

# Electrical and Fire Safety



## Introduction

### Course Accreditation Disclaimer

This is a general education course, and the Academy is not responsible for continuing education credits that are rejected in any way. Given the variation in the approval and acceptance of continuing education credits state to state, it is advised that you confirm recertification and training requirements, including accepted courses, with your administrator and check the accreditation page on our site that corresponds with your state.

### Welcome

Welcome to the eLearning for **Electrical and Fire Safety**. This course is designed to enhance your ability to identify the importance of proper training for your role.

An estimated annual average of 31,960 home structure fires involving electricity resulted in an estimated 400 civilian deaths, 1,180 civilian injuries. An estimated annual average of 14,760 non-home fires, also involving electricity, resulted in 20 civilian deaths. These stats further emphasize that employees should be aware of electricity and the dangers it can cause.

### Course Instructions

This course provides instruction, evaluation, and knowledge checks, presented in a linear format. Please read each page and review the associated materials thoroughly.

The course consists of the following components:

- Course Summary
- Course Instructions
- Course Sections
- Knowledge-Check Quizzes
- Final Exam

Please note that the Knowledge-Check Quizzes which appear after each section are not graded. You will only be graded in the Final Exam section of the course. If you do not pass the final exam, you are allowed to retake the exam two additional times. Also, keep in mind that your progress through the course is tracked and if you log out, you will be able to log in at a later date and continue the course from where you left off.

Once you have started a course, courses in progress are listed in My Dashboard of your account.

### Course Overview

This course is intended to give employees an understanding of the various hazards of that coming into contact with electricity may present. Also covered in this one-hour course is information on different type of fires, fire extinguishers, and how to use them properly.

### Learning Objectives

At the end of this course, the learner will be able to:

- **Describe** common electrical hazards and flammables.
- **List** the steps to take in the case of a fire.
- **Recognize** three types of fire extinguishers and their usage.

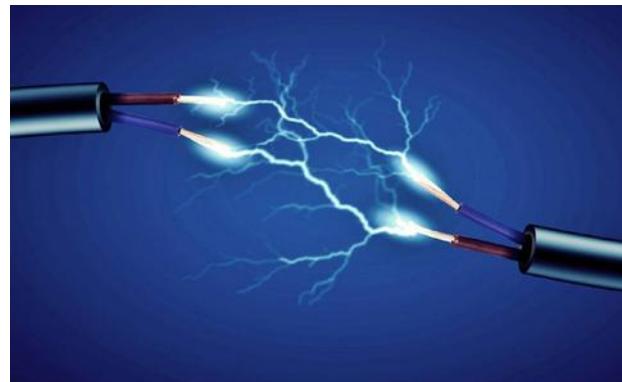
# Course Content

## Lesson 1: The Dangers of Electricity

This lesson focuses on practical information about electricity and its potential lethality. Employees are exposed to various environments and situations that may place them in harm's way of electricity. Unlike other forms of hazards, electricity has little room for error.

### "It will never happen to me."

Most employees don't give much thought to electrical accidents or fires occurring on the job. They go about their work, often in an "it won't happen to me" mentality. Unfortunately, that attitude can have dire consequences. Hopefully, you will never have to experience an electrical or fire-related tragedy at your place of work.



The best thing we can do to keep ourselves and our co-workers safe is to have an awareness of the causes of electrical accidents and fires, as well as acknowledging what to do when they occur. The information that follows in this course will help to raise both your level of awareness and your base of knowledge.

## Electricity Safety

Nearly 10 percent of all job-related deaths are due to electrocution. That makes it the fifth leading cause of workplace fatalities. Given that fact, every employee should know basic electrical safety practices. Electrical devices have become so well-built and doubly insulated that many of us have never experienced even a minor electrical shock.

This may cause us to become complacent about electrical hazard areas, or to take electrical safety for granted. In fact, careless use of electricity can result in falls, burns, and painful shocks that require a period of recovery. We need to be more aware of the power around us at all times.

