**Application Example 1**

A service is supplied by four 500 kcmil conductors in parallel for each phase. The minimum cross-sectional area of the bonding jumper is calculated as follows:

$$4 \times 500 \text{ kcmil} = 2000 \text{ kcmil}$$

Therefore, the main or system bonding jumper cannot be less than 12½ percent of 2000 kcmil, which results in a 250 kcmil copper conductor. The copper grounding electrode conductor for this set of conductors, based on Table 250.66, is not required to be larger than 3/0 AWG.

**Application Example 2**

**System Bonding Jumpers at Panelboards**

A 225-kVA transformer supplies three 3-phase, 208Y/120-V secondary feeders. Two sets of 3/0 AWG copper, THHW, ungrounded conductors terminate in panelboards with 200-A main breakers. One set of 3 AWG copper, THHW, ungrounded conductors terminates in a panelboard with a 100-A main breaker. A system bonding jumper is installed at each of the panelboards. Determine the size of the system bonding jumpers at each panelboard enclosure.

***200-A panelboards:***

Size of largest ungrounded conductor supplying the two 200-A panelboards:

3/0 AWG copper

System bonding jumper [from Table 250.102(C)(1)]:

3/0 AWG copper ungrounded conductors → 4 AWG copper or 2 AWG aluminum system bonding jumper

***100-A panelboard:***

Size of largest ungrounded conductor supplying the 100-A panelboard:

3 AWG copper

System bonding jumper [from Table 250.102(C)(1)]:

3 AWG copper ungrounded conductors → 8 AWG copper or 6 AWG aluminum system bonding jumper

**Application Example 3**

**System Bonding Jumper at the Transformer**

The same electrical equipment arrangement as in the previous example applies. In this case, however, the system bonding jumper is installed at the transformer and connects the transformer neutral terminal (XO) to individual supply-side bonding jumpers that are installed between the panelboard EGC terminals and a terminal bus attached to the transformer enclosure. Determine the size of the system bonding jumper.

Size the system bonding jumper from the terminal bus in the transformer to the transformer neutral terminal (XO). There are two secondary feeder circuits with 3/0 AWG ungrounded conductors and one with 3 AWG ungrounded conductors. Find the cumulative circular mil area of all ungrounded conductors of a phase.

From Chapter 9, Table 8:

3/0 AWG = 167,800 circular mils × 2 (number of sets of secondary conductors) = 335,600 circular mils

3 AWG = 52,620 circular mils

total = 388,220 circular mils

From Table 250.102(C):

388,220 circular mils copper ungrounded conductors → 2 AWG copper or 1/0 AWG aluminum system bonding jumper

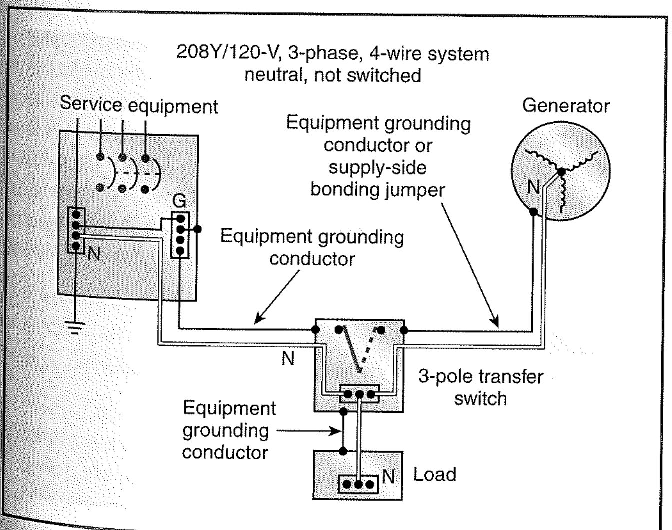


***EXHIBIT 250.13*** *A 208Y/120-volt, 3-phase, 4-wire system that has a direct electrical connection of the grounded circuit conductor (neutral) to the generator and is therefore not considered a separately derived system.*

electrical connection between the normal grounded system conductor (neutral) and the generator neutral through the neutral bus in the transfer switch, thereby grounding the generator neutral. Because the grounded circuit conductor is connected to the normal system grounded conductor, it is not a separately derived system and there are no requirements for grounding the neutral at the generator (see Informational Note No. 1 to 250.30).

In Exhibit 250.14, the grounded conductor (neutral) is connected to the switching contacts of a 4-pole transfer switch. The generator system does not have a direct electrical connection to the other supply system grounded conductor (neutral), other than the bonding and equipment grounding conductors. Therefore, the system supplied by the generator is considered separately derived.

**(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

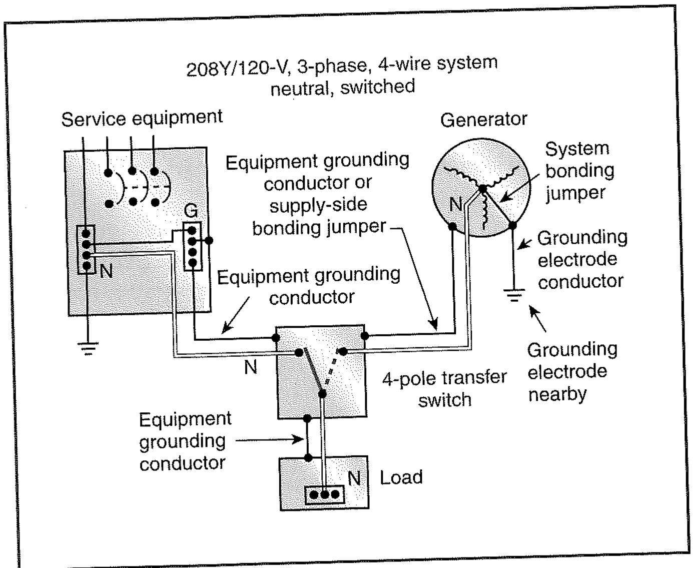


***EXHIBIT 250.14*** *A 208Y/120-volt, 3-phase, 4-wire system that does not have a direct electrical connection of the grounded circuit conductor (neutral) to the generator and is therefore considered a separately derived system.*

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 250.187, as applicable.*

**Common Misconception**

*Does installing a system bonding jumper at both the source of a separately derived system and the first system disconnecting means provide a better connection to ground for a separately derived system?*

Installing a system bonding jumper at both the source and the first disconnecting means can result in establishing an unintended parallel path for current that would otherwise utilize the grounded conductor. Exposed normally non–current-carrying metal components are often included as part of this parallel path and can present an unintentional safety hazard. This type of installation is prohibited with the exception of a building or structure supplied by an outdoor separately derived system, provided that such a connection does not create a parallel path for the grounded conductor.

**(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: If a building or structure is supplied by a feeder from an outdoor separately derived system, 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).

Separately derived systems are required to have a system bonding jumper to connect the grounded circuit conductor (neutral) to the supply side bonding jumper or equipment grounding conductor, or both.

The system bonding jumper can be installed in several ways. For example, if a multi-barrel lug is connected to the XO terminal of a transformer, the system bonding jumper, grounding electrode conductor, grounded conductor, and supply-side jumper can be connected at that connector. If a multi-barrel lug is connected to the transformer or generator enclosure, a common practice is to connect the system bonding jumper, the grounding electrode conductor, and the bonding jumper or conductor to that connector. The grounded conductor should always connect directly to the XO terminal.

**See also**

**250.28(D)** and its commentary feature for more information on sizing the system bonding jumper

**(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