210.4 Multiwire Branch Circuits.

(A) General. Branch circuits recognized by this article shall be permitted as multiwire circuits. A multiwire circuit shall be permitted to be considered as multiple circuits. All conductors of a multiwire branch circuit shall originate from the same panelboard or similar distribution equipment.

FPN: A 3-phase, 4-wire, wye-connected power system used to supply power to nonlinear loads may necessitate that the power system design allow for the possibility of high harmonic currents on the neutral conductor.

The power supplies for equipment such as computers, printers, and adjustable-speed motor drives can introduce harmonic currents in the system neutral conductor. The resulting total harmonic distortion current could exceed the load current of the device itself. See the commentary following 310.15(B)(4)(c) for a discussion of neutral conductor ampacity.

(B) Disconnecting Means. Each multiwire branch circuit shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates.

Multiwire branch circuits can be dangerous when not all the ungrounded circuit conductors are de-energized and equipment supplied from a multiwire circuit is being serviced. For this reason, all ungrounded conductors of a multiwire branch circuit must be simultaneously disconnected to reduce the risk of shock to personnel working on equipment supplied by a multiwire branch circuit. The simultaneous disconnecting means requirement takes the guesswork out of ensuring safe conditions for maintenance. In former editions of the NEC, this requirement applied only where the multiwire branch circuit supplied equipment mounted to a common yoke or strap.

For a single-phase installation, the simultaneous disconnection can be achieved by two single-pole circuit breakers with an identified handle tie, as shown in Exhibit 210.1 (top), or by a 2-pole switch or circuit breaker, as shown in Exhibit 210.1 (bottom). For a 3-phase installation, a 3-pole circuit breaker or three single-pole circuit breakers with an identified handle tie provides the required simultaneous disconnection of the ungrounded conductors. Where fuses are used for the branch-circuit overcurrent protection, a 2-pole or 3-pole switch is required.

The simultaneous opening of both “hot” conductors at the panelboard effectively protects personnel from inadvertent contact with an energized conductor or device terminal during servicing. The simultaneous disconnection can be achieved by a 2-pole switch or circuit breaker, as shown in Exhibit 210.1 (bottom), or by two single-pole circuit breakers with an identified handle tie, as shown in Exhibit 210.1 (top). Where fuses are used for the branch circuit overcurrent protection, a 2-pole disconnect switch is required.
**Exhibit 210.1** Examples where 210.4(B) requires the simultaneous disconnection of all ungrounded conductors to multiwire branch circuits supplying more than one device or equipment.

(C) **Line-to-Neutral Loads.** Multiwire branch circuits shall supply only line-to-neutral loads.

*Exception No. 1:* A multiwire branch circuit that supplies only one utilization equipment.

*Exception No. 2:* Where all ungrounded conductors of the multiwire branch circuit are opened simultaneously by the branch-circuit overcurrent device.

FPN: See 300.13(B) for continuity of grounded conductor on multiwire circuits.

The term *multiwire branch circuit* is defined in Article 100 as “a branch circuit that consists of two or more ungrounded conductors that have a voltage between them, and a grounded conductor that has equal voltage between it and each ungrounded conductor of the circuit and that is connected to the neutral or grounded conductor of the system.” Although defined as “a” branch circuit, 210.4(A) permits a multiwire branch circuit to be considered as multiple circuits and could be used, for instance, to satisfy the requirement for providing two small-appliance branch circuits for countertop receptacle outlets in a dwelling-unit kitchen.

The circuit most commonly used as a multiwire branch circuit consists of two ungrounded conductors and one grounded conductor supplied from a 120/240-volt, single-phase, 3-wire system. Such multiwire circuits supply appliances that have both line-to-line and line-to-neutral connected loads, such as electric ranges and clothes dryers, and also supply loads that are line-to-neutral connected only, such as the split-wired combination device shown in Exhibit 210.1 (bottom). A multiwire branch circuit is also permitted to supply a device with a 250-volt receptacle and a 125-volt receptacle, as shown in Exhibit 210.2, provided the branch-circuit...
overcurrent device simultaneously opens both of the ungrounded conductors.

Exhibit 210.2 An example of 210.4(C), Exception No. 2, which permits a multiwire branch circuit to supply line-to-neutral and line-to-line connected loads, provided the ungrounded conductors are opened simultaneously by the branch-circuit overcurrent device.

