

EARTHING & BONDING (REF:OTSENBO01)

Course Introduction

Proper grounding and bonding of electrical equipment helps ensure that the electrical equipment and systems safely remove the possibility of electric shock by limiting the voltage imposed on electrical equipment and systems from lightning, line surges, or unintentional contact with higher-voltage lines, as well as ground fault conditions (any phase-to-ground). Article 250 of the National Electric Code® identifies grounding and bonding system installation methods. Proper grounding and bonding is also important for personnel protection, as well as for compliance with OSHA 29 CFR 1910.304(g) Grounding.

This course focuses on the grounding and bonding requirements contained in Article 250 of NEC®. Specific topics that are addressed include, but are not limited to: definitions; grounded (neutral) conductor requirements; sizing equipment grounding conductors, equipment bonding jumpers, grounding electrode conductors, and main bonding jumpers; identifying types of grounding electrodes; requirements for multiple grounding electrodes; bonding requirements for non-electrical equipment; the purpose of impedance or resistance grounding; requirements for an isolated grounding system; and grounding and bonding requirements for the line side and the load side of the service disconnecting means.

Who Should Attend

This course is intended for new or experienced technicians, supervisors and fresh engineers that install, maintain, repair or troubleshoot power and auxiliary systems. The participant should have basic knowledge of power system components.

Learning Objectives: Upon completion of this course, the participant should be able to:

- Interpret applicable NEC article 100 and 250 definitions
- Identify safety hazards created by ineffective grounding systems
- Identify common types of grounding electrodes
- Explain the purpose of impedance or resistance ground fault detection systems
- Explain equipment utilization for grounding and bonding systems
- Describe grounding and bonding requirements for electrical panels on the load side of the service disconnecting means
- Describe the requirements for use of an isolated grounding system
- Perform earth resistivity tests and interpret results
- Perform fall-of-potential earth resistance test and interpret results

Day 1

I. Introduction

- A. Schedule
- B. Course Outline

2. Fundamentals of Grounding and Bonding

- A. Basic Electrical Concepts
- B. Hazards of Electricity
- C. Definitions
- D. Student Exercise – Code Search Definition

3. Basics of Grounding and Bonding

- A. Grounding and Bonding
- B. Grounding versus Bonding

4. Use and Identification of Grounded Conductors

- A. General
- B. Connection to Grounded System
- C. Neutral Conductors
- D. Means of Identifying Grounded Conductors
- E. Means of Identification of Terminals
- F. Identification of Terminals
- G. Polarity of Connections I. Student Exercise – Drawing In and Identifying Electrical System Components



5. Ground-Fault Circuit-Interrupter Requirements

- A. Ground-Fault Circuit Interrupter Protection for Personnel
- B. Student Exercise – Identifying Where GFCI Protection Is Required
 - 1. VI. General Requirements
 - A. General Requirements for Grounding and Bonding
 - B. Objectionable Current
 - C. Connection of Grounding and Bonding Equipment
 - D. Protection of Ground Clamps and Fittings

Day 2

6. System Grounding

- A. Alternating-Current Systems To Be Grounded
- B. Alternating-Current Systems of 50 Volts To Less Than 1000 Volts Not Required To Be Grounded
- C. Circuits Not To Be Grounded
- D. Grounding Service-Supplied Alternating-Current Systems
- E. Conductor To Be Grounded – Alternating-Current Systems
- F. Main Bonding Jumper and System Bonding Jumper
- G. Grounding Separately Derived Alternating-Current Systems
- H. Buildings or Structures Supplied by a Feeder(s) or Branch Circuit(s)

7. Grounding Electrode System and Grounding Electrode Conductor

- A. Grounding Electrode System
- B. Grounding Electrodes
- C. Grounding Electrode System Installation
- D. Auxiliary Grounding Electrodes
- E. Common Grounding Electrode
- F. Use of Strike Termination Devices
- G. Grounding Electrode Conductor Installation

Day 3

8. Bonding

- A. General
- B. Services
- C. Bonding for Other Systems
- D. Bonding Other Enclosures
- E. Bonding for Over 250 Volts
- F. Bonding Loosely Jointed Metal Raceways
- G. Bonding in Hazardous (Classified) Locations
- H. Bonding Conductors and Jumpers

9. Equipment Grounding and Equipment Grounding Conductors

- A. Equipment Fastened in Place (Fixed) or Connected by Permanent Wiring Methods
- B. Specific Equipment Fastened in Place (Fixed) or Connected by Permanent Wiring Methods
- C. Nonelectrical Equipment
- D. Types of Equipment Grounding Conductors
- E. Identification of Equipment Grounding Conductors
- F. Equipment Grounding Conductor Installation
- G. Use of Equipment Grounding Conductors
- H. Size of Equipment Grounding Conductors
- I. Equipment Grounding Conductor Continuity

10. Methods of Equipment Grounding

- A. Equipment Grounding Conductor Connections
- B. Short Sections of Raceway
- C. Equipment Fastened in Place or Connected by Permanent Wiring Methods (Fixed) – Grounding
- D. Equipment Considered Grounded
- E. Cord- and Plug-Connected Equipment
- F. Frames of Ranges and Clothes Dryers
- G. Use of Grounded Circuit Conductor for Grounding Equipment

