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## Grounding and Bonding and The NEC - Section 250

Contact us Today for a FREE quotation to deliver this course at your company's location.

<https://www.electricityforum.com/onsite-training-rfq>

### COURSE DATES AND TIMES

**May 6-7 , 2021**

10:00 am - 4:30 pm ET

**July 8-9 , 2021**

10:00 am - 4:30 pm ET

Our Grounding and Bonding and the NEC Training 12-Hour Live Online Course Is Founded On Article 250 of The National Electrical Code.

This interactive 12-hour live online instructor-led Grounding and Bonding and the NEC Training course takes an in-depth look at Article 250 of the National Electrical Code (NEC) and is designed to give students the correct information they need to design, install and

maintain effective electrical grounding and bonding systems in industrial, commercial and institutional power systems.

One of the most important AND least understood sections of the NEC is the section on Electrical Grounding.

No other section of the National Electrical Code can match Article 250 (Grounding and Bonding) for confusion that leads to misapplication, violation, and misinterpretation. It's generally agreed that the terminology used in Section 250 has been a source for much confusion for industrial, commercial and institutional electricians. Thankfully, this has improved during the last few revisions to Article 250.

Article 250 covers the grounding requirements for providing a path to the earth to reduce overvoltage from lightning, and the bonding requirements for a low-impedance fault current path back to the source of the electrical supply to facilitate the operation of overcurrent devices in the event of a ground fault.

Our Electrical Grounding Training course will address all the latest changes to the Electrical Grounding rules included in the NEC.

Our course will cover grounding fundamentals, identify which grounding system tests can prevent safety and operational issues at your facilities and details regarding which tests can be conducted while the plant is in operation versus which tests require a shutdown will be discussed.

Proper electrical grounding and bonding of 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, unintentional contact with higher-voltage lines, or ground-fault conditions. Proper grounding and bonding is important for personnel protection, as well as for compliance with OSHA 29 CFR 1910.304(g) Grounding.

It has been determined that more than 70 per cent of all electrical problems in industrial, commercial and institutional power systems are due to poor grounding, and bonding errors. Without proper electrical grounding and bonding, sensitive electronic equipment is subjected to destruction of data, erratic equipment operation, and catastrophic damage. This electrical grounding and bonding training course will give participants a comprehensive understanding

of practical applications of proper grounding and bonding practices that will comply with the National Electrical Code.

### **Increase Your Knowledge**

- Focus On Specific Electrical Grounding And Bonding Problems And Consequences Relating To Fires, Safety Of Personnel, And Damage To Equipment
- Participate In A Discussion Of Electrical Grounding And Bonding Problems And How To Overcome Or Avoid Them
- Gain A Firm Foundation Of Knowledge For Your Next Project Involving Electrical Grounding And Bonding
- Develop Your Knowledge Of Theory And Practice

### **Learn About**

- The Grounding and Bonding and the NEC Section 250
- Specific Grounding Problems, Installations And the National Electrical Code Requirements
- Testing Procedures For Industrial, Commercial And Institutional Electric Power Grounding Systems
- Practical Solutions To Grounding Problems

### **After Attending, You Will**

- Work More Safely And Efficiently
- Have A Better Understanding Of The NEC
- Make Fewer Installation Mistakes And Pass Inspections More Easily
- Be More Aware Of The Benefits Of Good Grounding And Bonding Systems
- Be Better Prepared To Design Your Next Grounding And Bonding System

Without good grounding and bonding, sensitive electronic equipment is subjected to destruction of data, erratic equipment operation, and catastrophic damage. Allen G.W. Segall (IBM Study) determined that 88.5% of all disturbances are caused by transient overvoltage and, therefore, it is of critical importance to know the "state-of-the-art"

protection technologies.

Inductive effects of lighting including transients, wiring errors, and code violations cause damages estimated at about \$20 billion dollars in the US each year, based on the following considerations: risk to personnel, equipment replacement cost, repairs cost, and destroyed data. The economics: Loss of sales, Loss of production, Loss of work in progress. The knowledge acquired in this course will enable the participant to apply correct electrical installation procedures according to the NEC, effective cabling and state-of-the-art technologies available for the protection of equipment and circuits. A code violation poses hazards to human life and equipment.