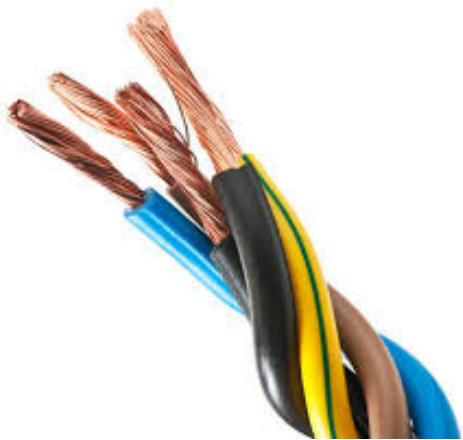
## How Electricity Works

Electricity is energy that is found in nature (such as lightning) and is generated from a variety of human-made sources such as hydro-electric dams, nuclear or coal-burning power plants, and windmills.

The circuits in the computer you are using right now work because of electricity. Once electricity is generated, even if it is by a battery in a flashlight, it "flows" along a path. Electricity is always trying to return to the earth. Lightning strikes are the best example. Electricity in the atmosphere builds to the point that it "arcs" in order to find its way to earth or ground. Unless something touches it and allows it to flow into the earth to "ground" itself, electricity is controllable and will do the work you want.

## Conductors and Non-Conductors

**Wires** are the highways that electricity travels through. They are made of common metals such as copper or aluminum. Most metals "conduct" electricity.



Materials that allow electricity to flow are called conductors. Good conductors of electricity include:

- Copper
- Aluminum
- Steel
- Lead
- Water containing metallic solids

Because these materials conduct electricity so well, wires are never left exposed. Instead, they are covered in materials such as rubber or plastic called insulators. Insulators resist electricity and keep the current in its intended path. Materials that DO NOT permit electricity to flow are called insulators. Insulators (poor conductors of electricity) include:

- Rubber
- Plastic
- Glass

- Wood

## Labeling and Accessibility

Because electrical wires spread out like the branches of a tree, sometimes the cut-off of the device is a considerable distance away from the end user. Electricians sometimes call cut-off switches, "disconnects," or in some cases a "disconnecting means."

**Disconnect switches** are vital because they stop the flow of electricity and protect workers and equipment. Therefore, each service, feeder, branch circuit, and its method of disconnect must be clearly marked to indicate its purpose. These markings should be clear and durable since oil, heat, or simple wear and tear can cause them to fade or become unreadable.

Most organizations keep employees and processes away from major switches and breakers. Many facilities paint lines in front of the switches and breakers to prevent anything from accidentally being parked or placed in the way, in case they must be turned off in an emergency. Nothing should be in front of or blocking switches or breakers. Exposed energized parts must have warning signs and tags on them.

## Electricity and the Human Body

Household electricity is usually 110 volts, but in your workplace, there could be voltages of 440 and higher. If you touch a bare wire while electricity is flowing through it, the electricity may run through you, as you become part of the "circuit." If electricity runs through you, you will receive a shock.

If you have ever had a strong shock, you will never want to have another! Shocks are disturbing, scary, painful, and sometimes lethal.

A person who receives a shock will be unable to control his or her thought processes or body movements during the incident. Electric shock can cause:

- Pain
- loss of muscle control and coordination
- internal bleeding permanent damage to nerves, muscles, or tissue
- cardiac arrest death

The longer your body is in contact with an electrical current, the higher the risk of severe injury or death.



## Electrocution

Electrocution is the most severe kind of shock, and it doesn't take much electrical power to kill you. The best thing to do if electricity is loose in any way is to turn off the power source as fast as you can.

A manager or supervisor in your department should show you where the switch or breakers are and how to turn off the electricity in case of an emergency. If you do not know how to turn the electricity off, ask someone. Seconds can mean the difference between life and death when electricity flows through a human being.

## Electrocution Accidents Involving Heavy Equipment

The construction industry represents 52% of all occupational electrocutions, according to the recent Centers for Disease Control (CDC) study. Below are some statistics on accidents related to heavy equipment and labor trades:



- Heavy equipment events accounted for 50% of those overhead power contacts, with cranes comprising 56.5%, drilling rigs 7.7%, dump trucks 6.7%, bucket trucks 6.7% and backhoes 4.9%.
- Carried items comprised 20.5% of overhead line contacts, ladders 12.9%, scaffolding 2.2%, and direct human contact another 10.2%.
- More than 90% of power line contact accidents involved overhead distribution conductors.
- Drop-down services from power poles to houses, and high power transmission lines connecting generating stations to substations, only resulted in 7% of workplace power line accidents.
- Labor trades with considerable risk, in addition to heavy equipment operators, were roofing/siding/sheet metal contractors (9.3%), tree trim contractors (8.5%), water/sewer/pipeline personnel and communication contractors (7.9%), and painting contractors (7.3%).

