, vapor barriers, films or similar items separating the concrete from the earth is not considered to be in “direct contact” with the earth.

***My take: This new section details the requirements for a concrete-encased electrode to be the Grounding Electrode. These are commonly used in renovation projects when a direct connection to the water piping or building steel is not available.***

**(7) Plate Electrodes.** Each plate electrode shall expose not less than 0.186 m<sup>2</sup> (2 ft<sup>2</sup>) of surface to exterior soil. Electrodes of bare or conductively coated iron or steel plates shall be at least 6.44 mm (1/4 in.) in thickness. Solid, uncoated electrodes of nonferrous metal shall be at least 1.55 mm (0.06 in.) in thickness.

### **250.53 Grounding Electrode System Installation**

**(A) Rod, Pipe, and Plate Electrodes.** Rod, pipe, and plate electrodes shall meet the requirements of 250.53(A)(1) through (A)(3).

**(1) Below Permanent Moisture Level.** If practicable, rod, pipe, and plate electrodes shall be embedded below permanent moisture level. Rod, pipe, and plate electrodes shall be free from nonconductive coatings such as paint or enamel.

**(2) Supplemental Electrode Required.** A single rod, pipe, or plate electrode shall be supplemented by an additional electrode of a type specified in 250.52(A)(2) through (A)(8). The supplemental electrode shall be permitted to be bonded to one of the following:

- (1) Rod, pipe, or plate electrode.

- (2) Grounding electrode conductor.
- (3) Grounded service-entrance conductor.
- (4) Nonflexible grounded service raceway.
- (5) Any grounded service enclosure.

*Exception: If a single rod, pipe, or plate grounding electrode has a resistance to earth of 25 ohms or less, the supplemental electrode shall not be required.*

***My take: This new section gives the requirements when a supplemental electrode is permitted for rod, pipe, and/or plate electrodes.***

**(3) Supplemental Electrode.** If multiple rod, pipe, or plate electrodes are installed to meet the requirements of this section, they shall not be less than 1.8m (6 ft) apart.

Informational Note: The paralleling efficiency of rods is increased by spacing them twice the length of the longest rod.

***My take: The Code is now stating that supplemental rod, pipe, and/or plate electrodes are to be spaced over 6ft. apart though its very common to space them 10ft. apart.***

**(B) Electrode Spacing.** Where more than one of the electrodes of the type specified in 250.52(A)(5) or (A)(7) are used, each electrode of one grounding system (including that used for **strike termination devices**) shall not be less than 1.83 m (6 ft) from any other electrode of another grounding system. Two or more grounding electrodes that are bonded together shall be considered a single grounding electrode system.

#### **(D) Metal Underground Water Pipe**

**(2) Supplemental Electrode Required.** A metal underground water pipe shall be supplemented by an additional electrode of a type specified in 250.52(A)(2) through (A)(8). **If** the supplemental electrode is of the rod, pipe, or plate type, it shall comply with **250.53(A)**. The supplemental electrode shall **be bonded** to **one of the following**:

- (1) Grounding electrode conductor
- (2) Grounded service-entrance conductor
- (3) Nonflexible grounded service raceway
- (4) Any grounded service enclosure
- (5) As provided by 250.32(B)

***My take: Additions to this existing section list the supplemental requirements for metal water underground piping. As stated above, the common way of supplementing is with a concrete-encased electrode.***

#### **250.120 Equipment Grounding Conductor Installation**

**(C) Equipment Grounding Conductors Smaller Than 6 AWG.** Where not routed with circuit conductors as permitted in 250.130(C) and 250.134(B) Exception No. 2, equipment grounding conductors smaller than 6 AWG shall be protected from physical damage by an identified raceway or cable armor unless installed within hollow spaces of the framing members of buildings or structures and where not subject to physical damage.

***My take: This is an existing section that has been re-written to include the "where not routed with circuit conductors" concept.***

#### **250.121 Use of Equipment Grounding Conductors**

An equipment grounding conductor shall not be used as a grounding electrode conductor.

***My take: New section. The equipment grounding conductor and grounding electrode conductor are bonded to one another but can never be substituted for one another.***

#### **250.122 Size of Equipment Grounding Conductors**

**(A) General.** Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122, but in no case shall they be required to be larger than the circuit conductors supplying the equipment. Where a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122.

### **Article 690 Solar Photovoltaic Systems**

#### **690.47 Grounding Electrode System**

***My take: Solar photovoltaic (PV) systems are slowly growing in popularity. From my design experience, there are companies that are making use of "solar farms" to produce electricity and which is sold to the regional utilities. In stands to reason that the Code would focus more on these systems and in this case the focus is on the grounding system.***

**(A) Alternating-Current Systems.** If installing an ac system, a grounding electrode system shall be provided in accordance with 250.50 through 250.60. The grounding electrode conductor shall be installed in accordance with 250.64.

