

OSHA Electrical Safety Standards

(4 day)

Nearly every safety professional or anyone responsible for safety is intimidated by the topic of electricity, electrical equipment and dealing with electrical workers (electricians). Imagine an electrical course that illustrates, demonstrates, and explains these electrical concepts and requirements (with virtually no mathematics) so simply and vividly that attendees actually understand it and have their apprehensions about electricity dispelled.

Even “qualified” electrical workers attending have learned much including various electrical myths/misnomers which are dispelled during the course including the false concepts such as “electricity flows to ground” and “electricity takes the path of least resistance”.

This is the definitive electrical safety course for safety professionals (and others) which prepares “unqualified” persons to be able to communicate with and understand the mystique and jargon of the “qualified” (electricians). This curriculum was developed by Grizzy for the OSHA investigators to prepare them to be able to effectively understand and communicate with qualified electrical workers as well as investigate electrical accidents and fatalities.

Learn such critical items as what the mysterious three phase is all about and how it works, the jargon associated with various electrical hardware including distinctions between the numerous raceways/conduits, cable assemblies, and much more, how these are properly used as prescribed by the codes and standards and numerous other important topical areas. This course is designed to provide the student with a survey of OSHA's key electrical standards as well as equivalent NFPA electrical standards and the hazards associated with electrical installations and equipment. Topics include: electrical fundamentals, overcurrent protection, ampacity, instrumentation, branch circuits, feeder circuits, equipment grounding, Ground Fault Circuit Interrupters, Three Phase Circuits, OSHA Standards requirements, equivalent NEC® requirements and introduction to NFPA 70E. In addition to the electrical installation specification standards this course also includes OSHA's electrical safety related work practice standards which are based on NFPA 70E. Nearly all concepts presented are vividly and visually demonstrated, illustrated and explained from an easy to understand

conceptual level with virtually no mathematics required. Emphasis is placed on electrical hazard recognition and OSHA policies and procedures are also discussed. Students are encouraged to bring their electrical test equipment and will be instructed on the safe and correct use of the testers as well as the limitations of the various electrical testers. Testers are provided for the hands on lab exercise for any attendees who do not have any electrical safety test equipment. Students will use electrical testers on “specially designed fault board outlets” provided in order to, determine branch circuit conditions, identify the associated hazards and reference the applicable standards for each separate condition as well as to illustrate uses and limitations of the circuit testers. These hands on fault boards are available nowhere else other than this course. Several application models/paradigms which have been developed by the instructor will be presented which will be useful in assisting attendees in locating the correct electrical standards reference as well as to identify causal factors in an electrically related accident / fatality investigation. OSHA policy and compliance are heavily discussed throughout the course with a focus on what will OSHA look for and how it can be cited. This is the only course of its type anywhere, which prepares safety professionals (and others) in understanding and communicating with “qualified” electrical workers, and is considered the definitive electrical course for safety professionals.

Instructional Methodology: Each student receives an interactive course workbook containing all of the course topics and reference materials which they use throughout the course, as well as a copy of a cross reference guide “CSHO Code Finder”. The “CSHO Code Finder” is unique cross reference guide (developed and exclusively published by Grizzly) used to locate equivalent code references between OSHA’s various electrical standards and the NFPA electrical standards. This reference guide cross references these standards line by line between OSHA’s General Industry Subpart S electrical standards (including .331-.335 electrical safety related work practices to NFPA 70E), OSHA’s Construction Subpart K standards, and the current edition of NFPA 70 (NEC® National Electrical Code).

The prodigious use of instructional media is employed. The instructional media includes video clips and stills of actual OSHA accident and fatality cases (electrocutions as well as arc flash/arc blast), many of which were investigated by the instructor in his official OSHA capacity with detailed explanations of causal factors revealed by the OSHA investigation and resulting citations

explained in class. Additionally, realia (actual equipment including tools, hardware, etc.) will be available for student examination which is especially important for students with kinesthetic learning tendencies. The extensive use of oral questioning techniques as well as reinforcement techniques are employed for a sound and effective didactic approach. Highlights of the course are application of instrumentation on fault boards to identify electrical wiring including the associated hazards and standards which apply. Most of all, Grizzys approach to training is that students should have fun learning...what a concept!

