

ARTICLE 250

GROUNDING AND BONDING

Introduction to Article 250—Grounding and Bonding

No other article can match this one for misapplication, violation, and misinterpretation. The terminology used in Article 250 has been a source of much confusion but has been improved during the last few *NEC* revisions. It is very important for you to understand the difference between grounding and bonding in order to correctly apply the provisions of this article. Pay careful attention to the definitions of important terms located in Article 100 that apply to grounding and bonding. Article 250 covers the grounding requirements for providing a path to the Earth to reduce overvoltage from lightning strikes, and the bonding requirements that establish a low-impedance fault current path back to the source of the electrical supply to facilitate the operation of overcurrent protective devices in the event of a ground fault.

This article is arranged in a logical manner as illustrated in Figure 250.1 in the *NEC*. It may be a good idea for you to just read through the entire article first to get a big picture overview. Then, study Article 250 closely so you understand the details and remember to check Article 100 for the definitions of terms that may be new to you. The illustrations that accompany the text in this textbook will help you better understand the key points.

250.102 Neutral Conductor, Bonding Conductors, and Bonding Jumpers

(B) Termination. Equipment bonding jumpers must terminate by any of the following means in accordance with 250.8(A):

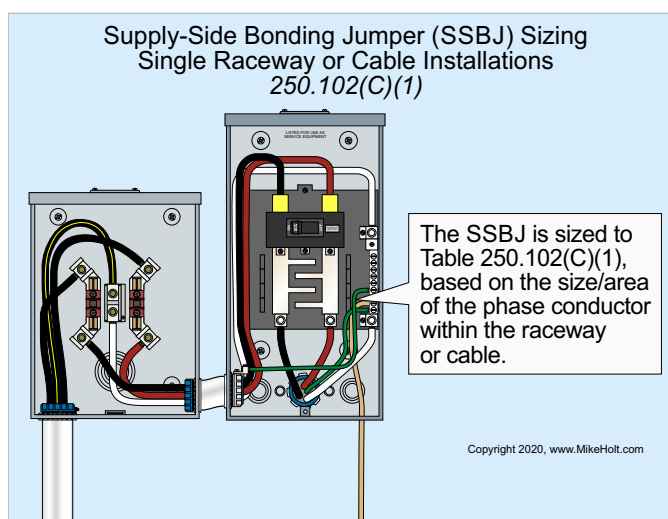
- ▶ Listed pressure connectors
- ▶ Terminal bars
- ▶ Pressure connectors listed as grounding and bonding equipment
- ▶ Exothermic welding
- ▶ Machine screw-type fasteners that engage not less than two threads or are secured with a nut
- ▶ Thread-forming machine screws that engage not less than two threads in the enclosure
- ▶ Connections that are part of a listed assembly
- ▶ Other listed means

(C) Supply-Side Bonding Jumper Sizing.



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(1) Single Raceway or Cable Installations. Supply-side bonding jumpers must be sized in accordance with Table 250.102(C)(1), based on the size/area of the phase conductor within the raceway or cable. ▶ [Figure 250-187](#)



▶ [Figure 250-187](#)

(2) Parallel Conductor Installations. If the phase supply conductors are paralleled in two or more raceways or cables, the supply-side bonding jumper for each is sized in accordance with Table 250.102(C)(1), based on the size/area of the phase conductors in each raceway or cable.

Table 250.102(C)(1) Neutral Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply-Side Bonding Jumper

Size of Largest Phase Conductor Per Raceway or Equivalent Area for Parallel Conductors	Size of Bonding Jumper or Neutral Conductor	
Copper	Aluminum or Copper-Clad Aluminum	Copper-Aluminum
2 or smaller	1/0 or smaller	8 CU–6 AL
1 or 1/0	2/0 or 3/0	6 CU–4 AL
2/0 or 3/0	Over 3/0 250 kcmil	4 CU–2 AL
Over 3/0–350 kcmil	Over 250–500 kcmil	2 CU–1/0 AL
Over 350–600 kcmil	Over 500–900 kcmil	1/0 CU–3/0 AL
Over 600–1,100 kcmil	Over 900–1,750 kcmil	2/0 CU–4/0 AL
Over 1,100 kcmil	Over 1,750 kcmil	See Notes 1 and 2.

