***Ewing-Foley, Inc. Continuing Education Training***

**Electrical Continuing Education, NEC Article 250**

**4-Hour Power point slide presentation**

 **Instructor Ralph Bliquez**

2023 MODEL CODE CHANGES IN NEC ARTICLE 250

 GROUNDING AND BONDING

Article 250 of the National Electric Code is the most extensive article in the code with the possible exception of Article 430, Motors. 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 2023 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 607D 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 both 250.4 (A) (5) and 250.5 (B) (4) which includes the definition of an Effective Ground-Fault Current Path. The absolute “shall” is in final line: “The earth shall **NOT** be considered as an effective ground-fault current path.”

IEEE and Telecommunications Industry (ANSI/TIA/EIA 607D), requires 5 ohms resistance for the Grounding Electrode system while Article 250.52 (A) accepts “a resistance to earth of 25 ohms”. Neither value will open most overcurrent protective device.

COURSE OUTLINE (Code Changes for 2023 are in Red)

Part I: General (45 min.)

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. Eliminated in 2023
	3. 240.4 General Requirements for Grounding and Bonding

New 250.6 (A) Objectionable Current shall be prevented but see (C)

New 250.6 (C) Currents from ground faults and “functional grounding” connections shall not be considered Objectional.

250.8—12) Connection Methods

* 1. Review of Mechanical Devices with samples

Part II: System Grounding (40 min.)

250.20 AC Systems to be Grounded

250.21 AC Systems Not Required to be Grounded

250.22 Eliminated in 2023

 250.24 Grounding of Service Supplied Systems

 (A) (5) is eliminated and Section (B) is new and replaces (A) (5).

 250.26 Conductor to be Grounded

 250.28 Main Bonding Jumper

 250.30 Grounding Separately Derived Systems

 System Bonding Jumper

 Supply Side Bonding Jumper

 Grounding Electrode Conductor

 250.32 Buildings Supplied by a Feeder or Branch Circuit

 250.34 Portable/Vehicle Mounted Generators

Part III: Grounding Electrode Systems and Conductor (45 min.)

 250.50 System Description

 250.52 Electrodes Permitted

 (B) Not permitted

250.53 System Installation

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.

 250.58-62 Auxiliary Electrodes and Materials

 250.64 Grounding Conductor Installation

 (G) is a new requirement not allowing conductor through ventilation openings

 250.66 Size of AC Grounding Electrode Conductor

 250.68-70 GEC Conductor and Bonding to Electrode

Part IV: Enclosure, Raceway and Service Cable Connections (15 min.)

 250.80-86 Insuring all metal parts are connected to the Grounding Electrode

 250.84 (A) & (B) Text deletions and revisions

Part V: Bonding (40 min.)

250.90—98 Bonding of Service, Communication and other Enclosures

All electrically conductive components

Clarify again distinction to Grounding.

250.100 Hazardous Locations

New: Requires the methods in 250.92 (B) (2)-(4) whether or not an EGC of the wire type is installed.

New Informational Note: The requirements in 501.30, 502.30 and 503.30 for (A) Grounding and (B) Bonding from the hazardous location back to the main disconnect or separately derived system.

250-102—106) Bonding Conductors and Jumpers

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

250.102 (C) (2) Revisions on Size for Parallel Conductors in 2 or more Raceways or Cables (

Part VI: Equipment Grounding and EGCs (30 min.)

 250--109 Metal Enclosures as the Fault Current Path

Metal enclosures shall be permitted to be used as the fault current path and to connect bonding jumpers or EGCs. Metal covers shall be considered to being connected as well. New: Extensive revisions in 250.109

Informational Note on 250.97, concentric, eccentric knockouts in circuits over 250 Volts to ground

250.114 New: Ice Makers must be connected to the GEC (250.114)

250.118 (A) (5)-(6) New: Rules for Flexible Metal Conduit and Stainless Steel are addressed

250.119 New (A) Identification of Wire-Type EGCs

250.122 Size of EGCs

Part VII: Methods of EGC Connections (25 min.)

250-130 (C) New: Rules for Existing non-grounding devices like snap switches, receptacles and branch circuit extensions.

250.140 (A) or (B) New: Rules for connecting Ranges, Dryers, Washers and Cooktops are expanded

 250-148 (A)-(C) New: Rules for attachments in Boxes are clarified

Part VIII: DC Systems, Part IX: Instruments and Relays & Part X: > 1000 Volts will not be part of this class.

There will be a 10 minute break at 2 hours into the class.

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 2023 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 2023 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 2023 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 quizzes (on-line or paper as appropriate) which reinforce the material.