ARTICLE

250 GROUNDING AND BONDING

Introduction to Article 250—Grounding and Bonding

Article 250 covers the general requirements for bonding and grounding electrical installations. The terminology used in this article has been a source of much confusion over the years so pay careful attention to the definitions pertaining to Article 250. Understanding the difference between bonding and grounding will help you correctly apply the provisions of this article. Because of the massive size and scope of Article 250, Figure 250.1 in the *NEC* is provided as a reference for the locations of the different types of rules. Of the ten parts contained in this article only parts one through seven are covered in this material. *Topics* covered in this material for Article 250 include:

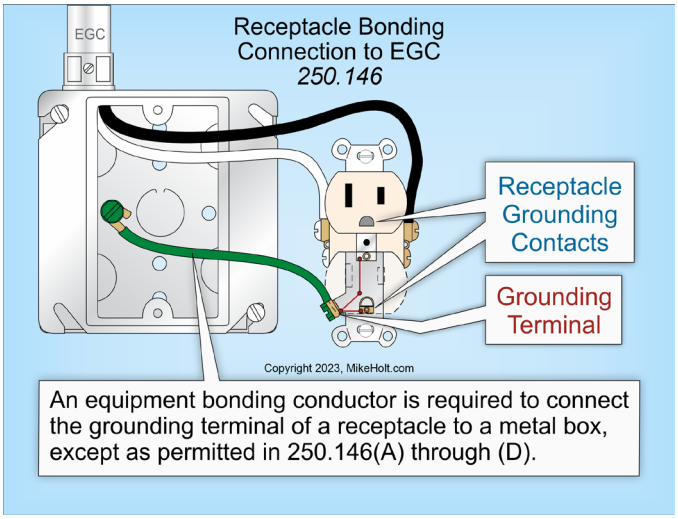
- General Requirements for Grounding and Bonding
- Objectionable Current
- Protection of Clamps and Fittings
- System Grounding Requirements
- Bonding Jumpers
- Generator Bonding
- Grounding Electrode System
- Service Equipment Bonding
- Piping System and Structural Steel Bonding
- Equipment Grounding conductors (EGCs)

Article 250 consists of ten parts:

- Part I. General
- Part II. System Grounding
- Part III. Grounding Electrode System and Grounding Electrode Conductor (GEC)
- Part IV. Enclosure, Raceway, and Service Cable Connections
- Part V. Bonding
- Part VI. Equipment Grounding Conductors (EGC)
- Part VII. Methods of EGC Connections
- Part VIII. Direct-Current Systems
- Part IX. Instruments, Meters, and Relays
- Part X. Grounding of Systems and Circuits of over 1000 Volts

250.146 Connecting Receptacle Grounding Terminal to an Equipment Grounding Conductor

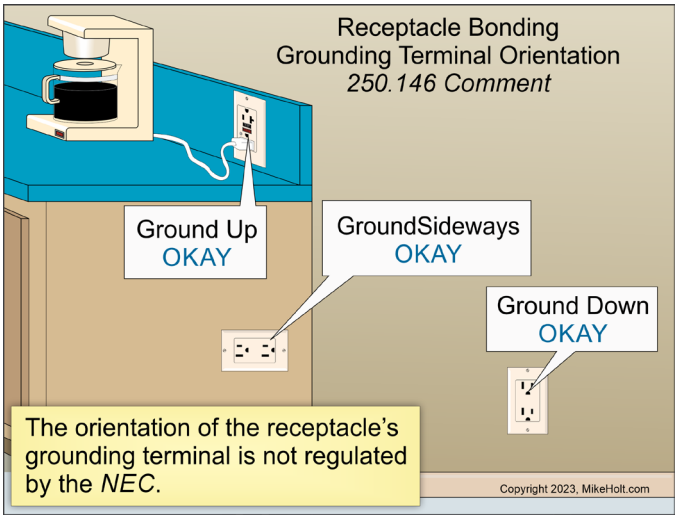
An equipment bonding conductor is required to connect the grounding terminals of a receptacle to a metal box, except as permitted in 250.146(A) through (D). ▸Figure 250–252