► Example

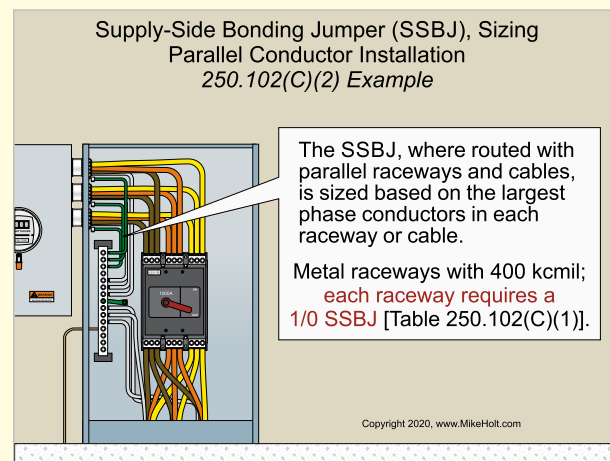
Question: What size supply-side bonding jumper is required for each of three metal raceways, each of which contain 400 kcmil service conductors? ►Figure 250–188

(a) 4 AWG (b) 2 AWG (c) 1 AWG (d) 1/0 AWG

Solution:

A 1/0 AWG supply-side bonding jumper is required for each raceway. [250.102(C)(2) and Table 250.102(C)(1)]. A single supply-side bonding jumper is permitted for multiple raceways based on the equivalent area of the supply-side phase conductors.

Answer: (d) 1/0 AWG

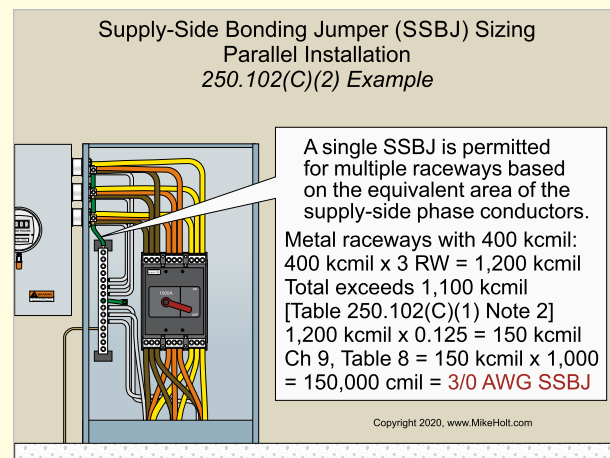


►Figure 250–188

► Example

Question: What size single supply-side bonding jumper is required for all three metal raceways, each of which contain 400 kcmil service conductors? ►Figure 250–189

(a) 1/0 AWG (b) 2/0 AWG (c) 3/0 AWG (d) 4/0 AWG



►Figure 250–189

Solution:

A single 3/0 AWG supply-side bonding jumper is required if using one conductor for all three raceways.

$400 \text{ kcmil} \times 3 \text{ Raceways} = 1,200 \text{ kcmil}$ which exceeds 1,100 kcmil [Table 250.102(C)(1) Note 2]

Conductor kcmil at 12½ % = $1,200 \text{ kcmil} \times 0.125$

Convert kcmil to cmil = $150 \text{ kcmil} \times 1,000$

Total bonding jumper cmil = 150,000 cmil

Use a 3/0 AWG supply-side bonding jumper [Chapter 9, Table 8].

Answer: (c) 3/0 AWG

Note 1: The term “supply conductors” includes phase conductors that do not have overcurrent protection on their supply side and terminate at the service disconnect or the first disconnect of a separately derived system.