Course: Electrical Safety Standards

Instructor: John “Grizzly” Grzywacz

	Day 1	Day 2	Day 3	Day 4	Day 5
1	<p>Introduction & Hazards of Electricity</p> <p>What all the electrical standards and codes address</p>	<p>Ampacity, overcurrent & Ω Law</p>	<p>Electrocution Investigation Model</p> <p>Fatality analysis workshops step & touch potentials How far can electricity jump?</p>	<p>Equipment Grounding Cont'd</p> <p>conductor path, Impedance, measuring ground impedance</p>	
2	<p>Hazards Cont'd</p>	<p>Cont'd</p> <p>Overcurrent device continuous current rating, interrupting capacity rating what that means Short circuits & open circuits</p>	<p>AC, 3\emptyset, Transformers</p> <p>“what is this 3 phase stuff” 1\emptyset, 3\emptyset, Delta, Wye Separately derived systems</p>	<p>GFCI's</p> <p>Ground Fault Circuit Interrupters</p>	
3	<p>Electrical Standard Categories</p> <p>Distinctions between OSHA's Subpart S & Subpart K Types of electrical standards – the big picture</p>	<p>Instrumentation</p> <p>Limitations of test equipment and how they can be fooled</p>	<p>Cont'd</p>	<p>OSHA's ESRWP standards</p> <p>Electrical Safety Related Work Practices</p>	
4	<p>Electrical Fundamentals</p> <p>Current, voltage, resistance, impedance, reactance</p>	<p>,Hardware & Wiring methods from the NEC Chapter 3</p> <p>“Electrical speak” Cable assemblies, conductors, raceways, conduits, bus, specialty</p>	<p>Branch Circuits Polarity 1910.304</p> <p>Feeders, Branch circuit conductors, three light circuit testers, outlet wiring, reverse polarity hazards</p>	<p>Cont'd</p>	
5	<p>Cont'd</p> <p>Voltage drop, Hazardous effects of resistance</p>	<p>General Standard Requirements</p> <p>Guarding live parts</p>	<p>Cont'd</p>	<p>Electrical Test Equipment Lab</p> <p>Student Test of Fault Boards</p>	
6	<p>Cont'd</p>	<p>Flexible Cords & cordsets</p> <p>Uses permitted – Uses not permitted Flexible cords properly used is a good thing</p>	<p>Grounding 1910.304(g)</p> <p>System grounding versus equipment grounding</p>	<p>Review, Fault board Lab & Course closing</p>	

Electrical Safety Standards Course Topics and Student Objectives

Hazards of Electricity

Objectives:

While participating in the classroom discussion students will create a list of the hazards of electricity

Upon successful completion of this lesson topic and without the use of reference materials each student will list the hazards of electricity

Upon successful completion of this lesson topic and without the use of reference materials each student will identify the primary hazard responsible for the majority of accidents and fatalities among *qualified* electrical workers.

Upon successful completion of this lesson topic and without the use of reference materials each student will identify the primary hazard responsible for the majority of accidents and fatalities among *unqualified* electrical workers.

Upon successful completion of this lesson and without reference materials each student will:

State the one primary safety professionals rule for the primary electrical hazards.

Categories of Electrical Standards

Objectives:

Upon successful completion of the lesson each student will, without the use of reference materials be able to:

List the 4 general categories / types of electrical standards, which will facilitate the location of the correct electrical standard based on the hazardous condition.

State of the official OSHA policy regarding OSHA certification or approval of equipment.

List at least four of OSHA's nationally recognized testing laboratories.
State the importance of NFPA 70E.

Upon successful completion of the lesson each student will be able to: Correctly classify the electrical hazard condition according to the correct electrical standard category.