## First Aid

The safety procedures outlined in this course, along with a sense of caution, should serve to prevent serious electrical injuries. However, it is still a good idea to know what to do in case of an accident occurs. The following first aid procedures should be followed if electrical accidents occur:

- Turn off the power to the electric current.
- Don't touch a shock victim.
- Use a stick or other non-conducting object to push the victim away from the source of the shock.
- Rinse minor electrical burns with cold water and cover with a clean, dry cloth.
- Get professional medical treatment.

For major burns, call 911 so that the injured person can get immediate and possibly life-saving medical attention.

If there is a fire, call 911 and let them know if the fire has its basis in electrical problems. Don't touch a burning object related to electrical fires or throw water on it. Remember that water is an excellent conductor, and electricity can travel right up the stream of water and into your body. If the fire is small **and you are properly trained**, you may use a CO<sub>2</sub> fire extinguisher or a dry chemical extinguisher on an electrical fire, but in most situations, it is best to wait for the professionals.



## **Lesson 1 Summary**



The risk of electrocution is a real and employees need to pay close attention to dealing with electricity. Keep in mind that some materials are conductors and some are not, and knowing the difference can be particularly useful in a high-risk situation. Most importantly, if you find a victim in electrocution, turn off the power before touching them. Failing to do so could have horrible consequences.

## Knowledge Check: The Dangers of Electricity

### Quiz

**1. Nearly \_\_\_\_\_ percent of all job-related deaths are due to electrocution.**

- 10
- 50
- 75
- 95

**2. Which of the following is NOT a good conductor of electricity?**

- Copper
- Steel
- Water
- Wood

**3. Which of the following is NOT a good insulator from electricity?**

- Rubber
- Plastic
- Glass
- Lead

## Knowledge Check: The Dangers of Electricity

### Answer Key

1. Nearly \_\_\_\_\_ percent of all job-related deaths are due to electrocution.

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## Course Content

### Lesson 2: Safety Tips for Electricity



There are several ways and types of equipment that allow for the safe use of electricity. Employees need to know how this type of equipment work and what their limitations are. This will help ensure that an employee is not placed in a dangerous situation or how to respond to call that involved electricity.

#### Using Electricity Safety

To use electricity safely, you must be able to identify the most common causes of electrical accidents and injuries:

- Loose electrical connections
- Cords and wiring with missing or frayed insulation
- Equipment running beyond capacity
- Tools that cause shocks or emit smoke, excessive heat, odors or sparks
- Wires running across the floor
- Electrical cords left near heat, flame or water
- Using electrical cords or equipment that creates an arc near hazardous, flammable or explosive materials (unless specifically designed for such uses).

#### Plugs and Extension Cords (Part 1)

Everyone uses standard extension cords at home and where they work. Inside the flexing cord is a metal wire, and outside the wire is a protective insulating material that keeps electricity running through the metal and not outside through your body.

There are electrical devices which have two-pronged plugs and three-pronged plugs. Most of the time, two-pronged plugs are for home use. In heavy use (or with larger electrical equipment), plugs have a third prong to accommodate a third wire called a "ground" wire. By connecting the wires to the third ground wire, which happens in the metal circuit box, any leakages usually find their way to the ground wire first, and not to you. The third wire will, in most instances, prevent your body from becoming a conductor through which electricity can travel.

Electrical cords and cables that are needed to flex or move a lot receive more wear than fixed electrical lines in the walls or in conduit, and that puts the insulation at risk. In these situations, you should watch for wear in things as simple as extension cords, as well as larger flexible electrical wires, cables, and cords that can be found on the following:



- Movable lights or lamp holders
- Portable lamps or appliances
- Elevator cables
- Lifts, cranes, and hoists
- Charging apparatus, such as forklift batteries and vehicle batteries

#### Plugs and Extension Cords (Part 2)

Flexible cords are at high risk of damage by activities in the area, movement across the floor, sharp edges, staples or fastenings, abrasion from rubbing against things or simply by aging. If the outside covering wears and the conductor becomes exposed even slightly, over a period of time, there will be a danger of shocks, burns, or fire. **Worn, frayed, or cracked flexible cords should be discarded and replaced!**



Flexible cords are to be used only in continuous lengths, which means without splicing or taping. Remember, electricity wants to find its way off the cord and into the ground, even if that means going through a human being. This is more likely to occur where any splicing has been done. It is also most likely to happen around water.