▸Figure 250–252

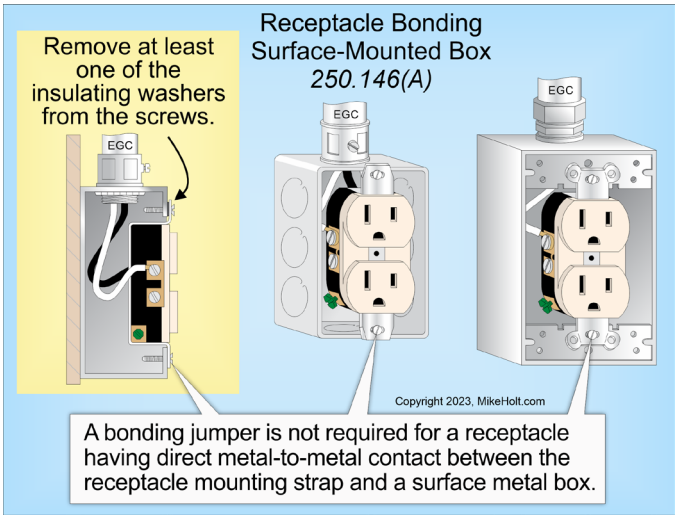
Author's Comment:

- The *NEC* does not restrict the position of the receptacle grounding terminal–it can be up, down, or sideways. *Code* proposals to specify the mounting position of receptacles have always been rejected. ▸Figure 250–253



▸Figure 250–253

(A) Surface-Mounted Box. A bonding jumper is not required for a receptacle having direct metal-to-metal contact between the receptacle mounting strap and a surface metal box. To ensure sufficient metal-to-metal contact, at least one of the insulating retaining washers on the yoke screw must be removed. ▸Figure 250–254

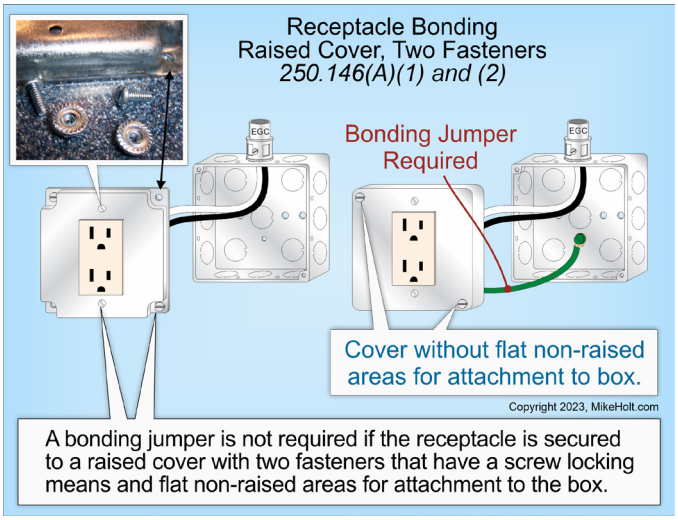


▸Figure 250–254

A bonding jumper is not required for a receptacle installed on a raised cover under both of the following conditions:

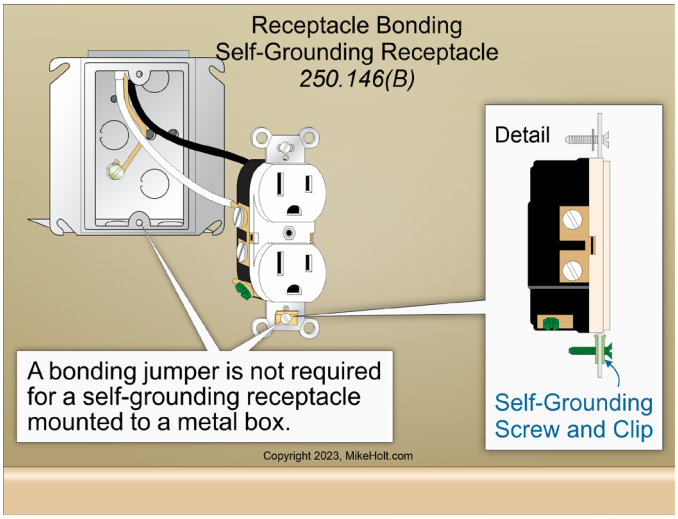
(1) The receptacle is attached to the metal cover with at least two fasteners that have a thread locking, or screw or nut locking means.

