

A/C  
BREAK  
LO

having the higher voltage to ground on 3-phase, connected systems. Other busbar arrangements permitted for additions to existing installations and modifications.

Equipment within the same single section or multi-section switchboard, switchgear, or panelboard as the meter on a 3-phase, delta-connected system shall be permitted to be on a 2-phase configuration as the metering equipment.

Note: See 110.15 for requirements on marking the phase conductor having the higher voltage to ground on a 4-wire, delta-connected system.

**Arrangement.** Direct-current ungrounded buses shall be in any order. Arrangement of dc buses shall be marked as to polarity, grounding system, and voltage.

**Signage, Switchgear, or Panelboard Identification.** Identification sign(s) or a label(s) provided in accordance with 110.1 through (F)(5) shall comply with 110.21(B).

**Field Identification.** A switchboard, switchgear, or panelboard containing a 4-wire, delta-connected system where one phase winding is grounded shall be legibly and permanently field marked as follows:

1. "\_\_\_\_ Phase Has \_\_\_\_ Volts to Ground"

Requirement for legible marking of a switchboard, switchgear, or panelboard that contains a 3-phase, 4-wire center-tap system results from injury and property damage to people not recognizing there is a high leg in the switchgear, or panelboard. This requirement eliminates the hazards of accidentally connecting outlets to and causing injury to people and damage to equipment.

**Ungrounded AC Systems.** A switchboard, switchgear, or panelboard containing an ungrounded ac electrical system in accordance with 250.21 shall be legibly and permanently field marked as follows:

1. "Ungrounded System Operating — \_\_\_\_ Volts Between Conductors"

This requirement is to delineate grounded from ungrounded electrical systems. When a ground fault occurs on an ungrounded system, the voltage to ground on the system may equal the line-to-line voltage. The operation of using an ungrounded system is continuity of service which in some processes might create a safer condition. This could be achieved by automatic or unplanned opening of the circuit. Section 250.21(B) requires ungrounded systems less than 120 volts and not more than 1000 volts to be equipped with ground detection. Ground detection will warn of a fault to permit an orderly shutdown of a process.

**(3) High-Impedance Grounded Neutral AC System.** A switchboard, switchgear, or panelboard containing a high-impedance grounded neutral ac system in accordance with 250.36 shall be legibly and permanently field marked as follows:

CAUTION: HIGH-IMPEDANCE GROUND  
NEUTRAL AC SYSTEM OPERATING — \_\_\_\_  
VOLTS BETWEEN CONDUCTORS AND MAY  
OPERATE — \_\_\_\_ VOLTS TO GROUND FOR  
INDEFINITE PERIODS UNDER FAULT CONDITIONS

**(4) Ungrounded DC Systems.** A switchboard, switchgear, or panelboard containing an ungrounded dc electrical system in accordance with 250.169 shall be legibly and permanently field marked as follows:

CAUTION: UNGROUNDED DC SYSTEM OPERATING —  
\_\_\_\_ VOLTS BETWEEN CONDUCTORS

**(5) Resistively Grounded DC Systems.** A switchboard, switchgear, or panelboard containing a resistive connection between current-carrying conductors and the grounding system to stabilize voltage to ground shall be legibly and permanently field marked as follows:

CAUTION: DC SYSTEM OPERATING — \_\_\_\_  
VOLTS BETWEEN CONDUCTORS AND MAY  
OPERATE — \_\_\_\_ VOLTS TO GROUND FOR  
INDEFINITE PERIODS UNDER FAULT CONDITIONS

**(G) Minimum Wire-Bending Space.** The minimum wire-bending space at terminals and minimum gutter space provided in switchboards, switchgear, and panelboards shall be as required in 312.6.

#### 408.4 Field Identification Required

**(A) Circuit Directory or Circuit Identification.** Every circuit and circuit modification shall be legibly identified as to its clear, evident, and specific purpose or use. The identification shall include an approved degree of detail that allows each circuit to be distinguished from all others. Spare positions that contain unused overcurrent devices or switches shall be described accordingly. The identification shall be included in a circuit directory that is located on the face or inside of the panel door in the case of a panelboard and at each switch or circuit breaker in a switchboard or switchgear. No circuit shall be described in a manner that depends on transient conditions of occupancy.