**(B) Direct-Current Systems.** If installing a dc system, a grounding electrode system shall be provided in accordance with 250.166 for grounded systems or 250.169 for ungrounded systems. The grounding electrode conductor shall be installed in accordance with 250.64.

A common dc grouping-electrode conductor shall be permitted to serve multiple inverters. The size of the common grounding electrode and the tap conductors shall be in accordance with 250.166. The tap conductors shall be connected to the common grounding-electrode conductor by exothermic welding or with connectors listed as grounding and bonding equipment in such a manner that the common grounding electrode conductor remains without a splice or joint.

***My take: New guidelines are added allowing multiplier dc inverters to be served by a grouping-electrode conductor.***

**(C) Systems with Alternating-Current and Direct-Current Grounding Requirements.**

Photovoltaic systems having dc circuits and ac circuits with no direct connection between the dc grounded conductor and the ac grounded conductor shall have a dc grounding system. The dc grounding system shall be bonded to the ac grounding system by one of the methods in (1), (2), or (3).

This section shall not apply to ac PV modules.

When using the methods of (C)(2) or (C)(3), the existing ac grounding electrode system shall meet the applicable requirements of Article 250, Part III.

Informational Note No. 1: ANSI/UL 1741, *Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems*, requires that any inverter or charge controller that has a bonding jumper between the grounded dc conductor and the grounding system connection point have that point marked as a grounding electrode conductor (GEC) connection point. In PV inverters, the terminals for the dc equipment grounding conductors and the terminals for ac equipment grounding conductors are generally connected to, or electrically in common with, a grounding busbar that has a marked dc GEC terminal.

Informational Note No. 2: For utility-interactive systems, the existing premises grounding system serves as the ac grounding system.

**(1) Separate Direct-Current Grounding Electrode System Bonded to the Alternating-Current Grounding Electrode System.** A separate dc grounding electrode or system shall be installed, and it shall be bonded directly to the ac grounding electrode system. The size of any bonding jumper(s) between the ac and dc systems shall be based on the larger size of the existing ac grounding electrode conductor or the size of the dc grounding electrode conductor specified by 250.166. The dc grounding electrode system conductor(s) or the bonding jumpers to the ac grounding electrode system shall not be used as a substitute for any required ac equipment grounding conductors.

**(2) Common Direct-Current and Alternating-Current Grounding Electrode.** A dc grounding electrode conductor of the size specified by 250.166 shall be run from the marked dc grounding electrode connection point to the ac grounding electrode. Where an ac grounding electrode is not accessible, the dc grounding electrode conductor shall be connected to the ac grounding electrode conductor in accordance with 250.64(C)(1). This dc grounding electrode conductor shall not be used as a substitute for any required ac equipment grounding conductors.

**(3) Combined Direct-Current Grounding Electrode Conductor and Alternating-Current Equipment Grounding Conductor.** An unspliced, or irreversibly spliced, combined grounding conductor shall be run from the marked dc grounding electrode conductor connection point along with the ac circuit conductors to the grounding busbar in the associated ac equipment. This combined grounding conductor shall be the larger of the sizes specified by 250.122 or 250.166 and shall be installed in accordance with 250.64(E).

***My take: Section (C) contains multiple guidelines for the bonding of the dc grounding system to the ac grounding system, with a dc grounding system. The combined grounding required in this section establishes one grounding system for the entire PV system from the PV array to the ac point of connection.***

## 2. Receptacles

### **210.52 Dwelling Unit Receptacle Outlets**

#### **(A) General Provisions**

**(1)-(3)** (No Change from NEC 2008)

**(4) Countertop Receptacles.** Receptacles installed for countertop surfaces as specified in 210.52(C) shall not be considered as the receptacles required by 210.52(A).

***My take: There are numerous changes to countertop receptacle requirements in 210.52(C) as you will see below. This section is added to state that countertop receptacles are in addition to, not included in, the General Provisions for Dwelling Unit receptacles as covered in 210.52(A).***

**(C)**

**(1)-(3)** (No Change from NEC 2008)

**(4) Separate Spaces.** Countertop spaces separated by rangetops, refrigerators, or sinks shall be considered as separate countertop spaces in applying the requirements of 210.52(C)(1). If a range, counter-mounted cooking unit, or sink is installed in an island or peninsular countertop and the depth of the countertop behind the range, counter-mounted cooking unit, or sink is less than 300mm (12in.), the range counter-mounted cooking unit, or sink shall be considered to divide the countertop space into two separate countertop spaces. Each separate countertop space shall comply with the applicable requirements in 210.52(C).

