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.

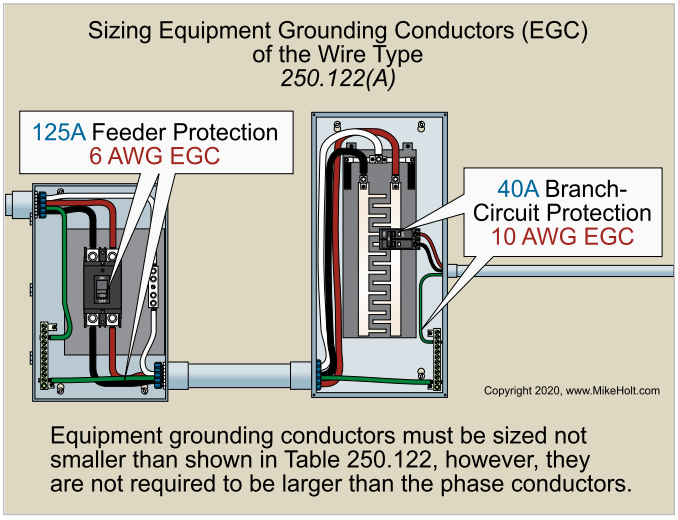
Part VI. Equipment Grounding and Equipment Grounding Conductors

250.122 Sizing Equipment Grounding Conductors

(A) General. Equipment grounding conductors must be sized not smaller than shown in Table 250.122; however, the equipment grounding conductor is not required to be larger than the phase conductors. ▸Figure 250–227

(B) Increased in Size. If phase conductors are increased in size for any reason other than as required in 310.15(B) or 310.15(C), wire-type equipment grounding conductors, if installed, must be increased in size proportionately to the increase in the circular mil area of the phase conductors. ▸Figure 250–228

Ex: Equipment grounding conductors can be sized by a qualified person to provide an effective ground-fault current path in accordance with 250.4(A)(5) or (B)(4).



▸Figure 250–227

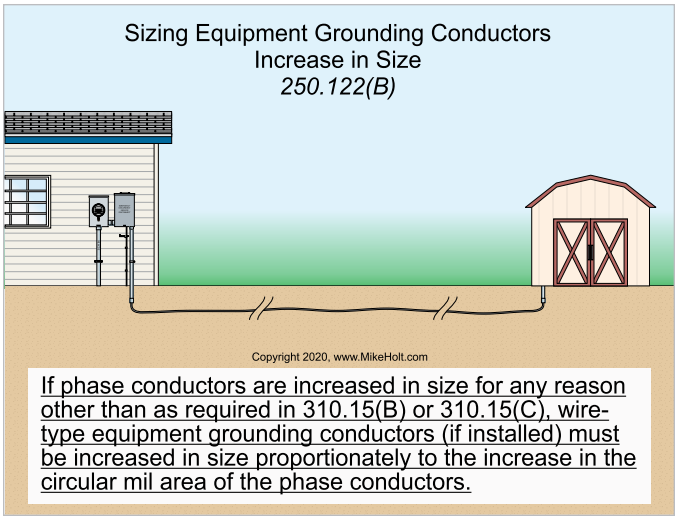


Figure 250–228

Author's Comment:

- Phase conductors are sometimes increased in size to accommodate conductor voltage drop, short-circuit rating, or simply for future capacity.

Table 250.122 Sizing Equipment Grounding Conductor

Overcurrent Protective Device Rating	Copper Conductor
15A	14 AWG
20A	12 AWG
25A–60A	10 AWG
70A–100A	8 AWG
110A–200A	6 AWG
225A–300A	4 AWG
350A–400A	3 AWG
450A–500A	2 AWG
600A	1 AWG
700A–800A	1/0 AWG
1,000A	2/0 AWG
1,200A	3/0 AWG

Note: Where necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor might be required to be sized larger than given in this table.