The circuit directory is an important feature for the safe operation of an electrical system under normal and emergency conditions. The purpose of an accurate and legible circuit directory in these types of equipment is to provide clear identification of circuit breakers and switches that may need to be operated by service personnel or others responding who need to operate a switch or circuit breaker in an emergency. This requirement is

specific to switchboards, switchgear, and panelboards; however, the identification requirements of 110.22 apply to all disconnecting means.

Circuits used for the same purpose must be identified by their location. For example, small-appliance branch circuits can supply outlets in the kitchen, dining room, and kitchen countertops. Identifying these circuits as small-appliance branch circuits is not acceptable; instead, they should be identified as "kitchen wall receptacles," "dining room floor receptacle," or "kitchen countertop receptacles left of sink." Circuit directories containing multiple entries with only "lights" or "outlets" do not provide the sufficient detail required by this section.

Spare devices are required to be marked to indicate that they are spares. Markings are required to indicate permanent features and not temporary conditions of occupancy. For example, for a circuit breaker supplying an office, a label with the employee's name is no longer useful when the employee no longer occupies that office.

**(B) Source of Supply.** All switchboards, switchgear, and panelboards supplied by a feeder(s) in other than one- or two-family dwellings shall be marked to indicate each device or equipment where the power originates.

Tracing a feeder circuit back to its originating switchboard, switchgear, panelboard, or other source can be a time-consuming and inaccurate process. Accurate identification of circuits promotes more efficient lockout/tagout processes, which provide a safer work environment for employees. Identification of the feeder circuit when the new feeder is being added is also more economical than the time-consuming process of tracing a circuit.

#### 408.5 Clearance for Conductor Entering Bus Enclosures

Where conduits or other raceways enter a switchboard, switchgear, floor-standing panelboard, or similar enclosure at the bottom, approved space shall be provided to permit installation of conductors in the enclosure. The wiring space shall not be less than shown in Table 408.5 where the conduit or raceways enter or leave the enclosure below the busbars, their supports, or other obstructions. The conduit or raceways, including their end fittings, shall not rise more than 75 mm (3 in.) above the bottom of the enclosure.

#### 408.7 Unused Openings

Unused openings for circuit breakers and switches shall be closed using identified closures, or other approved means that provide protection substantially equivalent to the wall of the enclosure.

The requirement of 110.12(A) for closing unused openings (other than those provided for equipment mounting or drainage) applies to all electrical enclosures, including panelboard cabinets, switchgear, and switchboard enclosures. An unused opening may exist as a result of a renovation or an alteration of existing equipment.

**TABLE 408.5** Clearance for Conductors Entering Bus Enclosures

Conductor	Minimum Spacing Between Bottom of Enclosure and Busbars, Their Supports, or Other Obstructions	
	mm	in.
Insulated busbars, their supports, or other obstructions	200	8
Noninsulated busbars	250	10

These two requirements are necessary to restore the electrical equipment enclosure integrity to a condition that minimizes the possibility of an escaping arc, spark, or molten metal igniting surrounding combustible material and also minimizes the potential for accidental contact with live parts.

## II. Switchboards and Switchgear

### 408.16 Switchboards and Switchgear in Damp or Wet Locations

Switchboards and switchgear in damp or wet locations shall be installed in accordance with 312.2.

### 408.17 Location Relative to Easily Ignitable Material

Switchboards and switchgear shall be placed so as to reduce to a minimum the probability of communicating fire to adjacent combustible materials. Where installed over a combustible floor, suitable protection thereto shall be provided.

Where flooring is combustible, one means of complying with this requirement is to form and attach a piece of sheet steel or other suitable noncombustible material to the floor under the electrical equipment.

### 408.18 Clearances

**(A) From Ceiling.** For other than a totally enclosed switchboard or switchgear, a space not less than 900 mm (3 ft) shall be provided between the top of the switchboard or switchgear and any combustible ceiling, unless a noncombustible shield is provided between the switchboard or switchgear and the ceiling.

**(B) Around Switchboards and Switchgear.** Clearances around switchboards and switchgear shall comply with the provisions of 110.26.

Sufficient access and working space permit safe operation and maintenance of switchboards and switchgear. Table 110.26(A)(1) indicates minimum working clearances from 0 to 600 volts, and Table 110.34(A) is used for voltages over 600 volts.