

# Wiring and Protection

## CHAPTER

# 2

### ARTICLE

## 200

### Use and Identification of Grounded Conductors

**200.1 Scope.** This article provides requirements for the following:

- (1) Identification of terminals
- (2) Grounded conductors in premises wiring systems
- (3) Identification of grounded conductors

Informational Note: See Article 100 for definitions of *Grounded Conductor*, *Equipment Grounding Conductor*, and *Grounding Electrode Conductor*.

**200.2 General.** Grounded conductors shall comply with 200.2(A) and (B).

**(A) Insulation.** The grounded conductor, if insulated, shall have insulation that complies with either one of the following:

- (1) Is suitably rated, other than color, for any ungrounded conductor of the same circuit for systems of 1000 volts or less.
- (2) Is rated not less than 600 volts for solidly grounded neutral systems of over 1000 volts in accordance with 250.184(A)

**(B) Continuity.** The continuity of a grounded conductor shall not depend on a connection to a metal enclosure, raceway, or cable armor.

Informational Note: See 300.13(B) for the continuity of grounded conductors used in multiwire branch circuits.

Grounded conductors are required to be connected to a terminal or busbar that is specifically intended and identified for connection of grounded or neutral conductors. Because grounded conductors are current carrying, connecting them to a separate equipment grounding terminal or bar (i.e., directly connected to a metal cabinet or enclosure) results in the enclosure becoming a neutral conductor between the equipment grounding terminal and the point of connection for the grounded conductor.

### See also

**300.13(B)**, which does not permit the wiring terminals of a device, such as a receptacle, to be the means of maintaining the continuity of the grounded conductor in a multiwire branch circuit

**200.3 Connection to Grounded System.** Grounded conductors of premises wiring systems shall be electrically connected to the supply system grounded conductor to ensure a common, continuous grounded system. For the purpose of this section, *electrically connected* shall mean making a direct electrical connection capable of carrying current, as distinguished from induced currents.

*Exception: Listed interactive inverters identified for use in distributed resource generation systems such as photovoltaic and fuel cell power systems shall be permitted to be connected to premises wiring without a grounded conductor if the connected premises wiring or utility system includes a grounded conductor.*

**200.4 Neutral Conductors.** Neutral conductors shall be installed in accordance with 200.4(A) and (B).

The grounded conductor is often, but not always, the neutral conductor. A neutral conductor is one that is connected to the neutral point of an electrical system. Some electrical systems do not have a neutral conductor. For example, in a 3-phase, corner-grounded delta system, the intentionally grounded conductor is not a neutral conductor, because it is not connected to a system neutral point. Because the conductor is connected to the same grounding electrode system as the non-current-carrying metal parts of the electrical equipment, generally no potential difference exists between the grounded conductor and those grounded metal parts. However, unlike an equipment grounding conductor, the grounded conductor is a current-carrying circuit conductor. Whether it is referred to as the grounded conductor or as the neutral conductor, the white or gray marking on a circuit conductor indicates that it is intentionally connected to the earth.



Electric shock injuries and electrocutions have occurred as a result of working on the grounded conductor while the circuit is energized. Extreme caution must be exercised where the grounded (neutral) conductor is part of a multiwire branch circuit.

#### See also

**210.4(B)** for disconnecting means for multiwire branch circuits

**Article 250** for more on the use and installation of grounded conductors

**(A) Installation.** Neutral conductors shall not be used for more than one branch circuit, for more than one multiwire branch circuit, or for more than one set of ungrounded feeder conductors unless specifically permitted elsewhere in this *Code*.

Informational Note: See 215.4 for information on common neutrals.

**(B) Multiple Circuits.** Where more than one neutral conductor associated with different circuits is in an enclosure, grounded circuit conductors of each circuit shall be identified or grouped to correspond with the ungrounded circuit conductor(s) by wire markers, cable ties, or similar means in at least one location within the enclosure.

*Exception No. 1: The requirement for grouping or identifying shall not apply if the branch-circuit or feeder conductors enter from a cable or a raceway unique to the circuit that makes the grouping obvious.*

*Exception No. 2: The requirement for grouping or identifying shall not apply where branch-circuit conductors pass through a box or conduit body without a loop as described in 314.16(B) (1) or without a splice or termination.*

A neutral conductor is not required to be installed with the ungrounded circuit conductors if line-to-neutral loads are not supplied by the branch circuit or feeder. However, each multiwire circuit must have its own neutral conductor.

