



PDH-Pro.com

Avoiding Electrical Hazards

Course Number: EE-02-200

PDH: 2

Approved for: AK, AL, AR, DE, FL, GA, IA, ID, IL, IN, KS, KY, LA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, SC, SD, TN, TX, UT, VA, VT, WI, WV, and WY

State Board Approvals

Florida Provider # 0009553 License #868

Indiana Continuing Education Provider #CE21800088

Maryland Approved Provider of Continuing Professional Competency

New Jersey Professional Competency Approval #24GP00025600

North Carolina Approved Sponsor #S-0695

NYSED Sponsor #274

How Our Written Courses Work

This document is the course text. You may review this material at your leisure before or after you purchase the course.

After the course has been purchased, review the technical material and then complete the quiz at your convenience.

A Certificate of Completion is available once you pass the exam (70% or greater).

If a passing grade is not obtained, you may take the quiz as many times as necessary until a passing grade is obtained).

If you have any questions or technical difficulties, please call (508) 298-4787 or email us at admin@PDH Pro.com.





Module 1: Introduction

Learning Objectives

By the end of this section, you will be able to:

- **Identify** the specific OSHA standards and federal regulations governing electrical safety across diverse industries.
- **Evaluate** the primary hazards posed by electricity and the statistical significance of electrical fatalities in the workplace.
- **Identify** how OSHA design standards and equipment certification processes function to minimize electrical risks.

Executive Summary: Electrical hazards remain a leading cause of workplace fatalities, accounting for approximately 5% of all on-the-job deaths annually. To mitigate these risks, engineers must adhere to rigorous design and work practice standards—primarily codified in 29 CFR 1910 and 1926—which are fundamentally based on NFPA 70 and 70E.

Professional Context of Electricity

Electricity is a fundamental utility essential to modern operations, yet its familiarity often leads to a dangerous lack of respect for its inherent hazards.

- **Direct Exposure:** Engineers, electricians, and power line workers interact with electrical systems as a primary job function.
- **Indirect Exposure:** Office and sales personnel depend on reliable electricity, though they typically interact only with equipment interfaces.

Why Should You Be Concerned About Electrical Hazards?

Electricity has long been recognized as a serious workplace hazard, exposing employees to electric shock, electrocution, burns, fires, and explosions.

- **Fatality Data:** In 1999, 278 workers died from electrocutions, representing nearly 5% of all workplace fatalities.
- **Preventability:** Most electrical fatalities are easily avoided through proper training, maintenance, and adherence to safety protocols.

What OSHA Standards Address Electrical Safety?

OSHA regulates electrical safety across various sectors, relying heavily on consensus standards from the National Fire Protection Association (NFPA).

General Industry Standards (29 CFR 1910)

- **Design Safety Standards:** 29 CFR 1910.302 through 1910.308 cover the design requirements for electrical systems.



Avoiding Electrical Hazards

- **Work Practice Standards:** 29 CFR 1910.331 through 1910.335 detail safety-related work practices.
- **Foundational Codes:** These standards are based on **NFPA 70 (National Electric Code)** and **NFPA 70E (Electrical Safety Requirements for Employee Workplaces)**.

Industry-Specific Standards

Industry	Regulation Reference
Construction	29 CFR 1926, Subpart K
Marine Terminals	29 CFR 1917 (References Subpart S)
Longshoring	29 CFR 1918 (References Subpart S)
Shipyards	29 CFR 1915.181 (Limited practices)

⚠ Safety Constraint: While federal OSHA provides the baseline, 24 states and 2 territories operate their own programs. You **shall** ensure compliance with state-specific programs, which must be at least as effective as federal requirements but may have non-identical procedures.

How Do OSHA Standards Minimize Electrical Hazards?

OSHA's regulatory framework focuses on both the hardware (design) and the human element (usage) of electrical systems.

Equipment and Installation Requirements

- **Element Coverage:** Standards apply to exposed or operating elements, including lighting, motors, switches, and enclosures.
- **Construction Mandates:** Installations must be constructed to minimize workplace electrical dangers.
- **Third-Party Certification:** Standards require that approved testing organizations certify electrical equipment prior to workplace deployment to ensure safety.

💡 Design Tip: When specifying equipment, verify that the components are tested and labeled by a Nationally Recognized Testing Laboratory (NRTL) to ensure compliance with OSHA 1910.303(a).