Flexible cords must be connected to devices and fittings so that strain relief is provided. This prevents pull from being directly transmitted to joints or terminal screws. A strain occurs at the ends of the cord, either at the plug or the receptacle. Never carry a tool by its cord. Always pull a cord from a receptacle by its plug...not the cord itself!

To protect against improper usage, electrical wires, cords, and equipment often have labels identifying their voltage and current capacity. Cords designed for

special uses are also labeled.

## Fast Life-Saving Switches: GFCIs



Since the 1980s, switches have been developed to save lives from electrical short circuits. These switches detect a surge in electricity and quickly turn the electricity off. GFCIs (ground fault circuit interrupters) cut off power if there is any electrical leakage that could cause shocks in wet areas. You may have several GFCIs in your home, and new homes are required by law to have them in the circuits in bathrooms and kitchens.

## OSHA Rules for Controlling Electricity

The Occupational Safety and Health Administration (OSHA) cited over 6,000 violations of its electrical safety standard in 2004, with penalties amounting to about \$3 million. OSHA has some very detailed regulations designed to keep electricity from becoming a hazard in the workplace such as:

- control panels or switch boxes that could produce dangers or sparks must be enclosed
- electrical equipment of 50 volts or more must be kept in separate rooms or enclosures, behind partitions or stored at least eight feet above the ground
- there must be a 30-inch minimum clearance in front of electrical equipment that has less than 600 volts. Electrical equipment over 600 volts must be locked or guarded behind an eight-foot fence.

One OSHA regulation is aimed explicitly at reducing electrical accidents and injuries. The detailed Electrical Safety-Related Work Practices Standards are aimed at "qualified" employees who have "training in avoiding the electrical hazards of working on or near exposed energized parts." Qualified employees must be able to recognize exposed live electrical parts and their voltage, as well as the clearance distances.

This standard defines all other employees as "unqualified." This means they have no specialized training in recognizing and avoiding electrical hazards, but might be exposed to electrical shock on the job.

Regardless of the regulation, all employees, both qualified and unqualified, need some knowledge of electrical safety and the protections outlined in the new standard.

## Common Sense Electrical Procedures (Part 1)



Other electrical safety procedures include:

- Make sure you know where electrical shut-offs are
- inspect electrical equipment and wires before use to make sure they're not damaged and are properly insulated and grounded
- Don't de-energize or turn off circuit breakers unless you've been trained as a qualified electrician
- Avoid using extension cords whenever possible
- Don't overload circuits by running multiple appliances from a single outlet
- Inspect portable equipment before each use
- Be sure electric plugs match their receptacles; never alter a plug
- Make sure your hands are dry before you handle anything electric, and never use such equipment in wet conditions.

## Common Sense Electrical Procedures (Part 2)

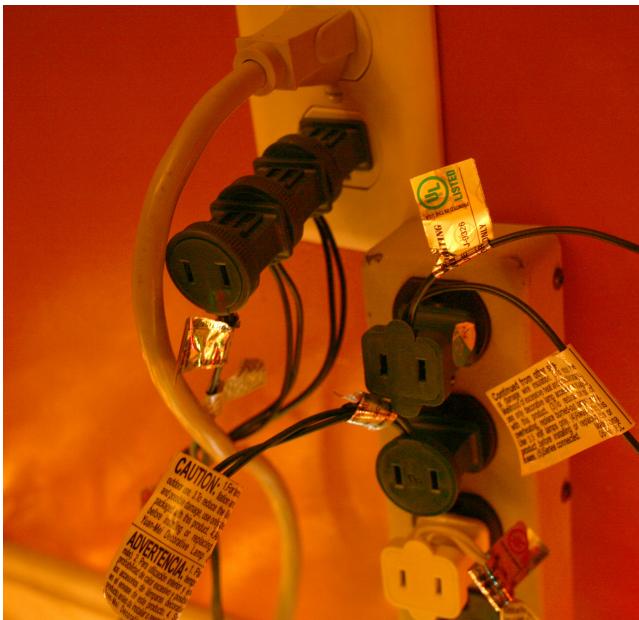
Observe the following electrical safety procedures as well:

- Be especially cautious with electricity around flammable liquids, vapors, dust or any area that might have held them.
- Keep metal objects away from electrical equipment. For example, never use a metal ladder around live electricity.
- Never put a ladder near electrical lines.
- Always obey barriers, signs and other warnings near electrical equipment.
- Keep machines and tools properly lubricated.
- Don't let grease, dust, or dirt buildup on machinery.