### **WHO SHOULD ATTEND**

- Utility And Industrial Electrical Engineers And Engineering Technicians
- Project Engineers
- Design Engineers
- Field Technicians
- Electrical Technicians
- Electricians
- Plant Operators
- Plant Engineers
- Electrical Supervisors

### **STUDENTS RECEIVE**

- 100-Page Digital Electrical Grounding Handbook - Value \$20 (Details Below)
- 1.2 Continuing Education Unit (CEU) Credits
- A **FREE** Magazine Subscription (Value \$25)
- **\$100** Coupon Toward Any Future Electricity Forum Course (Restrictions Apply)

### **COURSE OUTLINE**

#### **Grounding and Bonding and the NEC Training Course Outline**

#### **DAY ONE**

# **INDUSTRIAL, COMMERCIAL GROUNDING SYSTEMS**

## **Session 1: Electrical Grounding Overview**

- Scope / Introduction
- Grounding Definitions
- Why Electrical Grounding
- Grounding Concepts
- Major Cause Of Trouble In An Electrical Distribution System
- Faults In The Electrical System
- Codes/Handbooks & Industry Standards
- NEC Object, Scope And Definitions
- IEEE Grounding Standards, Guidelines & Recommendations
- Grounding Subsystems

## **Session 2: Grounding Electrode System**

- Earth Grounding Subsystems
- Soil Resistance, Resistance-To-Ground And Soil Resistivity
- Grounding Concept Frequency Limitations
- Grounding Electrodes- NEC
- Manufactured Grounding Electrodes
- In-Situ Grounding Electrodes
- Pipe Grounds, Metallic Water Lines & Steel Piling
- Primary & Secondary Facility's Grounding Systems
- Grounding Electrode Connections
- Empirical, Practical Formulas Of Grounding Electrodes
- Ground Rods, Accessories And Applications
- Other Electrodes: Conductor Encased In Concrete, Conductive Cement
- Resistance-To-Ground Components
- Voltage & Current Distribution In The Soil
- Grounding Connections & Connectors (Mechanical, Compression, Exothermic)
- Grounding Conductor's Material, Size
- Ground Resistance/Resistivity Testers – 3 & 4 Pole Earth Ground Measurements

### **Session 3: System and Circuit Grounding**

- Electrical Grounding Methods
- Grounding Of Alternating Current Systems
- Single-Phase, 3 Wire Solidly Grounded System
- 3-Phase, 4 Wire Solidly Grounded System (Mid-Point Grounded)
- 3-Phase, 4 Wire, Solidly Grounded System, WYE Configuration
- 3-Phase, 4 Wire, Solidly Grounded System With No-Neutral Load
- Grounding Connections For Equipment In Ungrounded Systems
- Ground Faults / Ground Faults Main Consequences
- Floating Systems
- Grounding Connections For Two Or More Buildings Supply From A Single Service
- Two Ground Faults On Different Lines On A 3-Phase Ungrounded Delta
- Simplified Electrical Distribution System Typical Of Commercial & Industrial Facilities

### **Session 4: Resistance Grounding**

- Resistance Grounding, Low & High Resistance (HRG)
- High Resistance Grounding Considerations
- High Resistance Of Medium Voltage Systems
- HRG Benefits
- HRG Current Sensing Alarm Relays
- HRG, Advantages & Disadvantages
- HRG Fault Location Tracking
- HRG Design Considerations. System Charging
- Zero Sequence Current Transformer
- Zero Sequence Charging Current
- CEC 10-1108 Conductors Used With Neutral Grounding Devices

### **Session 5: Grounding of Generator to Supply Emergency Power**

- Grounding Emergency Supply Systems (Generators & Motors)
- Objectives

- Sources Of Power Supply
- Isolation Transformer Grounding
- Emergency Supply Grounding, 3 And 4 Pole ATS Systems
- Power From Two Sources With Neutral Grounded In One Location
- Multiple Emergency Power Supplies Grounding
- UPS Grounding For Various Configurations
- Generators, Generator Disconnects Emergency Loads & Other Loads
- Grounding A Portable Generator