Multiwire branch circuits have many advantages, including using three wires to do the work of four (in place of two 2-wire circuits), less raceway fill, easier balancing and phasing of a system, and less voltage drop. See the commentary following 215.2(A)(3), FPN No. 3, for further information on voltage drop for branch circuits.

Multiwire branch circuits may be derived from a 120/240-volt, single-phase; a 208Y/120-volt and 480Y/277-volt, 3-phase, 4-wire; or a 240/120-volt, 3-phase, 4-wire delta system. Section 210.11(B) requires multiwire branch circuits to be properly balanced. If two ungrounded conductors and a common neutral are used as a multiwire branch circuit supplied from a 208Y/120-volt, 3-phase, 4-wire system, the neutral carries the same current as the phase conductor with the highest current and, therefore, should be the same size. The neutral for a 2-phase, 3-wire or a 2-phase, 5-wire circuit must be sized to carry 140 percent of the ampere rating of the circuit, as required by 220.61(A) Exception. See the commentary following 210.4(A), FPN, for further information on 3-phase, 4-wire system neutral conductors.

If loads are connected line-to-line (i.e., utilization equipment connected between 2 or 3 phases), 2-pole or 3-pole circuit breakers are required to disconnect all ungrounded conductors simultaneously. In testing 240-volt equipment, it is quite possible not to realize that the circuit is still energized with 120 volts if one pole of the overcurrent device is open. See 210.10 and 240.15(B) for further information on circuit breaker overcurrent protection of ungrounded conductors. Other precautions concerning device removal on multiwire branch circuits are found in the commentary following 300.13(B).

(D) Grouping. The ungrounded and grounded conductors of each multiwire branch circuit shall be grouped by wire ties or similar means in at least one location within the panelboard or other point of origination.

Exception: The requirement for grouping shall not apply if the circuit enters from a cable or raceway unique to the circuit that makes the grouping obvious.
PART I. GENERAL PROVISIONS

210.1 Scope. Article 210 contains the requirements for conductor sizing, overcurrent protection, identification, and GFCI protection of branch circuits, as well as receptacle outlets and lighting outlet requirements.

Author's Comment: Article 100 defines a "branch circuit" as the conductors between the final overcurrent device and the receptacle outlets, lighting outlets, or other outlets. Figure 210-1

210.2 Other Articles. Other NEC sections that have specific requirements for branch circuits include:

- Air-Conditioning and Refrigeration, 440.6, 440.31, and 440.32
- Appliances, 422.10
- Data Processing (Information Technology) Equipment, 645.5
- Electric Space-Heating Equipment, 424.3(B)
- Motors, 430.22
- Signs, 600.5

210.3 Branch-Circuit Rating. The rating of a branch circuit is determined by the rating of the branch-circuit overcurrent device, not the conductor size.

Author's Comment: For example, the branch-circuit ampere rating of 10 THHN conductors on a 20A circuit breaker is 20A. Figure 210-2

210.4 Multiwire Branch Circuits.

(A) General. A multiwire branch circuit can be considered a single circuit or a multiple circuit.

Author's Comments:

- See the definition of "Multiwire Branch Circuit" in Article 100.
- Two small-appliance circuits are required for receptacles that serve countertops in dwelling unit kitchens [210.11(C)(1) and 210.52(B)]. One 3-wire, single-phase, 120/240V multiwire branch circuit can be used for this purpose.

To prevent inductive heating and to reduce conductor impedance for fault currents, all conductors of a multiwire branch circuit must originate from the same panelboard.

Author's Comment: For more information on the inductive heating of metal parts, see 300.3(B), 300.50, and 300.20.

FPN: Unwanted and potentially hazardous harmonic neutral currents can cause additional heating of the neutral conductor of a 4-wire, three-phase, 120/208V or 277/480V wye-connected system, which supplies nonlinear loads.

Author's Comment: To prevent fire or equipment damage from excessive harmonic neutral currents, the designer should consider: (1) increasing the size of the neutral conductor, or (2) installing a separate neutral for each phase. Also see 220.61(C) (2) FPN No. 2, and 310.15(B)(4)(c) in this textbook. Figure 210-3
**210.4 Branch Circuits**

**Multiwire Branch Circuits**
 Harmonic Neutral Conductor Current
Section 210.4(A) FPN

![Diagram of Multiwire Branch Circuits](image)

Potentially hazardous harmonic currents can add to the neutral conductor of a 3-phase, 120/208V or 277/480V, 4-wire wye-connected power system.