▶ Example

Question: *If the phase conductors for a 40A circuit (with 75°C terminals) are increased in size from 8 AWG to 6 AWG due to voltage drop, the circuit equipment grounding conductor must be increased in size from 10 AWG to _____.* Figure 250–229

(a) 8 AWG (b) 6 AWG (c) 4 AWG (d) 3 AWG

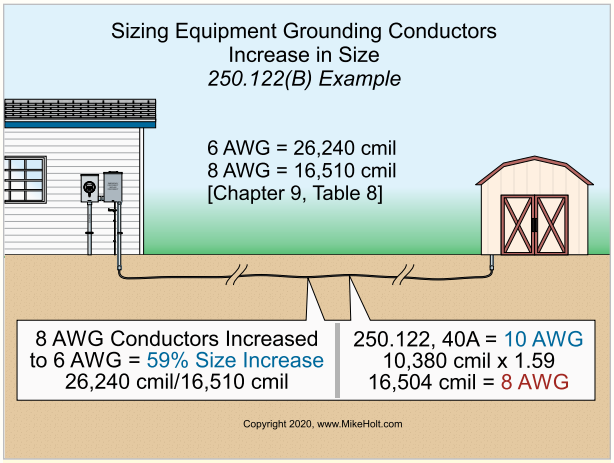


Figure 250–229

Solution:

The circular mil area of 6 AWG is 59 percent more than 8 AWG (26,240 cmil/16,510 cmil) [Chapter 9, Table 8]. According to Table 250.122, the circuit equipment grounding conductor for a 40A overcurrent protective device will be 10 AWG (10,380 cmil), but the circuit equipment grounding conductor for this circuit must be increased in size by a multiplier of 159 percent.

Conductor Size = 10,380 cmil × 159%
Conductor Size = 16,504 cmil

The circuit equipment grounding conductor must be increased to 8 AWG [Chapter 9, Table 8].

Answer: *(a) 8 AWG*

(C) Multiple Circuits. A single equipment grounding conductor sized in accordance with Table 250.122 when multiple circuits are installed in the same raceway, cable, trench, or cable tray. Figure 250–230

(D) Motor Branch Circuits. Equipment grounding conductors for motor circuits must be sized in accordance with 250.122(D)(1) or (D)(2).

(1) General. The equipment grounding conductor must not be smaller than determined by 250.122(A), based on the rating of the motor circuit branch-circuit short-circuit and ground-fault protective device sized in accordance with 430.52(C)(1) Ex 1.

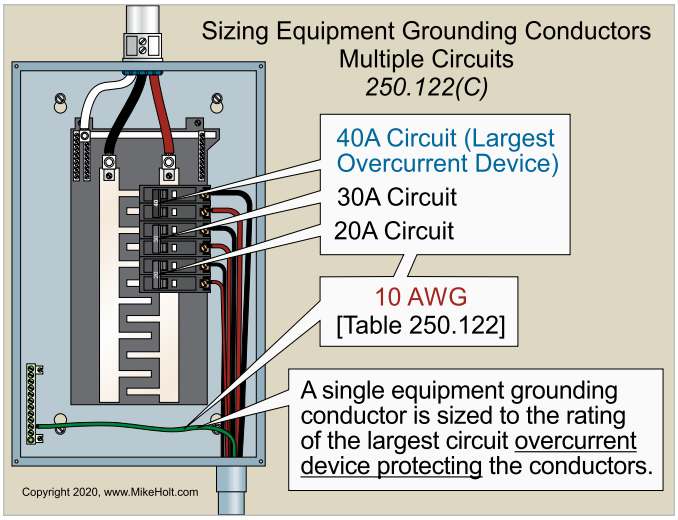


Figure 250–230

Author's Comment:

- The equipment grounding conductor is not required to be larger than the motor circuit conductors. See 250.122(A).

Example

Question: *What size equipment grounding conductor of the wire type is required for a 14 AWG motor branch circuit [430.22], protected with a 2-pole, 30A circuit breaker in accordance with 430.22 and 430.52(C)(1)?* Figure 250–231

(a) 14 AWG (b) 12 AWG (c) 10 AWG (d) 8 AWG

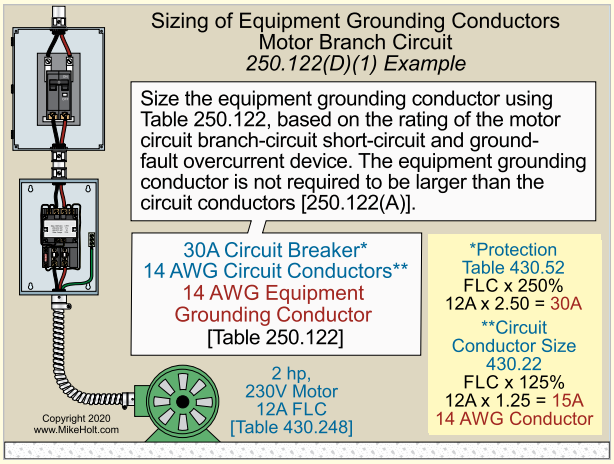


Figure 250–231

Solution:

The equipment grounding conductor is not required to be larger than the 14 AWG motor branch-circuit conductors [250.122(D)(1) and 250.122(A)].

Answer: *(a) 14 AWG*

(F) Parallel Conductors. Where circuit conductors are installed in parallel in accordance with 310.10(G), an equipment grounding conductor of the wire type must be installed in accordance with the following:

(1) Nonmetallic Raceways or Cable Trays

(a) Parallel Conductors in a Single Nonmetallic Raceway or Cable Tray. If parallel circuit conductors are installed in a single nonmetallic raceway or cable tray, a single wire-type equipment grounding conductor, sized in accordance with Table 250.122 based on the rating of the circuit overcurrent protective device, must be installed with the parallel circuit conductors.

(b) Parallel Conductors in Multiple Nonmetallic Raceways. If parallel circuit conductors are installed in multiple nonmetallic raceways, a wire-type equipment grounding conductor is required in each raceway. Figure 250–232

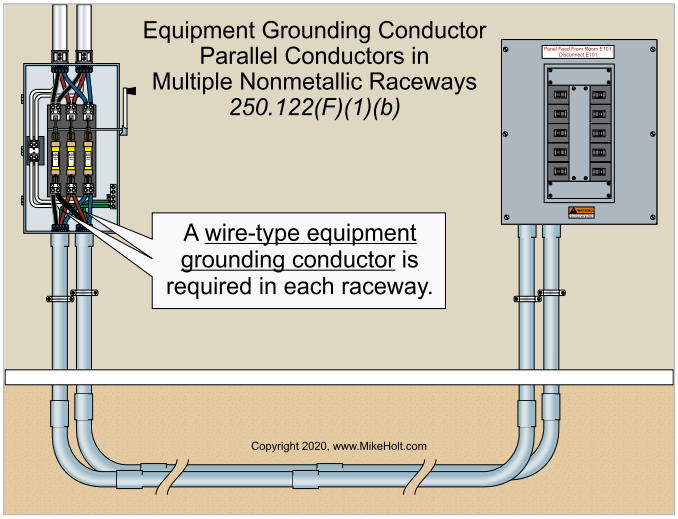


Figure 250–232

The equipment grounding conductors in each raceway must be sized in accordance with Table 250.122. Figure 250–233

Example

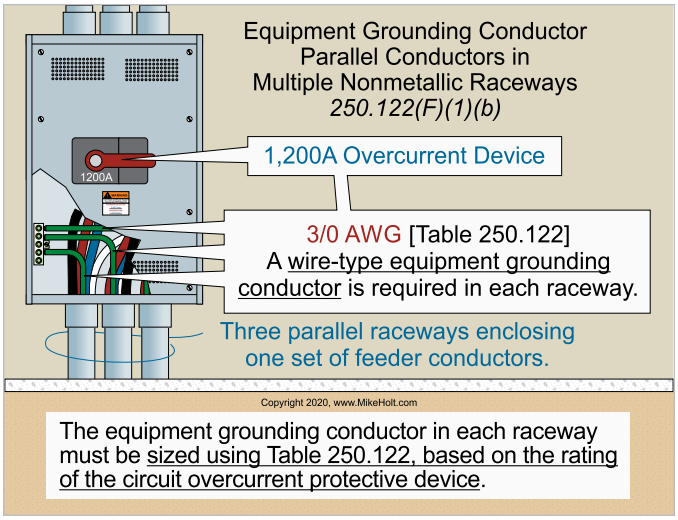
Question: *What size copper equipment grounding conductor of the wire type is required for a 4,000A feeder containing thirteen parallel sets of 500 kcmil conductors per phase in PVC conduit?*

(a) 250 kcmil (b) 300 kcmil (c) 400 kcmil (d) 500 kcmil

Solution:

According to Table 250.122, the equipment grounding conductor in each raceway must not be smaller than 500 kcmil.