***My take: This section has been clarified to address receptacle locations in islands or peninsular countertops.***

**(5) Receptacle Outlet Location.** Receptacle outlets shall be located on or above, but not more than 500mm (20in.) 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, or rangetops as covered in 210.52(C)(1), Exception, or appliances occupying dedicated space shall not be considered as these required outlets.

Informational Note: See 406.5(E) for requirements for installation of receptacles in countertops.

**(D) Bathrooms.** In dwelling units, at least one receptacle outlet shall be installed in bathrooms with 900mm (3 ft) of the outside edge of each basin. The receptacle outlet shall be located on a wall or partition that is adjacent to the basin or basin countertop, located on the countertop, or installed on the side or face of the basin cabinet not more than 300mm (12 in.) below the countertop. Receptacle outlet assemblies listed for the application shall be permitted to be installed in the countertop.

Informational Note: See 406.5(E) for requirements for installation of receptacles in countertops.

**(E)-(F)** (No Change from NEC 2008)

**(G) Basements, Garages, and Accessory Buildings.** For a one-family dwelling, the following provisions shall apply:

- (1) At least one receptacle outlet, in addition to those for specific equipment, shall be installed in each basement, in each attached garage, and in each detached garage or accessory building

with electric power.

(2) (No Change from NEC 2008)

(H) (No Change from NEC 2008)

**(I) Foyers.** Foyers that are not part of a hallway in accordance with 210.52(H) and that have an area that is greater than 5.6m<sup>2</sup> (60ft<sup>2</sup>) shall have a receptacle(s) located in each wall space 900mm (3 ft) or more in width and unbroken by doorways, floor-to-ceiling windows, and similar openings.

***My take: 210.52 now includes receptacle locations for Foyers. What has typically been a design standard in recent years, when locating receptacles, is now a requirement in the Code.***

#### **406.2 Definition**

**Child Care Facility.** A building or structure, or portion thereof, for educational, supervisory, or personal care services for more than four children 7 years old or less.

***My take: The inclusion of Child Care Facility in the definitions is a necessary addition as it is mentioned several times throughout the Code and could potentially be interpreted as several things. Also, the addition of this definition causes all subsequent sections in Article 406 to be re-numbered.***

#### **406.4 General Installation Requirements**

***My take: This was formerly section 406.3***

(A)-(C) (No Change from NEC 2008)

(D) (1)-(3) (No Change from NEC 2008)

(D)(4) **Arc Fault Circuit-Interrupter Protection.** See Arc Fault Circuit Interruption Section

**(5) Tamper-Resistant Receptacles.** Listed tamper-resistant receptacles shall be provided where replacements are made at receptacle outlet that are required to be tamper-resistant elsewhere in this Code.

**(6) Weather-Resistant Receptacles.** Weather-Resistant receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this Code.

***My take: Again, the Code got it right by adding clear definitions for Tamper-Resistant and Weather-Resistant Receptacles.***

#### **406.6 Receptacle Faceplates (Cover Plates)**

Receptacle faceplates shall be installed so as to completely cover the opening and seat against the mounting surface. Receptacle faceplates mounted inside a box having a recess-mounted receptacle shall effectively close the opening and seat against the mounting surface.

***My take: Further clarification of how to seal a recess-mounted***

**receptacle.**

#### **406.9 Receptacles in Damp or Wet Locations**

**My take: This was formerly Section 406.8.**

(A) (No Change from NEC 2008)

(B) **Wet Locations**

(1) **15- and 20-Ampere Receptacles in a Wet Location.** 15- and 20-ampere, 125- and 250-volt receptacles installed in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. For other than one- or two-family dwellings, an outlet box hood installed for this purpose shall be listed, and where installed on an enclosure supported from grade as described in 314.23(B) or as described in 314.23(F) shall be identified as “extra-duty”. All 15- and 20-ampere, 125- and 250-volt non-locking-type receptacles shall be listed weather-resistant type.

Informational Note No. 1: Requirements for extra-duty outlet box hoods are found in ANSI/UL 514D-2000, Cover Plates for Flush-Mounted Wiring Devices.

**My take: Revisions are made to this section to include "extra-duty" requirements.**

#### **406.12 Tamper-Resistant Receptacles for dwelling Units**

**My take: This was formerly Section 406.11.**

In all areas specified in 210.52, all nonlocking-type 125-volt, 15- and 20-ampere receptacles shall be listed tamper-resistant receptacles.