Distinguish between performance standards versus specification standards.

Electrical Fundamentals

Objectives:

Upon successful completion of the lesson and without the use of reference materials, each student will:

Define electricity.

Define and describe electrical parameters including: Current, Voltage, Resistance, Reactance and Impedance.

List the two types of electricity.

State how most of our electricity is produced.

State where electricity flows to (and it's not to ground).

Define and identify circuits, including: open circuit, series circuit, and parallel circuit.

List the 4 physical factors affecting resistance.

Define impedance and state the electrical phenomena causing reactance.

Briefly describe the effects of reactance and how it affects impedance.

State how the circuit reactance effects are minimized electrically and required by the standards.

Recognize and state the fundamental rules governing the behavior of electricity.

List the three components needed for a basic circuit.

Ampacity, Overcurrent and Ω Law

Objectives:

Without the use of reference materials, each student will:

Define ampacity.

List the ampacity of #14, #12, & #10 copper conductors.

List two types of overcurrent devices.

Define short circuit.

State the purpose of interrupting rating and short circuit rating.

State the 5 times rule and it's purpose

State why we need to know / apply Ω Law.

Using Ω Law calculate the maximum wattage load for 15, and 20 amp branch circuits.

Calculate total load conditions to determine overload (ampacity) hazard of outlets and relocatable power taps (power strips).

List code / standard references for exceeding the ampacity.

State what a short circuit causes to happen in a circuit.

Instrumentation

Objectives:

Students will examine: What these instruments indicate, their limitations and various applications of their use.

Hardware & Wiring Methods

Objectives:

Students will examine how the NEC is organized and applied relative to the Chapters and format.

Examine the various types of electrical hardware (look at actual samples of each) and categorize each into some simple basic categories for installation, including raceways, conduits, conductors, cable assemblies, busways, and other specialty types of hardware.

State where to find the approved installation methods for each type of hardware.

OSHA's General Electrical Standard Requirements

Objectives:

Students will examine key general provisions in the OSHA electrical standards.

Upon successful completion of the lesson, and with the use of a CFR each student will:

List two commonly found items which are no longer listed and locate the applicable standard.

Locate the electrical general duty clause and examine some equivalent 5(a)(2) citation options.

List at least 4 out of 6 of the installation & use requirements for Relocatable Power Taps (RPT's).

List items to document and applicable standards to cite when boxes with prepunched knockouts are used on the end of a flexible cord.

State the electrical threshold in volts which requires guarding of live electrical parts.

State the primary electrical hazard associated with the exposure to unused openings not effectively closed.

Locate & list the equipment marking requirements in the standard.

Locate and list requirements for identification of disconnects. Examine the OSHA compliance strategy pursued when disconnects are not labeled or labeled correctly.

Upon successful completion of the lesson each student will without the use of reference materials state the electrical inspection safety rule/requirement for unqualified person safety:

Electrocution Levels in Human Adults and Investigation Model

Objectives: Without the use of reference materials, each student will:

List at least four different electricity levels and their respective physiological effect on the adult human body, including electrocution level.

List reference standards of clearance distances to overhead lines.

Correctly state which path current will flow in a circuit (and it's not the path of least resistance).

Correctly state which element of the electrocution model is the starting point for electrocution fatality investigations.

During the topic discussion students will examine and record how far electricity can arc in air.

Students will apply previously learned electrical concepts to determine how step/touch potentials can cause electrocution simply standing on the ground without directly contacting overhead lines.

AC, 3Ø, Delta & Wye Separately Derived Systems

Objectives: Without the use of reference materials students will:

State equivalent term for RMS (root mean square)/ effective value parameter of ac.voltage.

State the purpose of 3 Ø (phase) and how it is derived.

State the function / purpose of a transformer and briefly describe how they work.

Recognize a separately derived system and identify various types including: 1Ø, 3Ø delta & 3Ø Wye systems.

