

# INDUSTRIAL ELECTRICAL GROUNDING AND THE CANADIAN ELECTRICAL CODE

March 6-7, 2018 Richmond, BC

March 8-9, 2018 Edmonton, AB

March 19-20, 2018 Winnipeg, MB

March 22-23, 2018 Toronto, ON



Gain Insight Into Canada's 2017 Electrical Code

## BONUS FEATURES

- 100-Page Digital Electrical Grounding Handbook
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2-DAY COURSE

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# ELECTRICAL GROUNDING AND THE CANADIAN ELECTRICAL CODE

One of the most important AND least understood sections of the 2017 Canadian Electrical Code is the section on Electrical Grounding and Bonding.

This basic electrical grounding course is founded on the 2017 Canadian Electrical Code and is designed to give you the correct information you need to design, install and maintain effective electrical grounding systems in industrial, commercial and institutional power systems.

This course will address all changes on Grounding & Bonding included in the 2015 CEC.

The 2017 CEC recognizes materials other than copper for uses as a grounding conductor in ten different articles of the code. It also addresses corrosion issues in new added subrule.

There are new sub rules on bonding conductors that bonds fixed equipment. Some other sub rules have been amalgamated into a new rule. One of the most important changes has been that the new code does not favor "Water Pipe" as a grounding electrode. Some other rules have been modified to require alarm indicator installation

to indicate a fault on certain systems.

Some other sections have been changed to be consistent with the rest of the code in particular the ground fault circuit interrupters. Changes have been made to station grounding, to meet the maximum permissible resistance of station grounding electrode. Some of the requirements for driven ground rods were deleted, to be consistent with CSA Standard 41.

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 2017 Canadian Electrical Code.

## AGENDA - DAY 1

### 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
- CEC & 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- CEC 10-700
- 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

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## AGENDA - DAY 2

- UPS Grounding for various configurations
- Generators, Generator Disconnects Emergency Loads & other Loads
- Grounding a Portable generator

### SESSION 6: BONDING

- Objective, Rule 10-002 Bonding & grounding
- Bonding Conductor- Bonding Jumpers
- Bonding Conductor Sizing- Table 16A & 16 B
- Types of Bonding
- Means ensuring Continuity at Service Equipment
- Interlocking Armor of MC Cable/CSA 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, CAN/CSA-B72-M87, CEC 10-702 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

### 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

### COURSE TIMETABLE

#### BOTH DAYS

Start: 8:00 a.m.  
Break: 10:00 a.m.

Lunch: 12:00 noon  
(included with course)  
Break: 2:30 p.m.  
Finish: 4:30 p.m.

*“Our motivation is your education.”*



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To receive registration fee discounts, you must  
**REGISTER AND PREPAY** prior to the course date.

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The registration fee to attend the 2-day Electrical Grounding and the 2015 Canadian Electrical Code training course is \$799.00 + GST/HST. The fee includes Course presentation materials, CEU Credits, refreshments, Lunch is Included.

**Register and prepay 14 days before forum date  
and receive an early bird discount of \$50.00**

**CANCELLATION AND REFUND POLICY**

Registration fees are refundable only upon receipt of written notification 10 days prior to the conference date, less a 10 per cent service charge. Substitution of participants is permissible.

The Electricity Forum reserves the right to cancel any conference it deems necessary and will, in such event, make a full refund of the registration fees.