*Exception: Receptacles in the following locations shall not be required to be tamper-resistant:*

- (1) Receptacles located more than 1.7m (5½ ft) above the floor.
- (2) Receptacles that are part of a luminaire or appliance.
- (3) A single receptacle or a duplex receptacle for two appliances located within dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug connected in accordance with 400.7(A)(6), (A)(7), or (A)(8).
- (4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a).

**My take: This section has been revised to provide 4 exceptions where tamper-resistant receptacles are not required. This section was new to the 2008 NEC but it was a bit extreme. By adding these exceptions, the Code is acknowledging that children's safety is important but that tamper-resistant receptacle placement should be practical as well.**

#### **406.13 Tamper-Resistant Receptacles in Guest Rooms and Guest Suites**

All nonlocking-type 125-volt, 15- and 20-ampere receptacles located in guest rooms and guest suites shall be listed tamper-resistant receptacles.

**My take: This new section requires that all Guest Rooms/Suites shall have tamper-resistant receptacles.**

#### **406.14 Tamper-Resistant Receptacles in Child Care Facilities**

In all child care facilities, all nonlocking-type 125-volt, 15- and 20-ampere receptacles shall be listed

tamper-resistant receptacles.

***My take: This is the reason that the definition of Child-Care Facility was added in 406.2. Tamper-resistant receptacles have been a design standard in Child Care Facilities for years so it's good to see that it is now a Code requirement.***

### 3. New/Updated Definitions

***My take: The definitions listed below are located in Article 100. The only ones included in this list are ones that are new or are revised.***

#### **Article 100 Definitions**

**Ampacity.** The **maximum** current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

**Arc-Fault Circuit-Interrupter (AFCI).** A device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and by functioning to de-energize the circuit when an arc fault is detected.

***My take: This definition is long overdue. The Code has gradually increased guidelines for arc fault protection during the last several editions without ever defining the exact meaning, per NFPA, of the phrase.***

**Automatic.** Performing a function without the necessity of human intervention.

**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.

**Bonding Conductor or Jumper.** A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected.

***My take: This is just a change in verbiage. It's always been known as a bonding jumper but it can now be referred to as a bonding conductor also.***

**Bonding Jumper, System.** The connection between the grounded circuit conductor and the supply-side bonding jumper, or the equipment grounding conductor, or both, at a separately derived system.

***My take: This definition refers to the system as a whole where the neutrals from the branch circuits are connected to the neutral bus in the panel and the neutral bus is then connected to the ground bus via the main bonding jumper.***

**Explosionproof Equipment.** **Equipment** enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

**Ground.** The earth.

***My take: Very simplistic but it was probably inserted to make clear there is only one way to ground an electrical system: into earth.***

**Ground Fault.** An unintentional, electrically conducting connection between an ungrounded conductor of an electrical circuit and the normally non-current-carrying conductors, metallic enclosures, metallic raceways, metallic equipment, or earth.

**Nonautomatic.** Requiring human intervention to perform a function.

**Overcurrent Protective Device, Branch-Circuit.** A device capable of providing protection for service, feeder, and branch circuits and equipment over the full range of overcurrents between its rated current and its interrupting rating. Branch-circuit overcurrent protective devices are provided with interrupting ratings appropriate for the intended use but no less than 5000 amperes.

**Overcurrent Protective Device, Supplementary.** A device intended to provide limited overcurrent protection for specific applications and utilization equipment such as luminaires and appliances. This limited protection is in addition to the protection provided in the required branch circuit by the branch-circuit overcurrent protective device.

***My take: The Code was revised to make the distinction between "branch circuit" and "supplementary" overcurrent protection. All electrical devices connected to a branch circuit must have a branch-circuit-rated overcurrent protective device. But the supplementary device is only used in a few instances (such as heavy machinery or an hvac unit) and is used in addition to the branch-circuit-rated overcurrent protective device.***

**Separately Derived System.** A premises wiring system whose power is derived from a source of electric energy or equipment other than a service. Such systems have no direct connection from circuit conductors of one system to circuit conductors of another system, other than connections through the earth, metal enclosures, metallic raceways, or equipment grounding conductors.

***My take: This is an attempt to further simplify the meaning of separately derived system from the previous edition. Examples of a separately derived system include a generator, transformer, photovoltaic solar system or a battery. There's more about this in the Grounding section.***

**Service Conductors, Overhead.** The overhead conductors between the service point and the first point of connection to the service-entrance conductors at the building or other structure.

**Service Conductors, Underground.** The underground conductors between the service point and the first point of connection to the service-entrance conductors in a terminal box, meter, or other enclosure, inside or outside the building wall.

Informational Note: Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.