- Don't leave machinery or heating equipment running unattended.
- Keep the work area clean, and leave at least three feet of workspace around electrical equipment.
- Don't leave cords tangled or lying across an area where people walk.

## Electrical Fires



Fire departments across the U.S. responded to an average of 45,210 home structure fires each year between 2010 and 2014. These fires involved some type of electrical failure as a contributing factor to the fire and resulted in an about 420 deaths, 1,370 injuries, and \$1.4 billion in property damage each year. Approximately 16,070 non-home structure fires involving electrical failure or malfunction as a contributing factor were also reported per year. These fires resulted in an annual average of about 12 civilian deaths, 210 civilian injuries, and \$614 million in direct property damage.

## Lesson 2 Summary

In this lesson, we learned that the improper use of plugs and extension cords can lead to electrocution or the cause of deadly and costly fires. Employees need to be aware of the various rules for controlling electricity, which are designed and developed to keep people safe in the workplace or at home.

# Knowledge Check: Safety Tips for Electricity

## Quiz

**1. Which of the following is NOT true of GFCIs?**

- They detect a surge in electricity and quickly turn the electricity off.
- GFCI stands for ground fault circuit interrupters.
- They turn on power if there is any electrical leakage that could cause shocks in wet areas.
- New homes are required by law to have them in the circuits in bathrooms and kitchens.

**2. OSHA states that control panels or switchboards that could produce dangers or sparks much be \_\_\_\_\_.**

- enclosed
- covered
- encased in wood
- wrapped in plastic

**3. In case of an emergency, at home and the office, you should know where the electrical \_\_\_\_\_ are located at.**

- shutoff
- wiring
- controllers
- flux capacitor

## Knowledge Check: Safety Tips for Electricity

### Answer Key

**1. Which of the following is NOT true of GFCIs?**

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- shutoff
- wiring
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# Course Content

## Lesson 3: Fire Safety

This section provides information regarding precautions that can be taken to prevent fire hazards in your office or home. In addition, we will explain some of the most common rules regarding fire exits and the provision of portable fire extinguishers.

### Safety First

Fire hazards are more common than you might think because flammables are everywhere.



Common flammables include:

- cleaning solvents and supplies
- stored paints and solvents glues
- oxygen/Acetylene and other pressurized gases
- oil gasoline

Containers must be marked and should clearly identify the risk and flammability of any material on the premises. Material Safety Data Sheets (MSDS) must be available on all materials as well.



### In Case of Fire (Part 1)

In case of a fire, there is a logical sequence to follow. The most important thing to remember about fires is to stay calm so that you can inform others. Some people have had a small fire start and thought they could put it out without anyone knowing. This is a risky and ill-advised move. Fire moves quickly, and there may be flammable materials nearby that you may not even be aware of.

You should always, in a calm but firm voice, yell, "FIRE!" Do this loud enough so that you're sure that others in the area have heard you before you run for the fire extinguisher. If the fire extinguisher does not handle the problem, everyone should leave the area as quickly and safely as possible, and the fire department should be called. Make your decision quickly. If the fire does not respond to your efforts, don't try to be the hero. Let professional firefighters handle the situation.

### In Case of Fire (Part 2)

You should have established assembly areas where you can quickly determine if anyone is missing or possibly trapped in the building.

The first thing the fire department will ask is, "Is everyone accounted for?" Be prepared to give them precise information. The building can be replaced; people cannot.

Whenever you are assigned to a new location, meet with your supervisor to review where fire extinguishers are located and which exits are approved and marked as fire exits.

### Fire Extinguishers (Part 1)



Most firefighting is best left to professionals, but some small fires can be handled with the company's portable fire extinguishers.