**Figure 210–3**

**Author’s Comments:**
- See the definition of “Nonlinear Load” in Article 100.
- For more information, please visit www.MikeHolt.com. Click on “Technical Information” on the left side of the page, then select “Power Quality.”

**(B) Disconnecting Means.** Each multiwire branch circuit must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates. **Figure 210–4**

**Multiwire Branch Circuit**
Disconnecting Means
Section 210.4(B)

- Two 1-pole breakers with identified handle tie, or
- One 2-pole breaker.

![Diagram of Multiwire Branch Circuit](image)

Each multiwire branch circuit must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates.

**Figure 210–4**

**Author’s Comment:** Individual single-pole circuit breakers with handle ties identified for the purpose, or a breaker with common internal trip, can be used for this application [240.15(B)(1)].

**CAUTION:** This rule is intended to prevent people from working on energized circuits they thought were disconnected.

**(C) Line-to-Neutral Loads.** Multiwire branch circuits must supply only line-to-neutral loads.

**Exception No. 1:** A multiwire branch circuit is permitted to supply an individual piece of line-to-line utilization equipment, such as a range or dryer.

**Exception No. 2:** A multiwire branch circuit is permitted to supply both line-to-line and line-to-neutral loads if the circuit is protected by a device (multipole circuit breaker) that opens all ungrounded conductors of the multiwire branch circuit simultaneously (common internal trip) under a fault condition. **Figure 210–5**

**Multiwire Branch Circuit**
Line-to-Line and Line-to-Neutral Loads
Section 210.4(C) Ex 2

![Diagram of Multiwire Branch Circuit](image)

A multiwire branch circuit can supply both line-to-line and line-to-neutral loads where all ungrounded conductors are opened simultaneously by the overcurrent device.

**Figure 210–5**

**FPN:** See 300.13(B) for the requirements relating to the continuity of the neutral conductor on multiwire branch circuits.

**CAUTION:** If the continuity of the neutral conductor of a multiwire circuit is interrupted (open), the resultant over- or undervoltage can cause a fire and/or destruction of electrical equipment. For details on how this occurs, see 300.13(B) in this textbook. **Figure 210–6**
(D) **Grouping.** The ungrounded and neutral conductors of a multiwire branch circuit must be grouped together in at least one location by wire ties or similar means at the point of origination. *Figure 210-7*

**Author's Comment:** Grouping all associated conductors of a multiwire branch circuit together by wire ties or other means within the panel or origination point of the circuit makes it easier to visually identify the conductors of the multiwire branch circuit. The grouping will assist in connecting multiwire branch circuit conductors to circuit breakers correctly, particularly where twin breakers are used. If proper diligence is not exercised when making these connections, two circuit conductors could be accidentally connected to the same phase conductor.

**CAUTION:** If the ungrounded conductors of a multiwire circuit are not terminated to different phases or lines, the currents on the neutral conductor will not cancel, but will add, which can cause an overload on the neutral conductor. *Figure 210-8*

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210.5 **Identification for Branch Circuits.**

(A) **Neutral Conductor.** The neutral conductor of a branch circuit must be identified in accordance with 200.6.

(B) **Equipment Grounding Conductor.** Equipment grounding conductors can be bare, covered, or insulated. Insulated equipment grounding conductors size 6 AWG and smaller must have a continuous outer finish either green or green with one or more yellow stripes [250.119].

On equipment grounding conductors larger than 6 AWG, insulation can be permanently reidentified with green marking at the time of installation at every point where the conductor is accessible [250.119(A)].
210.4 Multiwire Branch Circuits.

(A) General. Branch circuits recognized by this article shall be permitted as multiwire circuits. A multiwire circuit shall be permitted to be considered as multiple circuits. All conductors of a multiwire branch circuit shall originate from the same panelboard or similar distribution equipment.

FPN: A 3-phase, 4-wire, wye-connected power system used to supply power to nonlinear loads may necessitate that the power system design allow for the possibility of high harmonic currents on the neutral conductor.

The power supplies for equipment such as computers, printers, and adjustable-speed motor drives can introduce harmonic currents in the system neutral conductor. The resulting total harmonic distortion current could exceed the load current of the device itself. See the commentary following 310.15(B)(4)(c) for a discussion of neutral conductor ampacity.

(B) Disconnecting Means. Each multiwire branch circuit shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates.