The concern with multiple circuits sharing a neutral conductor is the possibility of overloading the neutral conductor. Typically, an overcurrent protective device is not present, nor is it required to be installed in series with the neutral conductor. Therefore, an overload condition can exist without being detected or responded to, and insulation damage can occur. Because of the electrical relationship between the ungrounded conductors and the neutral conductor in multiwire single-phase and 3-phase circuits, the possibility of overload does not exist except where the load characteristics result in additive harmonic currents in the neutral conductor.

Where multiple circuits enter an enclosure, each circuit is required to have all its conductors grouped together in at least one location to make it obvious which conductors are associated with the circuit. This grouping is not necessary if the conductors enter the enclosure as a single cable.

## 200.6 Means of Identifying Grounded Conductors.

**Δ (A) Sizes 6 AWG or Smaller.** The insulation of grounded conductors of 6 AWG or smaller shall be identified by one of the following means:

- (1) A continuous white outer finish.
- (2) A continuous gray outer finish.
- (3) Three continuous white or gray stripes along the conductor's entire length on other than green insulation.
- (4) Conductors with white or gray insulation and colored tracer threads in the braid identifying the source of manufacture.
- (5) A single-conductor, sunlight-resistant, outdoor-rated cable used as a solidly grounded conductor in photovoltaic power systems, as permitted by 690.31(C)(1), shall be identified at the time of installation by markings at terminations in accordance with 200.6(A)(1) through (A)(4).
- (6) The grounded conductor of a mineral-insulated, metal-sheathed cable (Type MI) shall be identified at the time of installation by a distinctive white or gray marking at its terminations. The marking shall encircle the conductor insulation.
- (7) Fixture wire shall comply with the requirements for grounded conductor identification in accordance with 402.8.
- (8) For aerial cable, the identification shall comply with one of the methods in 200.6(A)(1) through (A)(5), or by means of a ridge located on the exterior of the cable so as to identify it.

**Δ (B) Sizes 4 AWG or Larger.** An insulated grounded conductor 4 AWG or larger shall be identified by one of the following means:

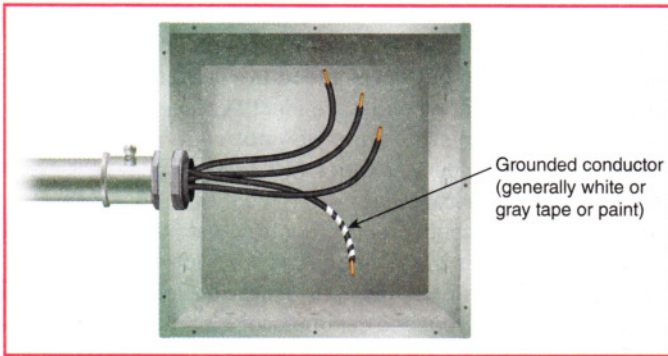
- (1) A continuous white outer finish.
- (2) A continuous gray outer finish.
- (3) Three continuous white or gray stripes along the entire length on other than green insulation.
- (4) At the time of installation, be identified by a distinctive white or gray marking at its terminations. This marking shall encircle the conductor insulation.

The most common method used to identify a single conductor as a grounded conductor is a white or gray marking to the insulation at all termination points at the time of installation. This field-applied white or gray marking must completely encircle the conductor insulation so that it is clearly visible. The marking can be applied by using tape or by painting the insulation. See Exhibit 200.1.

**(C) Flexible Cords.** An insulated conductor that is intended for use as a grounded conductor, where contained within a flexible cord, shall be identified by a white or gray outer finish or by methods permitted by 400.22.