(2) The cover mounting holes are on a flat non-raised portion of the cover. ▸Figure 250–255



▸Figure 250–255

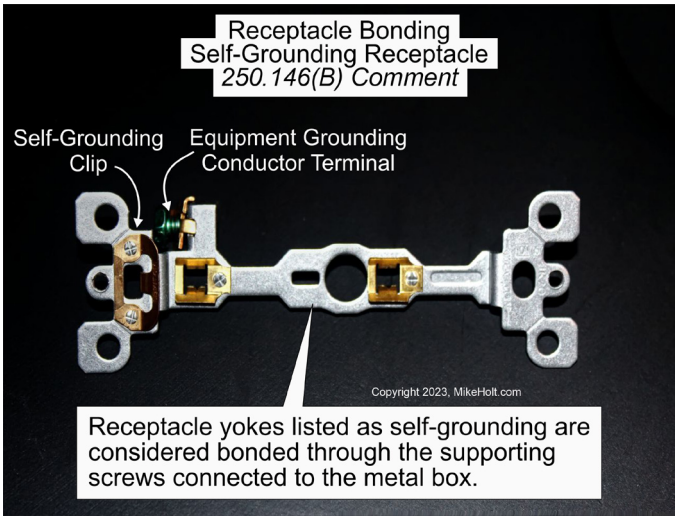
(B) Self-Grounding Receptacles. A bonding jumper is not required for a self-grounding receptacle mounted to a metal box. ▸Figure 250–256



▸Figure 250–256

Author's Comment:

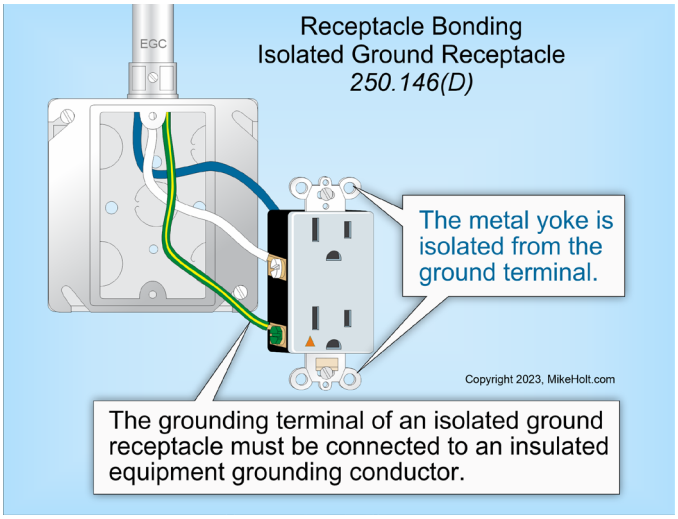
- Receptacle yokes listed as self-grounding are considered bonded through the supporting screws connected to the metal box. ▸Figure 250–257



▸Figure 250–257

(C) Floor Boxes. Metal floor boxes must establish the bonding path between the receptacle yoke and a metal box.

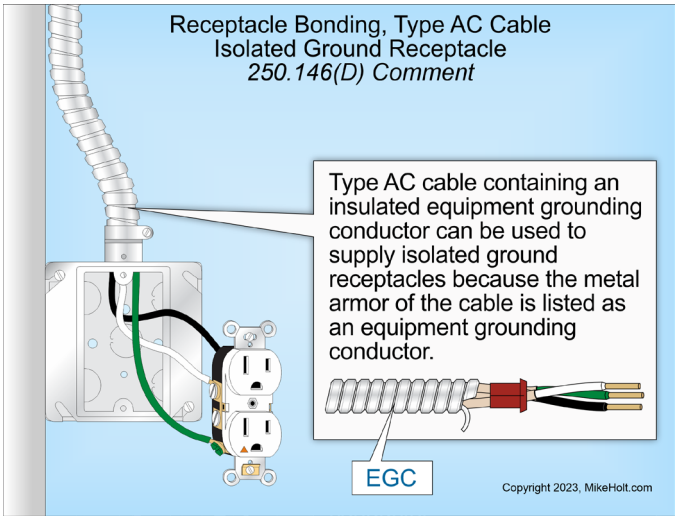
(D) Isolated Ground Receptacles. The grounding terminal of an isolated ground receptacle must be connected to an insulated equipment grounding conductor. ▸Figure 250–258