***My take: This is an attempt to clarify the difference between overhead***

***and underground service conductors but the thing to remember is that these are both types of secondary conductors that lead from the primary source of power to the main electrical service. The Code has diagrams of each of these.***

**Service Drop.** The overhead conductors between the utility electric supply system and the service point.

**Service Lateral.** The underground conductors between the utility electric supply system and the service point.

**Service Point.** The point of connection between the facilities of the serving utility and the premises wiring.

Informational Note: The service point can be described as the point of demarcation between where the serving utility ends and the premises wiring begins. The serving utility generally specifies the location of the service point based on the conditions of service.

**Uninterruptible Power Supply.** A power supply used to provide alternating current power to a load for some period of time in the event of a power failure.

Informational Note: In addition, it may provide a more constant voltage and frequency supply to the load, reducing the effects of voltage and frequency variations.

***My take: Uninterruptible Power Supplies (UPS) are commonly used in commercial construction for critical loads. In this case, the definition has been added to the Code to clearly defining the term.***

## 4. GFCI Protection

### **210.8 Ground Fault Circuit-Interrupter Protection for Personnel**

Ground-fault circuit-interruption for personnel shall be provided as required in 210.8(A) through (C). The ground-fault circuit-interrupter shall be installed in a readily accessible location.

(A) (1)-(2)(No Change from NEC 2008)

#### **(3) Outdoors**

*Exception to (3): Receptacles that are not readily accessible and are supplied by a branch circuit dedicated to electric snow-melting, deicing, or pipeline and vessel heating equipment shall be permitted to be installed in accordance with 426.28 or 427.22, as applicable.*

(4)-(6)(No Change from NEC 2008)

(7) Sinks --- Located in areas other than kitchens where receptacles are installed within 1.8m (6ft) of the outside edge of the sink.

(B) (1)-(3)(No Change from NEC 2008)

#### **(4) Outdoors**

*Exception No. 1 to (3) and (4): Receptacles that are not readily accessible and are supplied by a branch circuit dedicated to electric snow-melting, deicing, or pipeline and vessel heating equipment shall be permitted to be installed in accordance with 426.28 or 427.22, as applicable.*

***My take: Several minor additions to this section to exempt deicing, pipeline and vessel heating equipment from having GFCI protection. The key phrase though is "not readily accessible".***

(5) Sinks --- where receptacles are installed within 1.8m (6ft) of the outside edge of the sink.

*Exception No. 1 to (5): In industrial laboratories, receptacles used to supply equipment where removal of power would introduce a greater hazard shall be permitted to be installed without GFCI protection.*

*Exception No. 2 to (5): For receptacles located in patient bed locations of general care or critical care areas of health care facilities other than those covered under 210.8(B)(1), GFCI protection shall not be required.*

***My take: This is another case of a design standard becoming Code. Obviously, at a patient's bed where there is most likely emergency/critical circuits to be used during the loss of normal power, it is impractical to have GFCI-protected outlets that have the potential to shut off.***

(6) Indoor wet locations

(7) Locker rooms with associated showering facilities.

***My take: Another design standard becoming Code. It seems silly that they weren't previously required by Code but the rule of thumb is this: Wet location = GFCI receptacles.***

(8) Garages, service bays, and similar areas where electrical diagnostic equipment, electrical hand tools, or portable lighting equipment are to be used.

***My take: Same concept as above.***

**680.21 Motors**

**(C) GFCI Protection** Outlets supplying pool pump motors connected to single-phase, 120 volt through 240 volt branch circuits, rated 15 or 20 amperes, whether by receptacle or by direct connection, shall be provided with ground-fault circuit-interrupter protection for personnel.

***My take: I'm not sure why this was not previously part of the Code but it is a good addition. Outdoor pool pumps get wet on both the inside and outside so it makes perfect sense that the receptacles supplying power to them should be GFCI-protected.***

## **5. Arc Fault Circuits**

### **210.12 Arc-Fault Circuit-Interrupter Protections**

**(A) Dwelling Units.** All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets installed in dwelling unit family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas shall be protected by a listed arc-fault circuit interrupter, combination-type, installed to provide protections of the branch circuit.

*Exception 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 an outlet branch-circuit type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.*

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

*Exception No. 3: Where an individual branch circuit to a fire alarm system installed in accordance with 760.41(B) or 760.121(B) is installed in RMC, IMC, EMT, or steel-sheathed cable, Type AC or Type MC, meeting the requirements of 250.118, with metal outlet and junction boxes, AFCI protection shall be permitted to be omitted.*

***My take: The definition of Arc Fault Circuit Interrupter (AFCI) has been moved to Article 100. Exceptions have been added for branch circuits in dwelling units that do not need to be AFCI protected. It also allows for fire alarm to be exempt from AFCI protection if installed in MC Cable.***

**(B) Branch Circuit Extensions or Modifications --- Dwelling Units.** 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 one of the following:

- (1) A listed combination-type AFCI located at the origin of the branch circuit.
- (2) A listed outlet branch-circuit type AFCI located at the first receptacle outlet of the existing branch circuit.