Answer: *(d) 500 kcmil*



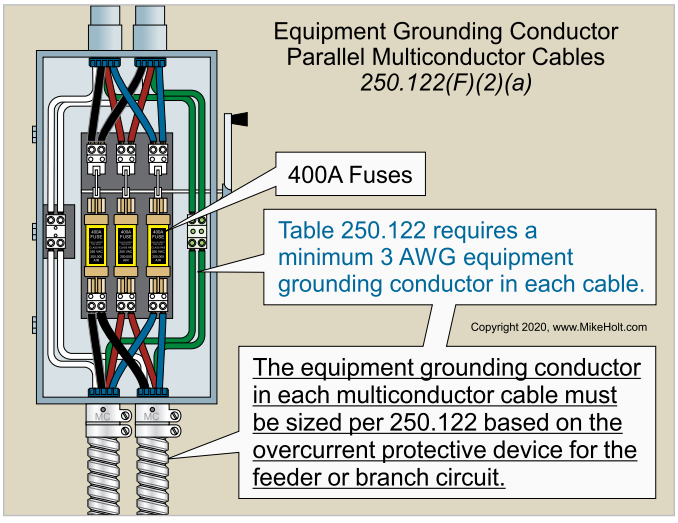
▸Figure 250–233

(c) Wire-Type Equipment Grounding Conductors in Cable Trays. Wire-type equipment grounding conductors installed in cable trays must meet the minimum requirements of 392.10(B)(1)(c).

(d) Metal Raceways or Cable Trays. Metal raceways can serve as the required equipment grounding conductor in accordance with 250.118 and cable trays complying with 392.60(B) can serve as the required equipment grounding conductor.

(2) Parallel Multiconductor Cables.

(a) Except as provided in 250.122(F)(2)(c) for raceway or cable tray installations, the equipment grounding conductor in each multiconductor cable must be sized in accordance with 250.122, based on the overcurrent protective device for the feeder or branch circuit. ▸Figure 250–234



▸Figure 250–234

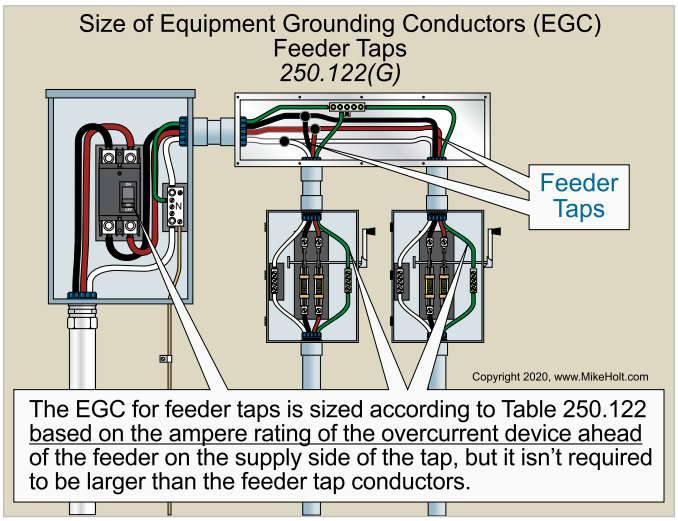
(b) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable must be connected in parallel.

(c) If multiconductor cables are paralleled in the same raceway or cable tray, a single equipment grounding conductor sized in accordance with 250.122 is permitted in combination with the equipment grounding conductors provided within the multiconductor cables and all equipment grounding conductors must be connected together.

(d) Equipment grounding conductors installed in cable trays must meet the requirements of 392.10(B)(1)(c).

Cable trays complying with 392.60(B) and metal raceways in accordance with 250.118 can be used as the required equipment grounding conductor.

(G) Feeder Tap Conductors. Equipment grounding conductors for feeder taps are not permitted to be smaller than shown in Table 250.122, based on the ampere rating of the overcurrent device ahead of the feeder on the supply side of the tap. The feeder equipment grounding conductor for the feeder tap is not be required to be larger than the tap conductors. ▸Figure 250–235



▸Figure 250–235