▸Figure 250–258

Author's Comment:

- Type AC cable containing an insulated equipment grounding conductor can be used to supply isolated ground receptacles because the metal armor of the cable is listed as an equipment grounding conductor [250.118(A)(8)]. ▸Figure 250–259



▸Figure 250–259

- Type MC$^{AP®}$ cable with a 10 AWG bare aluminum grounding/bonding conductor can be used to supply isolated ground receptacles because it is listed as an equipment grounding conductor [250.118(A)(10)(b)].
- An interlocked Type MC$^{AP®}$ cable is an acceptable wiring method to use for an isolated ground receptacle. ▸Figure 250–260

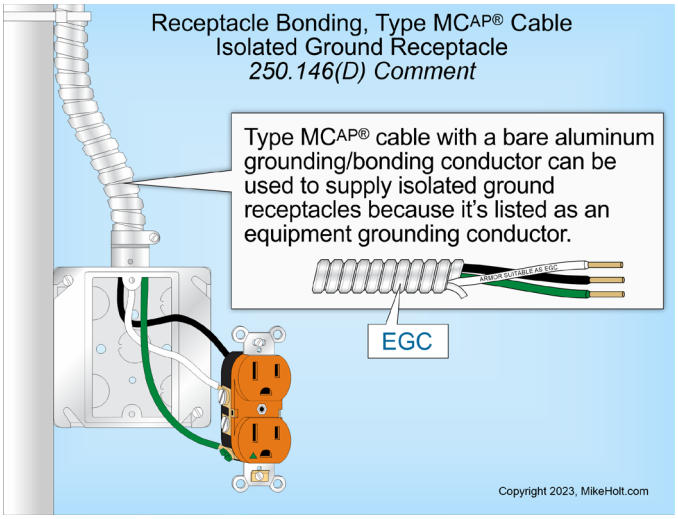


Figure 250–260

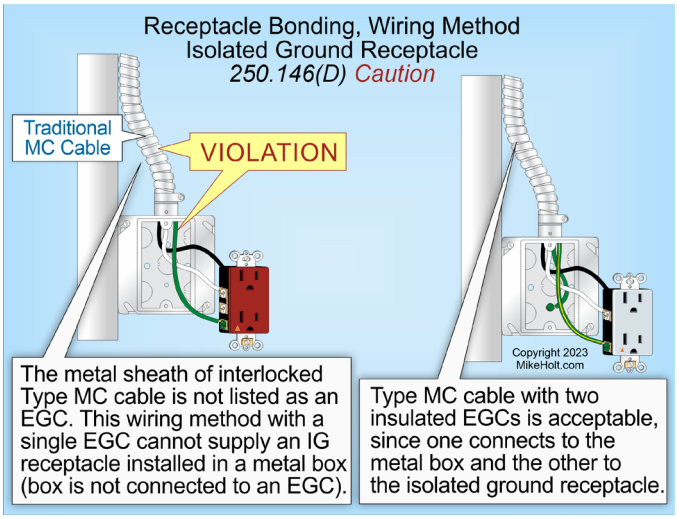


Figure 250–261

Caution

CAUTION: Type MC Cable. The metal armor sheath of traditional interlocked Type MC cable containing an insulated equipment grounding conductor is not listed as an equipment grounding conductor. Therefore, this wiring method with a single equipment grounding conductor cannot supply an isolated ground receptacle. Type MC cable with two insulated equipment grounding conductors is acceptable since one bonds to the metal box, and the other one connects to the isolated ground receptacle. Figure 250–261

Author's Comment:

- When should an isolated ground receptacle be installed and how should the isolated ground system be designed? These questions are design issues and are not answered based on the *NEC* alone [90.2(C)]. In most cases, using isolated ground receptacles is a waste of money. For example, IEEE 1100, *Powering and Grounding Electronic Equipment* (Emerald Book) section 8.5.3.2 states, "The results from the use of the isolated ground method range from no observable effects, the desired effects, or worse noise conditions than when standard equipment bonding configurations are used to serve electronic load equipment."
- Few electrical installations truly require an isolated ground system. For those systems that can benefit from one, engineering opinions differ as to what is a proper design. Making matters worse—of those properly designed, few are correctly installed, and even fewer are properly maintained.