***My take: Section (B) is new and deals with AFCI protection to dwelling unit branch circuit renovations.***

### **Article 406 - Receptacles**

#### **406.4 General Installation Requirements**

**(D)(4) Arc Fault Circuit-Interrupter Protection.** Where a receptacle outlet is supplied by a branch circuit that requires arc-fault circuit interrupter protection as specified elsewhere in this Code, a replacement receptacle at this outlet shall be one of the following:

- (1) A listed outlet branch circuit type arc-fault circuit interrupter receptacle.
- (2) A receptacle protected by a listed outlet branch circuit type arc-fault circuit interrupter type receptacle.
- (3) A receptacle protected by a listed combination type arc-fault circuit interrupter type circuit breaker.

This requirement becomes effective January 1, 2014.

***My take: This entire section is new. It is the Code's attempt to address the need for AFCI protection in existing systems during receptacle replacements. As the last statement notes, it is effective Jan. 1, 2014.***

## 6. Environmental Air / Plenum

### **300.22 Wiring in Ducts Not Used for Air Handling, Fabricated Ducts for Environmental Air, and Other Spaces for Environmental Air (Plenums)**

The provisions of this section shall apply to the installation and uses of electrical wiring and equipment in ducts used for dust, loose stock, or vapor removal; ducts specifically fabricated for environmental air, and other spaces used for environmental air (plenums).

***My take: The title of this section is revised to clarify the Spaces for Environmental Air or plenums. The NEC is the only code book that seems to tip-toe around the term "plenum". But this version of the Code attempts to close the gap between Environmental Air and Plenum by classifying them together.***

(A) (No Change from NEC 2008)

(B) **Ducts Specifically Fabricated for Environmental Air.** Only wiring methods consisting of Type MI Cable, Type MC cable employing a smooth or corrugated impervious metal sheath without an overall nonmetallic covering, electrical metallic tubing, flexible metallic tubing, intermediate metal conduit, or rigid metal conduit without an overall nonmetallic covering shall be installed in **ducts specifically** fabricated to transport environmental air. Flexible metal conduit shall be permitted, in lengths not to exceed 1.2m (4 ft), to connect physically adjustable equipment and devices permitted to be in these **fabricated ducts**. The connectors used with flexible metal conduit shall effectively close any openings in the connection. Equipment and devices shall be permitted within such **ducts only** if necessary for the direct action upon, or sensing of, the contained air. Where equipment or devices are installed and illumination is necessary to facilitate maintenance and repair, enclosed gasketed-type luminaires shall be permitted.

(C) **Other Spaces Used for Environmental Air (Plenums).** This section shall apply to spaces not specifically fabricated for environmental air-handling purposes but used for air-handling purposes as a plenum. This section shall not apply to habitable rooms or areas of buildings, the prime purpose of which is not air handling.

Informational Note No. 1: The space over a hung ceiling used for environmental air-handling purposes is an example of the type of other space to which this section applies.

Informational Note No. 2: The phrase "Other Spaces Used for Environmental Air (Plenum)" as used in this section correlates with the use of the term "plenum" in NFPA 90A-2009, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, and other mechanical codes where the plenum is used for return air purposes, as well as some other air-handling spaces.

*Exception: This section shall not apply to the joist or stud spaces of dwelling units where the wiring passes through such spaces perpendicular to the long dimension of such spaces.*

***My take: Again, this section further clarifies that the terms "Environmental Air" and "Plenum" both refer to spaces used for air-handling purposes.***

(1) **Wiring Methods.** The wiring methods for such other spaces shall be limited to totally

enclosed, nonventilated, insulated busway having no provisions for plug-in connections, Type MI cable, Type MC cable without an overall nonmetallic covering, Type AC cable, or other factory-assembled multiconductor control or power cable that is specifically listed for use within an air-handling space, or listed prefabricated cable assemblies of metallic manufactured wiring systems without nonmetallic sheath. Other types of cables, conductors, and raceways shall be permitted to be installed in electrical metallic tubing, flexible metallic tubing, intermediate metal conduit, rigid metal conduit without an overall nonmetallic covering, flexible metal conduit, or, where accessible, surface metal raceway or metal wireway with metal covers.

(2) **Cable Tray Systems.** The provisions in (a) or (b) shall apply to the use of metallic cable tray systems in other spaces used for environmental air (plenums), where accessible, as follows:

(a) *Metal Cable Tray Systems.* Metal cable tray systems shall be permitted to support the wiring methods in 300.22(C)(1).