Not all fire extinguishers are created equal. They are designed to handle different types of fires, so it is imperative to understand which extinguisher to use on what kind of fire. The wrong choice not only won't put out the fire but could make the fire worse. Besides water hoses for fires, you should know that fire extinguishers are rated to cover the following three fire ratings:

- Class A fires - Ordinary combustibles or fibrous material, such as wood, paper, cloth, rubber and some plastics. Use water or dry chemical extinguishers (classified as "ABC")
- Class B fires - Flammable or combustible liquids, such as gasoline, kerosene, paint, paint thinners and propane. Use CO<sub>2</sub> or dry chemical extinguishers.
- Class C fires - Energized electrical equipment, such as appliances, switches, panel boxes and power tools. Use CO<sub>2</sub> or dry chemical extinguishers.

### Video: Portable Fire Extinguishers

The following OSHA training video discusses the types and uses of various portable fire extinguishers. We will take a look at the proper selection, the PASS method, and hazards associated with incipient stage fire-fighting.

\*Please note, in this video, there are references to MSDS (Material Safety Data Sheets). Since the creation of this video, OSHA has updated their terminology and now calls them SDS.



## Fire Extinguishers (Part 2)

There are single extinguishers available that are rated for all three classes. It's best to have this type of extinguisher at each location. Check all fire extinguishers near your work area to determine what class the extinguishers are. Be aware that some dry chemical extinguishers are classified "ABC," which means they can be used for all classes of fires, while others are classified "BC" only, meaning that they would not be useful to use on a Class A fire.

- Class A - Water Extinguisher  
Used to extinguish ordinary combustibles (wood, paper, etc.)
- Class B & C - CO<sub>2</sub> Extinguisher  
Used to extinguish flammable liquids and energized electrical components
- Multiple Class - Dry Chemical Extinguisher
- Multi-Purpose - usage for all types of fire classes

## Fire Extinguisher (Part 3)



### Fire extinguishers should be:

- Easily accessible and no more than 50 feet away
- Located in every work area (no doors or walls between)
- Inspected monthly
- The gauge should read full or be "in the green"
- The safety pin should be in place. The seal should not be broken
- Mounted with easy-to-read and approved "Fire Extinguisher" signage
- Mounted in the proper manner and within reach
- Quick-release
- Between 36 inches and 60 inches off the floor
- Never left loose on a bench or the floor

### Using a Fire Extinguisher



The actual operating procedure for a fire extinguisher is straightforward:

- Pull the pin.
- Stand about eight feet from the fire. Aim the hose at the base of the fire.
- Squeeze the trigger and sweep back and forth.

A fire extinguisher generally only lasts three to 20 seconds, so make

sure you aim correctly.

## Lesson 3 Summary

When it comes to dealing with fire, safety and knowledge are essential. When it comes to dealing with electrical, combustible, and chemical-fueled fires, use the right type of fire extinguisher. Failure to do so can put you and others in danger and potentially make the fire spread needlessly. Remember, before trying to put out a fire yourself, call for fire service support.

## Knowledge Check: Fire Safety

### Quiz

**1. Class A fires are fueled by?**

- Wood
- Paper
- Cloth
- All of the above

**2. Class B fires are fueled by?**

- Electrical equipment
- Dry Chemicals
- Combustible liquids
- Water

**3. A Multiple Class Dry Chemical extinguisher can be used on what type of fires?**

- Combustible fire
- Energized fire
- Chemical fire
- All of the above

## Knowledge Check: Fire Safety

### Answer Key

**1. Class A fires are fueled by?**

- Wood
- Paper
- Cloth
- All of the above

**2. Class B fires are fueled by?**

- Electrical equipment
- Dry Chemicals
- Combustible liquids
- Water

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- Combustible fire
- Energized fire
- Chemical fire
- All of the above

## Course Content

### Summary/Wrap Up



While it's not always possible to avert disaster or avoid an accident from electricity or fire, we can minimize the frequency and reduce the level of damage and loss by understanding what causes them and what to do if they occur.

It's a very old saying, but "An ounce of prevention is worth a pound of cure" has no more significant application than where fire and electrical safety is concerned. If you see anything you consider potentially hazardous, notify your supervisor. It is much better to err on the side of caution than to put yourself and other co-workers at risk.

### Assessment for Course Completion

You've arrived at the end of the module. Complete the following assessment to receive course completion credit. The standard to complete this course is 80%.