Multiwire branch circuits can be dangerous when not all the ungrounded circuit conductors are de-energized and equipment supplied from a multiwire circuit is being serviced. For this reason, all ungrounded conductors of a multiwire branch circuit must be simultaneously disconnected to reduce the risk of shock to personnel working on equipment supplied by a multiwire branch circuit. The simultaneous disconnecting means requirement takes the guesswork out of ensuring safe conditions for maintenance. In former editions of the NEC, this requirement applied only where the multiwire branch circuit supplied equipment mounted to a common yoke or strap.

For a single-phase installation, the simultaneous disconnection can be achieved by two single-pole circuit breakers with an identified handle tie, as shown in Exhibit 210.1 (top), or by a 2-pole switch or circuit breaker, as shown in Exhibit 210.1 (bottom). For a 3-phase installation, a 3-pole circuit breaker or three single-pole circuit breakers with an identified handle tie provides the required simultaneous disconnection of the ungrounded conductors. Where fuses are used for the branch-circuit overcurrent protection, a 2-pole or 3-pole switch is required.

The simultaneous opening of both “hot” conductors at the panelboard effectively protects personnel from inadvertent contact with an energized conductor or device terminal during servicing. The simultaneous disconnection can be achieved by a 2-pole switch or circuit breaker, as shown in Exhibit 210.1 (bottom), or by two single-pole circuit breakers with an identified handle tie, as shown in Exhibit 210.1 (top). Where fuses are used for the branch circuit overcurrent protection, a 2-pole disconnect switch is required.
(C) **Line-to-Neutral Loads.** Multiwire branch circuits shall supply only line-to-neutral loads.

*Exception No. 1:* A multiwire branch circuit that supplies only one utilization equipment.

*Exception No. 2:* Where all ungrounded conductors of the multiwire branch circuit are opened simultaneously by the branch-circuit overcurrent device.

FPN: See 300.13(B) for continuity of grounded conductor on multiwire circuits.

The term *multiwire branch circuit* is defined in Article 100 as “a branch circuit that consists of two or more ungrounded conductors that have a voltage between them, and a grounded conductor that has equal voltage between it and each ungrounded conductor of the circuit and that is connected to the neutral or grounded conductor of the system.” Although defined as “a” branch circuit, 210.4(A) permits a multiwire branch circuit to be considered as multiple circuits and could be used, for instance, to satisfy the requirement for providing two small-appliance branch circuits for countertop receptacle outlets in a dwelling-unit kitchen.

The circuit most commonly used as a multiwire branch circuit consists of two ungrounded conductors and one grounded conductor supplied from a 120/240-volt, single-phase, 3-wire system. Such multiwire circuits supply appliances that have both line-to-line and line-to-neutral connected loads, such as electric ranges and clothes dryers, and also supply loads that are line-to-neutral connected only, such as the split-wired combination device shown in Exhibit 210.1 (bottom). A multiwire branch circuit is also permitted to supply a device with a 250-volt receptacle and a 125-volt receptacle, as shown in Exhibit 210.2, provided the branch-circuit...
overcurrent device simultaneously opens both of the ungrounded conductors.

![Diagram showing a two-pole circuit breaker or switch, a multiwire branch circuit, and a combination receptacle.](image)

**Exhibit 210.2** An example of 210.4(C), Exception No. 2, which permits a multiwire branch circuit to supply line-to-neutral and line-to-line connected loads, provided the ungrounded conductors are opened simultaneously by the branch-circuit overcurrent device.

Multiwire branch circuits have many advantages, including using three wires to do the work of four (in place of two 2-wire circuits), less raceway fill, easier balancing and phasing of a system, and less voltage drop. See the commentary following 215.2(A)(3), FPN No. 3, for further information on voltage drop for branch circuits.

Multiwire branch circuits may be derived from a 120/240-volt, single-phase; a 208Y/120-volt and 480Y/277-volt, 3-phase, 4-wire; or a 240/120-volt, 3-phase, 4-wire delta system. Section 210.11(B) requires multiwire branch circuits to be properly balanced. If two ungrounded conductors and a common neutral are used as a multiwire branch circuit supplied from a 208Y/120-volt, 3-phase, 4-wire system, the neutral carries the same current as the phase conductor with the highest current and, therefore, should be the same size. The neutral for a 2-phase, 3-wire or a 2-phase, 5-wire circuit must be sized to carry 140 percent of the ampere rating of the circuit, as required by 220.61(A) Exception. See the commentary following 210.4(A), FPN, for further information on 3-phase, 4-wire system neutral conductors.