(b) *Solid Side and Bottom Metal Cable Tray Systems.* Solid side and bottom metal cable tray systems with solid metal covers shall be permitted to enclose wiring methods and cables, not already covered in 300.22(C)(1), in accordance with 392.10(A) and (B).

(3) **Equipment.** Electrical equipment with a metal enclosure, or electrical equipment with a nonmetallic enclosure listed for use within an air-handling space and having adequate fire-resistant and low-smoke-producing characteristics, and associated wiring material suitable for the ambient temperature shall be permitted to be installed in such other space unless prohibited elsewhere in the *Code*.

Informational Note: One method of defining adequate fire-resistant and low-smoke producing characteristics for electrical equipment with a nonmetallic enclosure is in ANSI/UL 2043-2008, Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

*Exception: Integral fan systems shall be permitted where specifically identified for use within an air-handling space.*

**My take: (2) is a new section added to address the use of cable tray systems in plenums.**

## 7. Conductors

### Article 310 Conductors for General Wiring

#### 310.2 Definitions

**Electrical Ducts.** Electrical conduits, or other raceways round in cross section, that are suitable for use underground or embedded in concrete.

**Thermal Resistivity.** As used in this *Code*, the heat transfer capability through a substance by conduction. It is the reciprocal of thermal conductivity and is designated Rho and expressed in the units °C-cm/W.

#### II. Installation

##### 310.10 Uses Permitted

The conductors described in 310.104 shall be permitted for use in any of the wiring methods covered in Chapter 3 and as specified in their respective tables or as permitted elsewhere in this *Code*.

*Informational Note: Thermoplastic insulation may stiffen at temperatures lower than -10°C (+14 °F). Thermoplastic insulation may also be deformed at normal temperatures where subjected to pressure, such as at points of support. Thermoplastic insulation, where used on dc circuits in wet locations, may result in electroendosmosis between the conductor and insulation.*

(A) (No Change from NEC 2008)

(B) (No Change from NEC 2008)

(C) (No Change from NEC 2008)

(D) (No Change from NEC 2008)

(E) **Shielding.** Non-shielded, ozone-resistant insulated conductors with a maximum phase-to-phase voltage of 5000 volts shall be permitted in Type MC Cables in industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation. For other establishments, solid dielectric insulated conductors operated above 2000 volts in permanent installations shall have ozone-resistant insulation and shall be shielded. All metallic insulation shields shall be connected to a grounding electrode conductor, a grounding busbar, an equipment grounding conductor, or a grounding electrode.

*Informational Note: The primary purposes of shielding are to confine the voltage stresses to the insulation, dissipate insulation leakage current, drain off the capacitive charging current, and carry ground-fault protective devices in the event of an electrical cable fault.*

**My take: Clarifications have been made in this section with regards to MC Cable.**

*Exception No. 1 (No Change from NEC 2008)*

*Exception No. 2: Non-shielded insulated conductors listed by a qualified testing laboratory shall be permitted for use up to 5000 volts to replace existing nonshielded conductors, on existing equipment in industrial establishments only, under the following conditions:*

(a) *Where the condition of maintenance and supervision ensures that only qualified personnel install and service the installation.*

(b) *Conductors shall have insulation resistant to electric discharge and surface tracking, or the insulated conductor(s) shall be covered with a material resistant to ozone, electric discharge, and surface tracking.*

(c) Where used in wet locations, the insulated conductor(s) shall have an overall nonmetallic jacket or a continuous metallic sheath.

(d) Insulation and jacket thickness shall be in accordance with Table 310.13(D).

Informational Note: Relocation or replacement of equipment may not comply with the term existing as related to this exception.

**My take: Exception No. 2 was added to provide clarification on insulated conductors in a renovation situation where they're replacing existing conductors.**

(F) (No Change from NEC 2008)

(G) (No Change from NEC 2008)

(H) **Conductors in Parallel**

(1) **General.** Aluminum, copper-clad aluminum, or copper conductors, for each phase, polarity, neutral, or grounded circuit shall be permitted to be connected in parallel (electrically joined at both ends) only in sizes 1/0 AWG and larger where installed in accordance with 310.10(H)(2) through (h)(6).

*Exception No. 1* (No Change from NEC 2008)

*Exception No. 2:* Under engineering supervision, 2 AWG and 1 AWG grounded neutral conductors shall be permitted to be installed in parallel for existing installations.

(2) **Conductor Characteristics.** The paralleled conductors in each phase, polarity, neutral, grounded circuit conductor, equipment grounding conductor, or equipment bonding jumper shall comply with all of the following:

- (1) Be the same length.
- (2) Consist of the same conductor material.
- (3) Be the same size in circular mil area.
- (4) Have the same insulation type.
- (5) Be terminated in the same manner.

