2020 MODEL CODE CHANGES NEC ARTICLE 250

GROUNDING AND BONDING

Article 250 of the National Electric Code is the most extensive article in the code. The reasons for the extensive coverage of grounding and bonding are because these two practices are responsible for the correct operation of all overcurrent protective devices in a building; they bring all metal enclosures to an equal potential; they insure a safe path for voltage surges caused by lightning or other transients to ground; and they provide a consistent reference for technical equipment that is forced to operate in difficult electrical environments.

This 4 hour course will be a review of Article 250 in the 2020 National Electric Code concentrating on how bonding and grounding are different and serve different purposes; how bonding back to the electrical source guarantees the safe operation of overcurrent protective devices; how grounding while in most cases is a necessity for the safe dissipation of high voltage surges is not an effective ground-fault current path; how bonding insures correct transmission of telecommunications; and how different systems of various voltages must comply with the code. It is important that both the NEC and ANSI/TIA 607c require the same single building ground for both safety and performance.

One of the most important requirements of Article 250 is under the general requirements for Grounding and Bonding in 250.4 (A) (5) which includes the definition of an Effective Ground-Fault Current Path. The absolute “shall” is in the final line: “The earth shall **NOT** be considered as an effective ground-fault current path.”

While the NFPA recommends a ground resistance of 5 ohms or fewer and the IEEE and Telecommunications Industry have made the same recommendation (ANSI/TIA/EIA 607C), Article 250 makes reference in 250.52 (A) 2 that “a resistance to earth of 25 ohms” is acceptable for a grounding electrode and auxiliary electrodes. That statement is a very good place to start a discussion of grounding and bonding.

COURSE OUTLINE

1. Scope of the Article (250.1)
   1. A review of the article to show both the reason for the code requirements and the mechanical means to comply.
2. 250.3 Grounding and Bonding Requirements in other Articles (Revised in 2020)
3. NEW 250.25 Grounding Systems Permitted to be Connected on the Supply Side of the Disconnect
   1. Grounding connections permitted in 230.82 must comply with 250.25 (A)(B)
4. Objectionable Current (250.6)
   1. Neutral/Ground Problem
5. Connection Methods (250.8—12)
   1. Review of Mechanical Devices with samples
6. Part II: System Grounding (250.20—30)
   1. Grounding of sources as opposed to equipment.
   2. Ungrounded/Grounded Systems
   3. Code Changes: 250.25

New: Grounding Systems Permitted to Be Connected on the Supply Side of the Disconnect as permitted in 230.82…shall comply with 250.25 (A) or (B)

1. Part III: Grounding Electrode System and GEC (250.50—53)
   1. Code Revision

* 250.53 specifies the requirements of grounding electrodes:
  + If practicable, pipe electrodes must be embedded below the permanent moisture level and be free from nonconductive coatings (e.g., paint or enamel) [250.53(A)(1)].
  + A rod electrode must be supplemented by an additional electrode that’s bonded to the service disconnect or one of the other four items listed in 250.53(A)(2).
  + The supplemental electrode for a rod electrode must be installed at least 6 ft from the rod electrode [250.53(A)(3)].
  + Electrodes for premises systems must be at least 6 ft from lightning protection system grounding electrodes [250.53(B)].
  + Two or more grounding electrodes bonded together are considered a single grounding electrode system.
  + The bonding connection for the interior metal water piping system, as required by 250.104(A), can’t depend on equipment likely to be disconnected for repairs or replacement. Install a bonding jumper around insulated joints and equipment likely to be disconnected for repairs or replacement [250.53(D)].
  + When an underground metal water pipe grounding electrode is present, it must be used as part of the grounding electrode system [250.52(A)(1)].
  + Rod electrodes must be installed with at least 8 ft of length in contact with the soil. If rock bottom is encountered, the rod must be driven at an angle not to exceed 45 degrees from vertical [250.53(G)].
  + Rebar shall not be used as a conductor to interconnect the GEC system.

1. Installation of Grounding Electrode Conductors
   1. Code Revisions

250.64 (A) contain multiple changes in how Grounding Electrode Conductors of aluminum or copper- clad aluminum are to be installed.

250.66 Size of the GEC proportional to the ungrounded conductors

250.68 Additional rebar revisions

1. Bonding (250.90—98)
   1. All electrically conductive components
   2. Clarify again distinction to Grounding
2. Bonding Conductors and Jumpers (250-102—106)
   1. Revision: Bonding Conductors or jumpers shall be sized to table 250-102 (C) 1 except that it shall not be required to be larger than 3/0 copper or 250 kcm aluminum or copper-clad aluminum
3. Part VI: Equipment Grounding and Methods (250-109—148)
   1. Code Change: Metal enclosures shall be permitted to be used to connect bonding jumpers or EGCs. Metal covers shall be considered to being connected as well.
   2. Rods, piping, rings, plates, concrete encasement, etc.

DEFINITIONS

* Grounding
* Bonding
* Overload, Short Circuit, Ground Fault
* Effective Ground-Fault Current Path
* Objectionable Current
* Main Bonding Jumper
* System Bonding Jumper/ Supply Side Bonding Jumper
* Grounding Electrode Conductor / Grounding Electrode

COURSE OBJECTIVES

Classes on Grounding and Bonding can take days if each part of 2020 NEC Article 250 is examined completely. This course is designed to cover in four hours the basic understanding of the article’s scope; insure a proper understanding of the terms used; clearly distinguish the purpose of grounding as opposed to bonding and how each method has a distinct role to play in the safe operation of electrical power; preventing magnetic interference; and review the different kinds of mechanical connections in any properly designed grounded and bonded system.

LEARNING OUTCOME

Electricians who take this class will understand clearly the difference between Grounding and Bonding. They will understand the scope and complexity of documents; they will be able to explain why the 2020 NEC prohibits grounding as an effective ground fault current path; they will be aware of how lightning and transients affect electrical systems; they will understand the importance of an effective ground fault current path in a bonded system; and they will gain some familiarity with the different mechanical grounding and bonding methods.

INSTRUCTOR

The course instructor is Ralph Bliquez who has taught at the NECA/IBEW Training Center and is authorized to teach continuing education classes for credit by the states of Oregon, Washington, California, Nevada, Montana and Utah.

COURSE MATERIALS

The materials for the course will be a selection of slides with quotations taken directly from Article 250 of the 2020 NEC, examples of the different jumpers and ground connections both in slides and physical examples, illustrations of the correct and incorrect methods of bonding and grounding per the Article, sources of Objectionable Current and its effects on electromagnetic interference and the four quizzes which reinforce the material.