If loads are connected line-to-line (i.e., utilization equipment connected between 2 or 3 phases), 2-pole or 3-pole circuit breakers are required to disconnect all ungrounded conductors simultaneously. In testing 240-volt equipment, it is quite possible not to realize that the circuit is still energized with 120 volts if one pole of the overcurrent device is open. See 210.10 and 240.15(B) for further information on circuit breaker overcurrent protection of ungrounded conductors. Other precautions concerning device removal on multiwire branch circuits are found in the commentary following 300.13(B).

**240.15 Ungrounded Conductors.**

**A Overcurrent Device Required.** A fuse or an overcurrent trip unit of a circuit breaker shall
be connected in series with each ungrounded conductor. A combination of a current transformer and overcurrent relay shall be considered equivalent to an overcurrent trip unit.

FPN: For motor circuits, see Parts III, IV, V, and XI of Article 430.

(B) Circuit Breaker as Overcurrent Device. Circuit breakers shall open all ungrounded conductors of the circuit both manually and automatically unless otherwise permitted in 240.15(B)(1), (B)(2), and (B)(3).

(1) Multiwire Branch Circuit. Except where limited by 210.4(B), individual single-pole circuit breakers, with or without identified handle ties, shall be permitted as the protection for each ungrounded conductor of multiwire branch circuits that serve only single-phase line-to-neutral loads.

(2) Grounded Single-Phase and 3-Wire dc Circuits. In grounded systems, individual single-pole circuit breakers with identified handle ties shall be permitted as the protection for each ungrounded conductor for line-to-line connected loads for single-phase circuits or 3-wire, direct-current circuits.

(3) 3-Phase and 2-Phase Systems. For line-to-line loads in 4-wire, 3-phase systems or 5-wire, 2-phase systems having a grounded neutral point and no conductor operating at a voltage greater than permitted in 210.6, individual single-pole circuit breakers with identified handle ties shall be permitted as the protection for each ungrounded conductor.

Before discussing handle ties, it is important to understand the Article 100 definition of the term multiwire branch circuit, as well as 210.4(C) and its two exceptions. Multiwire branch circuits are permitted to supply line-to-line connected loads where the loads are associated with a single piece of utilization equipment or where all of the ungrounded conductors are opened simultaneously by the branch-circuit overcurrent device (automatic opening in response to overcurrent). See the commentary following 210.4(C) for additional information.

The basic rule in 240.15(B) requires circuit breakers to open all ungrounded conductors of the circuit when it trips (automatic operation in response to overcurrent) or is manually operated as a disconnecting means. For 2-wire circuits with one conductor grounded, this rule is simple and needs no further explanation. For multiwire branch circuits of 600 volts or less, however, there are three acceptable methods of complying with this rule.

The first, and most widely used, method is to install a multipole circuit breaker with an internal common trip mechanism. The use of such multipole devices ensures compliance with all of the Code requirements for overcurrent protection and disconnecting of multiwire branch circuits. This breaker is operated by an external single lever internally attached to the two or three poles of the circuit breaker, or the external lever may be attached to multiple handles operated as one, provided the breaker is a factory-assembled unit in accordance with 240.8. Underwriters Laboratories refers to these devices as multipole common trip circuit breakers. This type of circuit breaker is required to be used for branch circuits that comprise multiple ungrounded conductors supplied by ungrounded 3-phase and single-phase systems. Where circuit breakers are used on ungrounded systems, it is important to verify compliance with the application
requirements in 240.85. Of course, multipole common trip circuit breakers are permitted to be
installed on any branch circuit supplied from a grounded system where used within their
ratings.

The second option permitted for multiwire branch circuits is to use two or three single-pole
circuit breakers and add an identified handle tie to function as a common operating handle.
This multipole circuit breaker is field assembled by externally attaching an identified common
lever (handle tie) onto the two or three individual circuit breakers. It is important to understand
that handle ties do not cause the circuit breaker to function as a common trip device; rather,
they only allow common operation as a disconnecting means. Handle tie mechanism circuit
breakers are permitted as a substitute for internal common trip mechanism circuit breakers only
for limited applications. Unless specifically prohibited elsewhere, circuit breakers with
identified handle ties are permitted for multiwire branch circuits only where the circuit is
supplied from grounded 3-phase or grounded single-phase systems. The single-pole circuit
breakers used together in this fashion must be rated for the dual voltage encountered, such as
120/240 volts. It is important to note that the term approved was revised to identified for the
2005 Code, to require the use of hardware designed specifically to perform this common
disconnecting means function. The use of approved, homemade hardware to perform this
function is no longer permitted.