(3) **Separate Cables or Raceways.** Where run in separate cables or raceways, the cables or raceways with conductors shall have the same number of conductors and shall have the same electrical characteristics. Conductors of one phase, polarity, neutral, grounded circuit conductor, or equipment grounding conductor shall not be required to have the same physical characteristics as those of another phase, polarity, neutral, grounded circuit conductor, or equipment grounding conductor.

(4) **Ampacity Adjustment.** Conductors installed in parallel shall comply with the provisions of 310.15(B)(3)(a).

(5) **Equipment Grounding Conductors.** Where parallel equipment grounding conductors are used, they shall be sized in accordance with 250.122. Sectioned equipment grounding conductors smaller than 1/0 AWG shall be permitted in multiconductor cables in accordance with 310.104, provided the combined circular mil area of the sectioned equipment grounding conductors in each cable complies with 250.122.

(6) **Equipment Bonding Jumpers.** Where parallel equipment bonding jumpers are installed in raceways, they shall be sized and installed in accordance with 250.102.

***My take: Article 310 has been heavily revised with regards to the Conductor Allowable Ampacity Tables. All of these tables have been re-numbered as Table 310.15, from their previous section. For the sake of brevity I have not re-printed them in this article but they begin on page 154 of the Code (pg 336 of the Handbook).***

***Two important things to note: Table 310.15(B)(16) is renumbered as it is the former Table 310.16. This table is very commonly used to size conductors in conduits, particularly the 75°C column. There are minor changes to ampacities allowed for #14, #12, #10, #3, #1 and #600 wire sizes.***

***The second noticeable thing is that the term "derate" is rarely used in the Code. Derating is the adjustment to conductor sizes enclosed in conduit in order to limit the current. The fact that the term "derate" is being replaced with "ampacity adjustment" is a big change from previous versions of the Code.***

## 8. Means of Disconnect

### **450.14 Disconnecting Means**

Transformers, other than Class 2 or Class 3 transformers, shall have a disconnecting means located either in sight of the transformer or in a remote location. Where located in a remote location, the disconnecting means shall be lockable, and the location shall be field marked on the transformer.

***My take: Once and for all the Code states that a transformer is required to have a disconnect on the primary side. This is accomplished by either location the transformer within sight of the circuit breaker controlling it or by providing a means of disconnect beside the transformer. Either way, this is no longer a gray area as it has been in the past.***

### **514.11 Circuit Disconnects (Motor Fuel Dispensing Facilities)**

**(A) General.** Each circuit leading to or through dispensing equipment, including all associated power, communications, data, and video circuits, and equipment for remote pumping systems, shall be provided with a clearly identified and readily accessible switch or other approved means, located remote from the dispensing devices, to disconnect simultaneously from the source of supply, all conductors of the circuits, including the grounded conductor, if any. Single-pole breakers utilizing handle ties shall not be permitted.

***My take: The clarifications to this section are to emphasize that emphasize that all power, data/comm and video circuits are required to have a means of disconnect and they are to disconnect simultaneously.***

## 9. Small Wind Electric Systems

### **ARTICLE 694**

#### **Small Wind Electric Systems**

##### **I. General**

**694.1 Scope** The provisions of this article to small wind (turbine) electric systems that consist of one or more wind electric generators with individual generators having a rated power up to and including 100 KW. These systems can include generators, alternators, inverters, and controllers.

***My take: This entire article is new and is the Code's attempt to deal with the rising usage of wind turbine electric systems. The goal of adding this to the Code is to bring to light new technology and an attempt at regulating its safety.***

## 10. Plug-In Hybrid Electric Vehicle (PHEV)

### **625.2 Definitions**

**Electric Vehicle.** An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, **electric motorcycles**, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other sources of electric current. **Plug-in hybrid electric vehicles (PHEV) are considered electric vehicles.** For the purpose of this **article, off-road**, self-propelled electric vehicles, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats, and the like, are not included.

**Electric Vehicle Supply Equipment.** The conductors, including the ungrounded, grounded, and equipment grounding conductors and the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of **transferring energy between** the premises wiring **and** the electric vehicle.

**Plug-In Hybrid Electric Vehicle (PHEV).** A type of electric vehicle intended for on-road use with the ability to store and use off-vehicle electrical energy in the rechargeable energy storage system, and having a second source of motive power.

**Rechargeable Energy Storage System.** Any power source that has the capability to be charged and discharged.

***My take: Pug-In hybrid vehicles are a relatively new technology and far from being mainstream. The Code is revised to further define what a PHEV is and its associated terms.***