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Grounding and Bonding NEC - Section 250

[View Course Details](#)

COURSE DATES AND TIMES

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

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

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

Proper electrical grounding and bonding (G&B) of equipment help ensure that the equipment and systems are safe from electric shock by limiting the voltage imposed on them from lightning, line surges, unintentional contact with higher-voltage lines, or ground-fault conditions. Proper G&B is important for personnel protection and for compliance with OSHA 29 CFR 1910.304(g).

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 G&B, sensitive electronic equipment is at risk of data loss, erratic operation, and catastrophic damage. This electrical grounding and bonding training course will give participants a comprehensive understanding of practical applications of proper G&B practices that will comply with the National Electrical Code.

Effective G&B systems maintain electrical continuity between conductive components, ensuring a reliable fault-current path during electrical faults. Equipment grounding conductors connect exposed metal parts of electrical equipment to the grounding network, while grounding electrode conductors link the system to the building's grounding electrode system. Together, these components ensure that fault current returns safely to the source, allowing overcurrent protective devices to operate quickly and reducing the risk of shock hazards, equipment damage, and electrical fires.

Increase Your Knowledge

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

Learn About

- The Grounding and Bonding and the NEC Section 250
- Specific G&B Problems, Installations And the National Electrical Code Requirements
- Testing Procedures For Industrial, Commercial And Institutional Electric Power Grounded Systems
- Practical Solutions To Earthing 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 G&B Systems
- Be Better Prepared To Design Your Next G&B System

Without proper G&B, sensitive electronic equipment is at risk of data loss, erratic 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 critical to understand 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 in the US each year, based on the following considerations: risk to personnel, equipment replacement costs, repair costs, and data destruction. 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 in accordance with the NEC, implement effective cabling, and use state-of-the-art technologies to protect 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

- Grounding and Bonding NEC Course Certificate
- 1.2 Continuing Education Unit (CEU) Credits (12 Professional Development Hours)
- 100-Page Digital Electrical G&B Handbook - Value \$20 (Details Below)
- A FREE Magazine Subscription (Value \$25)
- \$100 Coupon Toward Any Future Electricity Forum Course (Restrictions Apply)

COURSE OUTLINE

Grounding and Bonding 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, Ggrounding 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.

[Request Quote](#)