It is important to correlate the requirements of 240.15 with those in 210.4(B) covering
disconnection of multiwire branch circuits. The revision to 210.4(B) in the 2008 Code requires
a means to simultaneously disconnect all ungrounded conductors of the multiwire branch
circuit. The use of a multipole switch or circuit breaker satisfies the 210.4(B) requirement, as
does the use of single-pole circuit breakers with identified handle ties. The use of a multipole
circuit breaker or single-pole circuit breakers joined with handle ties to comply with 210.4(B)
also satisfies the requirements of 240.15 on the use of circuit breakers to provide overcurrent
protection of multiwire branch circuits.

Exhibits 240.4 through 240.6 illustrate the application of 240.15(B). In Exhibit 240.4, where
multipole common trip circuit breakers are required, handle ties are not permitted because the
circuits are supplied from ungrounded systems. In Exhibit 240.5, where the supply systems are
grounded, single-pole circuit breakers are permitted and handle ties or common trip operation
is not required because the circuits supply line-to-neutral loads. In Exhibit 240.6, in which
line-to-line loads are supplied from single-phase or 4-wire, 3-phase systems, identified handle
ties or multipole common trip circuit breakers are permitted.
Exhibit 240.4 Examples of circuits that require multipole common trip–type circuit breakers, in accordance with 240.15(B).

Exhibit 240.5 Examples of circuits in which single-pole circuit breakers are permitted, in accordance with 240.15(B)(1), because they open the ungrounded conductor of the circuit.
Exhibit 240.6 Examples of circuits in which identified handle ties are permitted to provide the simultaneous disconnecting function in accordance with 240.15(B)(2) or 240.15(B)(3).

(C) Closed-Loop Power Distribution Systems. Listed devices that provide equivalent overcurrent protection in closed-loop power distribution systems shall be permitted as a substitute for fuses or circuit breakers.
ANY MULTIVOLT BRANCH CIRCUIT MUST HAVE A "MEANS" FOR SIMULTANEOUSLY DISCONNECTING ALL UNGROUNDED CONDUCTORS AT THE POINT WHERE THE BRANCH CIRCUIT ORIGINATES …

2-pole CB or two 1-pole CBs with handle tie

… OR THIS MAY BE DONE …

Multivolt circuit that supplies any split-wire receptacles or combination devices

Panel

Multiwire circuit with plug fuses

2-pole switch with plug fuses

Panel N

Split-wired receptacle, duplex switch, or combination switch-receptacle

To other receptacles and/or other outlets

240 V receptacle

120 V receptacle

Only a 2-pole protective device (2-pole CB) may be used here to open both poles on any overcurrent when phase-to-phase load (240 V receptacle) is supplied.

Fig. 2107.

It should also be noted that although a 2-pole switch ahead of fuses may satisfy the simultaneous disconnect requirement ahead of split-wire receptacles, such a switch does not satisfy the simultaneous multiple "branch-circuit protective device" that is required by Exception No. 2 of 210-24. If a multivolt circuit supplies any twist-connected phase-to-phase, in such a case a 2-pole CB must be used because fuses are single-pole devices and do not ensure simultaneous opening of all hot legs on installation or ground fault.

It should be noted that the threat of motor burnout, shown in the diagram of Fig. 2105, may arise just as readily where the 230 V receptacle device and the 115 V motor are fed from a dual-voltage (240 V, 120 V) duplex receptacle as where loads are fixed wired. As shown in Fig. 2108, the 2-pole CB (not single-pole CBs or fuses) for a 2-pole CB (not single-pole CBs or fuses) for a circuit supplying a dual-voltage receptacle. In such a case a line-to-line load and a line-to-neutral load could be connected and subjected to the condition shown in Fig. 2109.

Fig. 2108.

At the end of part (C), a fire-protective note calls attention to 210-24(B), which replaces maintaining the continuity of the grounded neutral wire in a multivolt branch circuit by signaling the neutral to the neutral terminal of a receptacle. Exception No. 2 of 210-12(C) and 210-13(E) are both aimed at the same safety objective: to prevent the use of electrical equipment that can result when hot sides of ungrounded conductors are connected from hot leg to hot leg as a result of opening the neutral of an energized multivolt branch circuit or an ungrounded conductor or to neutral (210-12(C)) or the Like wires of different systems (210-13(E)) in parallel between the neutral and any ungrounded conductor. To the neutral terminal of a receptacle. If the neutral is removed, the neutral will not be energized.