Observe how both single phase and 3 phase systems are terminated/wired to electrical panels.

State the benefits of ac versus dc as evidenced by the use of transformers used for power distribution.

List the important separately derived system technical specifications / information required for case documentation in an arc blast/arc flash investigation.

Flexible Cords/Cordsets

Objectives: Upon successful completion of the topic students will be able to:

State where to find “uses permitted” and “uses not permitted” for flexible cords in the codes and standards.

State where to find the code which allows extension cords/cordsets to be plugged into one another (cascaded/daisy chained).

Determine or distinguish between a cable/cable assembly versus a flexible cord according to the codes.

State why vinyl electrical tape generally won't meet the code requirements for repairs.

Branch Circuit Wiring, & Three light circuit testers

Objectives: Without the use of reference materials each student will:

Define: ground, grounded, grounding, branch circuit, and identify each along with their purpose.

List the 4 purposes of “system grounding” as required by the codes and standards (first appearing in the 1913 NEC®).

State the proper wiring configuration for a correctly wired receptacle outlet.

Recognize and describe at least two hazards associated with reverse polarity.

State the hazard of an open neutral conductor or switching the neutral.

List the purposes of the grounding electrode (system ground).

List the code language and the more commonly used language which identifies each of the branch circuit conductors.

List the normally current carrying branch circuit conductors.

Upon successful completion of the lesson and without reference materials each student will be able to state the important safety rule for testing receptacle outlets.

Equipment Grounding

Objectives:

In one sentence state the purpose of the equipment grounding conductor.

State how the equipment grounding conductor works.

Correctly reference the appropriate 1910, 1926, NEC, & NEC® standard regarding the quality / integrity / effectiveness / impedance of the equipment grounding conductor.

While participating in the lesson discussion each student will examine common raceways & other items which the NEC allows to be used as an equipment grounding conductor.

Visually recognize common raceways & cable assembly installation problems with respect to grounding and list the appropriate standards.

State the purpose of the 5x rule.

After participating in the classroom presentation on the application of Ohms Law to determine the resistance / impedance of the equipment grounding conductor each student will correctly state the maximum allowable impedances for 15 amp, 20 amp and 30 amp branch circuits.

Ground Fault Circuit Interrupter (GFCI)

Objectives: Upon successful completion of the lesson and without the use of reference materials each student will:

Given a CFR locate the requirements for GFCI's in Part 1910 & 1926

Explain how a GFCI operated and state the hazard(s) still encountered with the use of GFCI's.

List the proper procedure as explained in class for correctly testing the GFCI and demonstrate a correct test.

List the testing requirements and standard reference requiring same.

Examine if equipment grounding is required for a GFCI for it to properly operate and protect.

OSHA's Electrical Safety Related Work Practices & NFPA 70E

Objectives:

While participating in the lesson each student will review the applicability of this standard and apply it to different workplaces.

Examine how the OSHA Electrical Safety Related Work Practice requirements apply to workers (both qualified electrical workers as well as unqualified / other workers).

Examine the electrical training required for all unqualified workers, from office workers to painters.

List some common electrical hazards this standard requires all workers to inspect for prior to using portable electric tools.

Without the use of reference materials each student will:

State how the standard requires all electrical work to be performed.

State the two limited exemptions which allow qualified persons to work energized under this standard.

State the prohibited clothing for electrical workers.

Recognize electrically insulated and insulating hand tools required by the standards.

Electrical Test Equipment Lab and Electrical Fault Boards

Objectives:

Upon successful completion of the course and given an electrical fault board, three light tester, a dynamic circuit tester, a CFR, and the "3 light electrical outlet tester guide & Code Reference" each student will be able to:

Demonstrate the correct and safe usage of the three light tester as shown in class to determine condition of each receptacle outlet wiring.

For specific faults found each student will list the hazard(s) for each fault and the applicable standard(s).

Using the necessary test equipment each student will correctly and safely test and record the quality of the ground (Z) according to the demonstrated procedures.

Course Close