**Δ (D) Grounded Conductors of Different Nominal Voltage Systems.** If grounded conductors of different nominal voltage systems are installed in the same raceway, cable, box, auxiliary





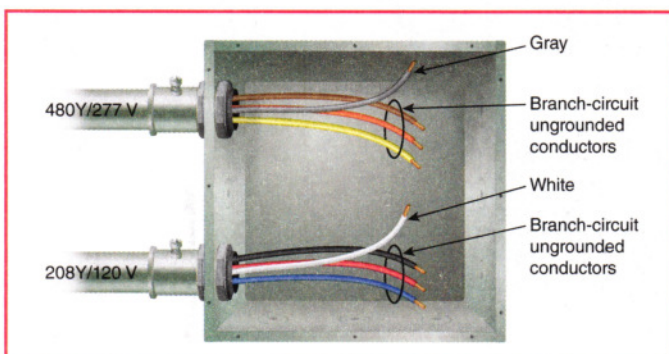
**EXHIBIT 200.1** Field-applied identification of a 4 AWG conductor to identify it as the grounded conductor.

gutter, or other type of enclosure, each grounded conductor shall be identified by nominal voltage system. Identification that distinguishes each nominal voltage system grounded conductor shall be permitted by one of the following means:

- (1) One nominal voltage system grounded conductor shall have an outer covering conforming to 200.6(A) or (B).
- (2) The grounded conductor(s) of other nominal voltage systems shall have a different outer covering conforming to 200.6(A) or (B) or by an outer covering of white or gray with a distinguishable colored stripe other than green running along the insulation.
- (3) Other and different means of identification allowed by 200.6(A) or (B) shall distinguish each nominal voltage system grounded conductor.

The means of identification shall be documented in a manner that is readily available or shall be permanently posted where the conductors of different nominal voltage systems originate.

This requirement applies only where grounded conductors of different systems are installed in a common enclosure, such as a junction or pull box or a wireway. Exhibit 200.2 illustrates an enclosure containing grounded conductors of two different systems



**EXHIBIT 200.2** Grounded conductors of different systems in the same enclosure.

that are distinguished from each other by color, which is one of the methods specified by 200.6(D). Gray and white colored insulation on conductors is recognized by the NEC® as two separate means of identifying grounded conductors. The industry practice of using white for lower-voltage systems and gray for higher-voltage systems is permitted but not mandated by the NEC.

Identifying the grounded conductors associated with one system from the grounded conductors of another system helps to ensure proper system connections. As more systems with grounded conductors are installed in a common enclosure, more means to distinguish each system grounded conductor from the other system grounded conductor in that enclosure become necessary. The only acceptable means of identifying grounded conductors are those specified in 200.6(A) and (B).

The means of identification must be included in readily accessible documentation or be posted where the conductors originate. Exhibit 200.3 is an example of a permanent label posted at electrical distribution equipment, indicating the identification scheme for the grounded conductors of each nominal voltage system.

**(E) Grounded Conductors of Multiconductor Cables.** The insulated grounded conductor(s) in a multiconductor cable shall be identified by a continuous white or gray outer finish or by three continuous white or gray stripes on other than green insulation along its entire length. For conductors that are 4 AWG or larger in cables, identification of the grounded conductor shall be permitted to comply with 200.6(B). For multiconductor flat cable with conductors that are 4 AWG or larger, an external ridge shall be permitted to identify the grounded conductor.

*Exception No. 1: Conductors within multiconductor cables shall be permitted to be re-identified at their terminations at the time of installation by a distinctive white or gray marking or other equally effective means.*

*Exception No. 2: The grounded conductor of a multiconductor varnished-cloth-insulated cable shall be permitted to be identified at its terminations at the time of installation by a distinctive white marking or other equally effective means.*

**Informational Note:** The color gray may have been used in the past as an ungrounded conductor. Care should be taken when working on existing systems.

SYSTEM 1		SYSTEM 2	
480Y/277V		208Y/120V	
PHASE A	brown	PHASE A	black
PHASE B	orange	PHASE B	red
PHASE C	yellow	PHASE C	blue
NEUTRAL	gray	NEUTRAL	white

**EXHIBIT 200.3** A label on a piece of equipment containing conductors of two nominal voltage systems that provides the required identification of the two systems.



All shades of gray insulation and marking are reserved for grounded conductors. This Informational Note warns that some existing systems have used gray to identify ungrounded conductors in those systems.

### 200.7 Use of Insulation of a White or Gray Color or with Three Continuous White or Gray Stripes.

**(A) General.** The following shall be used only for the grounded circuit conductor, unless otherwise permitted in 200.7(B) and (C):

- (1) A conductor with continuous white or gray covering
- (2) A conductor with three continuous white or gray stripes on other than green insulation
- (3) A marking of white or gray color at the termination

**(B) Circuits of Less Than 50 Volts.** A conductor with white or gray color insulation or three continuous white stripes or having a marking of white or gray at the termination for circuits of less than 50 volts shall be required to be grounded only in accordance with 250.20(A).