This rule is intended to prevent the establishment of ungrounded voltages should a neutral conductor be opened first when a receptacle or similar device is opened on an energized circuit. In such cases, the line-to-neutral connections downstream from this point (former of the point of supply) could result in a considerably higher-than-normal voltage on one part of a multivolt circuit and damage equipment, because of the "voltage" reversal. If the downstream load is balanced, this may result in a substantial overvoltage. If the conductors enter a cable assembly that makes the grounding obvious, or in a receptacle containing only one multivolt circuit so that the grounding is obvious, then the rule is satisfied. However, if multiple multivolt circuits enter through common panels or rooms in a receptacle, you must keep track of which wire (white or gray) goes with which ungrounded conductors, and ground them together at least once using white or gray or similar methods.

Note that if a two-wire assembly contains multivolt circuits enter a panel through a multivolt circuit, additional grounding within the panel would probably be required because the two multivolt would no longer satisfy as obvious.

2105. Identification for Branch Circuits. For grounding and grounded circuits (use section simply, check the feeder to comply with other Code notes that cover conductor color-coding or color-identification schemes. It directs that "grounded and neutralizing" conductors in branch circuits utilize the specific color identification given in 210-13 and 210-14. These rules generally provide the color identification for grounding and service conductors and white, gray, or three continuous white wires on other than green-identified conductors for the grounded conductor section.

It should be noted that rules on color-coding of conductors given in Art. 210 apply only to branch-circuit conductors and do not directly require color coding of feeder conductors. But the rules given in 210-13 and 210-14 are generally observed, and could apply to feeder and service conductors. 210-13(c) requires identification of phase leads of feeder to parallelize switches, and so forth—and requires that for marking the phase leads, those provisions are not harmonized with the ones here for branch circuits. Note that many design engineers have insisted on color coding of feeder conductors all along to afford a better balance of loads on the different phase legs.

Color identification for branch-circuit conductors is divided into three categories:

Grounded conductor. As indicated, grounded conductors must satisfy 210-13(f), that generally requires that the grounded conductor of a branch circuit (the neutral of a single conductor of a grounded phase of a delta) must be identified by a continuous white color for the entire length of the conductor, or have three continuous white stripes for the entire length, or otherwise as specified (when used in parallel with different systems). When used in parallel with different systems, the neutral must be identified by a solid white wire if the first one is white, and a solid gray wire if the second one is white, etc., or it must be otherwise distinguished—such as by peeling or painting. The point is that neutral of different systems must be distinguished from each other when they are in the same conductor.

210-9(d) and 210-19(d) for more. 2004 NEC.

Fig. 2109.

WHEN BUILDING CONTAINS ONLY ONE SYSTEM VOLTAGE FOR CIRCUITS:

Neutral must be white or gray . . .

[Diagram showing 3-phase, 4-wire circuit with neutral and ground connections indicated]
Ex. No. 1. A multiwire branch circuit may supply a single utilization equipment with line-to-line and line-to-neutral voltage using single-pole switching devices in branch-circuit protection.

Ex. No. 2. A multiwire branch circuit may supply loads connected only to line-to-line and/or line-to-neutral. These 3 loads could be 600 V balanced connected line-to-line, line-to-neutral, or with a single 3-pole fused switch.

Fig. 210.5 Line-to-line loads may only be connected on multiwire circuits that conform to the Exception given in Section 210.16.

Exception No. 1 permits use of single-pole disconnecting means for an individual circuit to "only one utilization equipment," which the load may be connected line-to-line as well as line-to-neutral. "Utilization equipment," as defined in Art. 100, is an equipment which utilizes electric energy for electrical, electromechanical, chemical, heating, lighting, or similar purposes. The definition of "appliances" in Art. 100 notes that an appliance is utilized equipment, generally other than motor, that is normally built in standardized sizes and types and is installed or connected as a unit to perform one or more functions such as washing clothes, all conditioning, food mixing, deep frying, and so forth. Because of these definitions, the wording of Exception No. 1 applies to commercial and industrial equipment as well as residences. It should be noted that 210.4(B) applies in these cases and therefore means must still be provided such as hand ties, etc., for proper switching.