Checkpoint Quiz

1. Which NFPA standard serves as a primary basis for OSHA's electrical safety-related work practices?

- a) NFPA 101
- b) NFPA 70E
- c) NFPA 13
- d) NFPA 99

Answer: (b). OSHA standards for electrical safety-related work practices are explicitly based on NFPA 70 and NFPA 70E.

2. According to 1999 Bureau of Labor Statistics data, electrocutions accounted for approximately what percentage of job-site fatalities?

- a) 1%
- b) 10%
- c) 5%
- d) 15%

Answer: (c). Electrocutions accounted for 278 deaths in 1999, which was nearly 5 percent of all workplace fatalities.

3. In states with their own OSHA-approved programs, which statement best describes their relationship to federal standards?

- a) They may be less stringent if industry-specific.
- b) They must be identical in every procedural detail.
- c) They must be at least as effective as federal standards.
- d) They only apply to public sector employees.

Answer: (c). State-operated programs may have non-identical procedures but are legally required to be at least as effective as federal OSHA requirements.



Module 2: Electricity: The Basics

Learning Objectives

By the end of this section, you will be able to:

- **Identify** materials that act as conductors and insulators and explain how environmental factors like water alter these properties.
- **Evaluate** the physiological effects of electric shock based on current amperage, path, and duration of exposure.
- **Select** appropriate emergency response actions for a "frozen" victim while maintaining rescuer safety.

Executive Summary: Electrical safety is dictated by the relationship between conductors, insulators, and the human body's susceptibility to current. Even low voltages can be lethal if exposure is prolonged or if environmental conditions—such as moisture—reduce electrical resistance.

What Affects the Flow of Electricity?

Electricity flows through materials with varying degrees of ease:

- **Conductors:** Materials like metals that offer minimal resistance to current. The earth's surface and subsurface are also common conductors.
- **Insulators:** Substances such as glass, plastic, porcelain, and dry wood that significantly slow or stop current flow.
- **Variable States:** Normally insulating materials, such as air, can become conductive during events like lightning strokes or electrical arcs.

How Water Affects Conductivity?

Water dramatically alters the electrical properties of common materials:

- **Impurities:** While pure water is a poor conductor, impurities like salt, acid, or solvents transform it into a strong conductor.
- **Material Transformation:** Dry wood, an insulator, becomes a conductor when saturated with water.
- **Human Physiology:** Dry skin offers high resistance, but moist or wet skin acts as an efficient conductor, increasing hazard levels in damp environments.

What Causes Shocks?

A shock occurs when the human body inadvertently completes a closed electrical circuit. This happens when the body contacts:

- Both wires of an energized circuit.



- One energized wire and the ground.
- An energized metal part, such as a tool housing with broken insulation.
- Any other conductor carrying current.

What Effect Do Shocks Have on the Body?

The severity of a shock ranges from a mild tingle to immediate cardiac arrest.

Factors Influencing Severity

- **Amperage:** The total amount of current flowing through the body.
- **Path:** The route the current takes through vital organs.
- **Duration:** The length of time the body remains part of the circuit.
- **Frequency:** The characteristics of the current itself.

Effects of Electric Current in the Human Body (Current flow from hand to foot for 1 second)

Current	Reaction
Below 1 milliamperere	Generally not perceptible.
1 milliamperere	Faint tingle.
5 milliamperes	Slight shock felt; disturbing but not painful. Individual can typically let go.
6–25 milliamperes (women)	Painful shock; loss of muscular control.
9–30 milliamperes (men)	"Freezing" current or "let-go" range. Individual cannot let go.
50–150 milliamperes	Extreme pain, respiratory arrest, severe contractions. Death possible.
1,000–4,300 milliamperes	Rhythmic heart pumping ceases; nerve damage occurs. Death likely.
10,000 milliamperes	Cardiac arrest; severe burns. Death probable.

Types of Electrical Burns

Burns are the most prevalent shock-related injury:

- **Electrical Burns:** Caused by current flowing through tissue or bone; these are among the most serious and require immediate medical care.
- **Arc/Flash Burns:** Result from the high temperatures of an explosion or arc near the body.
- **Thermal Contact Burns:** Caused by skin contacting overheated conductors or ignited clothing.

The "Freezing" Effect

Electrical stimulation can cause muscles to contract involuntarily, preventing a victim from pulling free.

- **Blistering:** Current causes blisters, which lower the body's resistance and increase current flow.



Purchase this course to
see the remainder of
the technical materials.