**(C) Circuits of 50 Volts or More.** The use of insulation that is white or gray or that has three continuous white or gray stripes for other than a grounded conductor for circuits of 50 volts or more shall be permitted only as in the following:

- (1) If part of a cable assembly that has the insulation permanently reidentified to indicate its use as an ungrounded conductor by marking tape, painting, or other effective means at its termination and at each location where the conductor is visible and accessible. Identification shall encircle the insulation and shall be a color other than white, gray, or green. If used for single-pole, 3-way or 4-way switch loops, the reidentified conductor with white or gray insulation or three continuous white or gray stripes shall be used only for the supply to the switch, but not as a return conductor from the switch to the outlet.
- (2) A flexible cord having one conductor identified by a white or gray outer finish or three continuous white or gray stripes, or by any other means in accordance with 400.22, that is used for connecting an appliance or equipment in accordance with 400.10. This shall apply to flexible cords connected to outlets whether or not the outlet is supplied by a circuit that has a grounded conductor.

**Informational Note:** The color gray may have been used in the past as an ungrounded conductor. Care should be taken when working on existing systems.

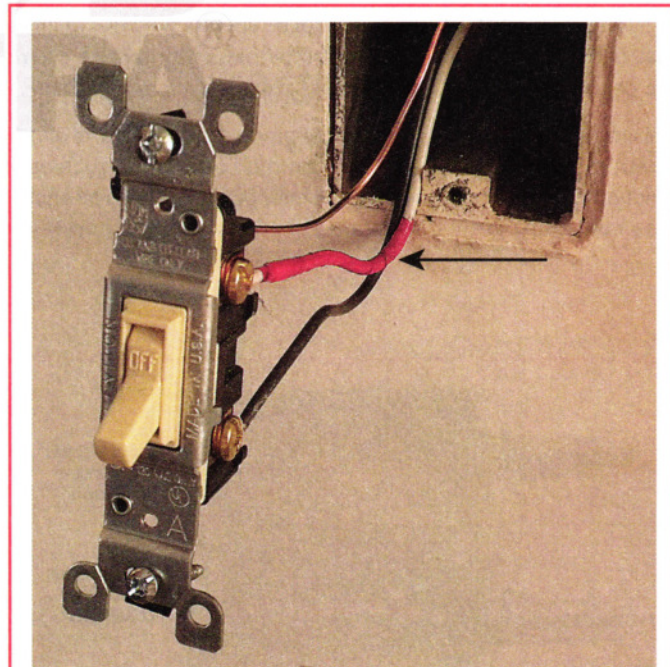
Re-identification and use of a white or gray insulated conductor as an ungrounded conductor could include conductors for water heaters, electric heating equipment, motors, and switch loops. The insulation is re-identified to avoid confusing it with grounded conductors having white or gray insulation or neutral conductors at switch and outlet points and at other points in the wiring system where the conductors are accessible.

In previous editions, the NEC permitted switch loops using a white insulated conductor to serve as an ungrounded conductor supplying the switch but not as the return ungrounded conductor to supply the lighting outlet. Re-identification of a white conductor used for this purpose was not required. However, electronic switching devices with small power supplies are available that can be installed at switch locations. These devices require a grounded conductor in order to power the internal components. Although in switch loops the conductor with white or gray insulation is re-identified at all accessible locations to indicate that it is an ungrounded conductor, it is permitted to supply only the switch and cannot be the switched ungrounded conductor to the controlled outlet.

Exhibit 200.4 shows a switch location where the conductor with the white insulation is re-identified with red tape at the termination to indicate that it is the ungrounded supply conductor run to the switch.

**Δ 200.9 Means of Identification of Terminals.** In devices or utilization equipment with polarized connections, identification of terminals to which a grounded conductor is to be connected shall be white or silver in color. The identification of other terminals shall be of a distinguishable different color.

*Exception: If the conditions of maintenance and supervision ensure that only qualified persons service the installations, terminals for grounded conductors shall be permitted to be permanently identified at the time of installation by a distinctive white marking or other equally effective means.*



**EXHIBIT 200.4** The re-identified conductor at a switch location, limited to use only as the ungrounded conductor that supplies the switch.