Exception No. 2 permits a multiwire branch-circuit to supply line-to-line connected loads, but only when it is protected by a multiwire branch-circuit fuse (CB). The intent of Exception No. 2 is to allow a line-to-line connected load to be used (rather than in Exception No. 3) only where the place of the circuit protective device operates together or simultaneously. A multiwire CB satisfies this requirement, but a fused multiwire switch would not comply because the hot circuit conductors are not switched simultaneously by the branch-circuit overcurrent device. This rule requiring a multiwire CB for any circuit that supplies line-to-line connected loads, as well as line-to-neutral loads, was put in the Code to prevent equipment loss under the conditions shown in Fig. 210.7.

Use of a 2-pole CB is the switch would cause opening of both hot legs on any fault and prevent the short circuit.

Should fuse B open, the heater and motor would be in series on 115 volts, and the out would burn up if not properly protected.

Fig. 210.6 Single-pole protection can expose equipment to damage. (Sec. 210.2)
It is important to note that if the size of the overcurrent device that actually determines the rating of any component of a circuit is equal to or smaller than that of the protective device, in a typical case, a 20A circuit breaker in a panelboard might be used to protect a branch circuit on which 10 A wires conductors are used as the circuit wires. Although the load on the circuit does not exceed the rating of the 20A and 12 A conductors would have sufficient current-carrying capacity to be used in the circuit, the 10 A conductors with their rating of 20 A were selected to reduce the voltage drop to an acceptable level. This configuration complies with the requirements of the overcurrent device. The current rating of the wire does not enter into the simple classification of the circuit.

210.4. Multiconductor Branch Circuits. A branch circuit, as defined by Art. 210, may be a 2wire circuit or it may be a 'multiconductor' branch circuit. A 'multiconductor' branch circuit considers the condition of two or more ungrounded conductors having a potential difference between them and an identified grounded conductor having equal potential differences between them and each of the ungrounded conductors and which is connected to the neutral conductor of the system. Thus, a 2-wire circuit consisting of two approximately equally spaced ungrounded conductors and a neutral conductor is defined as a 'nonelectric' 2-wire circuit. A 3-wire circuit consisting of a neutral wire and two 2-wire circuits is a single multiconductor branch circuit. This is one circuit, even though it involves two or three single- or double-pole devices in the panelboard (Fig. 210.1B). This is important, because the general definition of the Code refers to a circuit consisting of one branch circuit or the single branch circuit. (See 210.32 Exception and 410.85.)

NOTE: Typical receptacles supplied by such layout could be rated 60 A, 100 A, 200 A or 400 A—with their supply circuit of the same rating. Such hookups are common in jet aerial power installations for supplying cord-connected equipment used for servicing individual planes in their hangar bays.

**Fig. 210.4:** A circuit to a single load device or equipment may have any rating. (Sec. 210.3)

It is not required that the size of the overcurrent device that actually determines the rating of any component of a circuit be equal to or smaller than that of the protective device. It is also common practice to determine the rating of any component of a branch circuit on a single conductor rated higher than that of the protective device. In a typical case, a 20A circuit breaker in a panelboard might be used to protect a branch circuit on which 10 A wire conductors are used as the circuit wires. Although the load on the circuit does not exceed the rating of the 20A and 12 A conductors would have sufficient current-carrying capacity to be used in the circuit, the 10 A conductors with their rating of 20 A were selected to reduce the voltage drop to an acceptable level. This configuration complies with the requirements of the overcurrent device. The current rating of the wire does not enter into the simple classification of the circuit.

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**Fig. 210.4:** A circuit to a single load device or equipment may have any rating. (Sec. 210.3)

**INDIVIDUAL BRANCH CIRCUIT**

**Fuse or CB:** No size limitation

Supplies only utilization equipment

**Fig. 210.6:** Branch circuits may be 2-wire or multiwire types. (Sec. 210.6)

**Fig. 210.8:** This is the basic rule

**Fig. 210.9:** Multiconductor branch circuits shall supply only line-to-neutral connected loads. (Sec. 210.4)

**Fig. 210.10:** With single-pole protection only line-to-neutral loads may be fed. (Sec. 210.4)

**Fig. 210.11:** Multiconductor branch circuits shall supply only line-to-neutral connected loads. (Sec. 210.4)

**Fig. 210.12:** With single-pole protection only line-to-neutral loads may be fed. (Sec. 210.4)