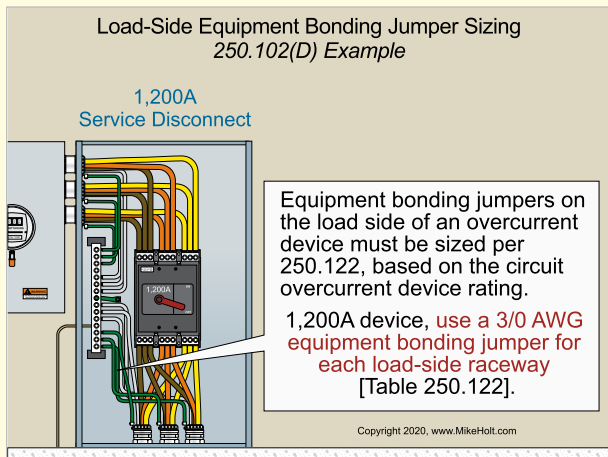
Note 2: See Chapter 9, Table 8 for the circular mil area of conductors 18 AWG through 4/0 AWG.

(D) Load-Side Bonding Jumper Sizing. Bonding jumpers on the load side of feeder and branch-circuit overcurrent devices are sized in accordance with 250.122.

► Example

Question: What size equipment bonding jumper is required for each metal raceway where the circuit conductors are protected by a 1,200A overcurrent protective device? ►Figure 250–190

(a) 1/0 AWG (b) 2/0 AWG (c) 3/0 AWG (d) 4/0 AWG



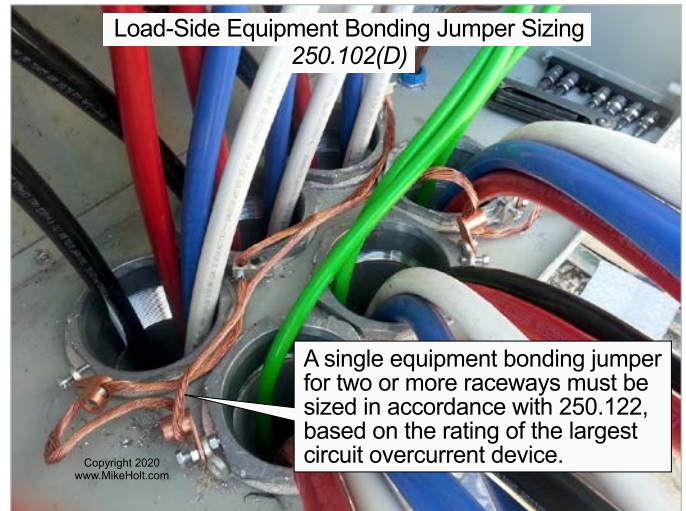
►Figure 250–190

Answer: (c) 3/0 AWG [Table 250.122]

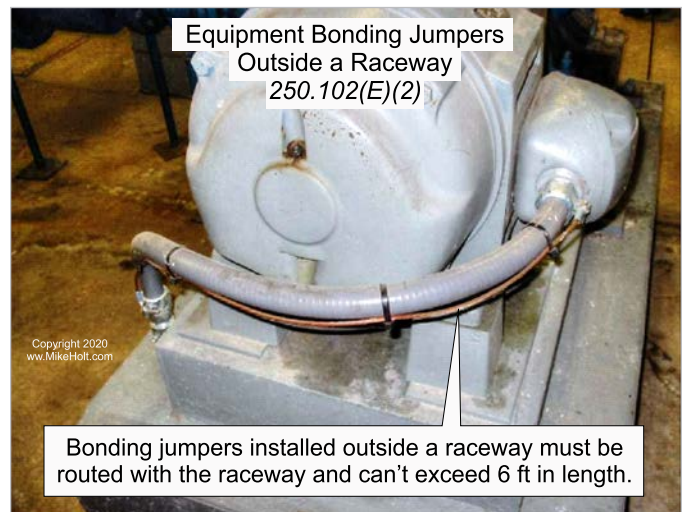
If a single bonding jumper is used to bond two or more metal raceways, it must be sized in accordance with 250.122, based on the rating of the largest circuit overcurrent protective device. ►Figure 250–191

(E) Installation of Bonding Jumpers. Bonding jumpers can be installed inside or outside of a raceway or an enclosure.

(2) Outside a Raceway. Bonding jumpers installed outside a raceway must be routed with the raceway and the conductor cannot exceed 6 ft in length. ►Figure 250–192



►Figure 250–191



►Figure 250–192