## **DAY TWO**

### **Session 6: Bonding**

- Objective, NEC Rule, Bonding & Grounding
- Bonding Conductor- Bonding Jumpers
- Bonding Conductor Sizing
- Types Of Bonding
- Means Ensuring Continuity At Service Equipment
- Interlocking Armor Of MC Cable Tech 90 Cable
- Color Of Bonding Conductor
- Electrical Shock/Severity Of An Electrical Shock
- Touch & Step Potential
- Grounding/Bonding Myths & Fatal Consequences
- Personal Protective Equipment
- Ground Fault Circuit Interrupter (GFCI)
- Bonding Indoor Metal Piping Systems
- Effective Grounding- Code Requirement
- Effective Grounding Fault Current Path- Diagram
- Star Point Grounding- Petrochemical Industry
- Industrial Automation Wiring, Bonding & Grounding
- Grounding & Bonding AC Power Distribution System With Master Control Relay
- Bonding To Racks/Cabinets In The Telecommunications Industry

## **Session 7: Renewable- Solar Photovoltaic Systems (PV) and Wind Power System**

- Renewable Energy Systems
- System Grounding- Section 50
- Ungrounded Solar PV Systems
- Equipment Grounding In DC-Only Systems
- Grounding Options, New Bonding Conductor From Inverter
- Grounding In A Grid-Tied PV System
- PV Array/AC Service Equipment/Generator/Inverter/Battery System
- Charge Controllers/ DC Subpanels
- PV Arrangement/PV Inverter & Service Equipment Grounding Electrode System
- Renewable Energy Source/ DC Disconnect/Inverter/Utility Disconnect

## **Session 8: Grounding Computer Rooms/SCADA Systems**

- Objectives
- Isolated Grounding Subsystem- Rule 10-904
- Isolated Bonding Conductors Serving A Receptacle
- Isolated Grounds With & Without Metallic Conduits
- Signal Reference High Frequency Subsystems
- Signal Reference Grounding Systems For ADP High Frequency Equipment
- Design & Installation Of A Signal Reference Grid
- SRG For Sensitive Electronic Equipment Grounding
- Power Supply Installation & Placement For ADP/Computer Room Power Center
- Equipment Mesh/Mats For SRG Systems
- Cable Management

## **Session 9: Electro Magnetic Interference (EMI) on Electronic Circuits**

- Susceptibility Of Components & Electronic Circuits
- Shielding/By Absorption & Reflection
- Considerations For Utilizing Shields
- Data Processing Systems Protection
- Grounding Connections/Twin Axial & Coax Cable



- Shielding Of Shielded Cables
- Grounding For Differential Amplifiers
- Proper Bonding & Grounding For PLC Applications
- PLC Enclosure Grounding
- Grounding Systems For Programmable Controllers
- Grounding For Better Communications (Less Noise) With PLC
- Formation Of Ground Loops/Multiple Loops In Instrumentation Grounding
- Multiple Circuits Common Grounds
- Grounding Of Shielded Standard Cable & Cables Equipped With Inner Shields
- Typical Single Point Ground Network For A Control System
- Recommended Process Automation Grounding Scheme (Typical CCR Or PIB)
- How Not-To-Ground (IACS/DCS/PLC)

### **Session 10: Lightning Protection**

- Lightning Data/Isoceraunic Maps
- Lightning Protection Subsystem Diagram- Rule 10-706/CAN/CSA-B72
- Types Of Air Terminals
- Cable Supports, Bolted Connectors, Compression Lugs, Ground Bars, Conductors, Grounding Electrodes.
- Spacing & Interconnecting Grounding Electrodes
- Installation & Grounding Of Lightning Arresters/Surge Protection Devices (SPDs)
- Conventional Lightning Protection Systems Hardware
- Rule 10-706, NFPA 780, UL 96A. LPI 175, NEC Requirements
- Metallic & Non-Metallic Tank's Lightning Protection
- Substation Shielding Design Methods
- Single Mast Or Shield Wire, Two-Masts & Principle Of The Rolling Sphere
- Telecommunications Lightning Protection System

### **COURSE SCHEDULE:**

**Both days:**

Start: 10 a.m. Eastern Time  
Finish: 4:30 p.m. Eastern Time

Contact us Today for a FREE quotation to deliver this course at your company's location.

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