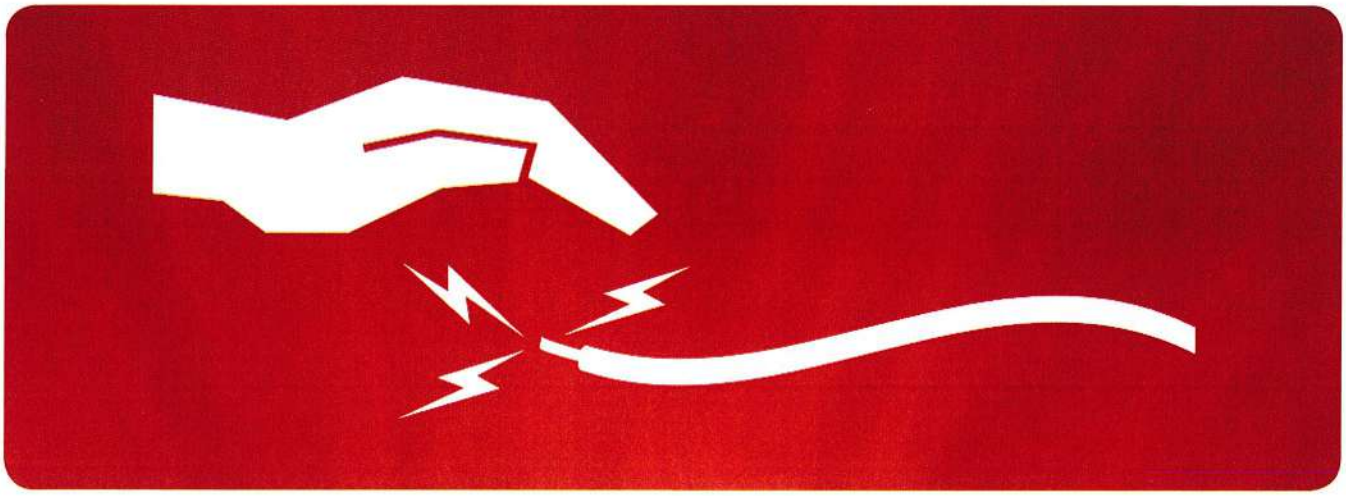


Electrical Hazards

Lesson 4 Study Guide

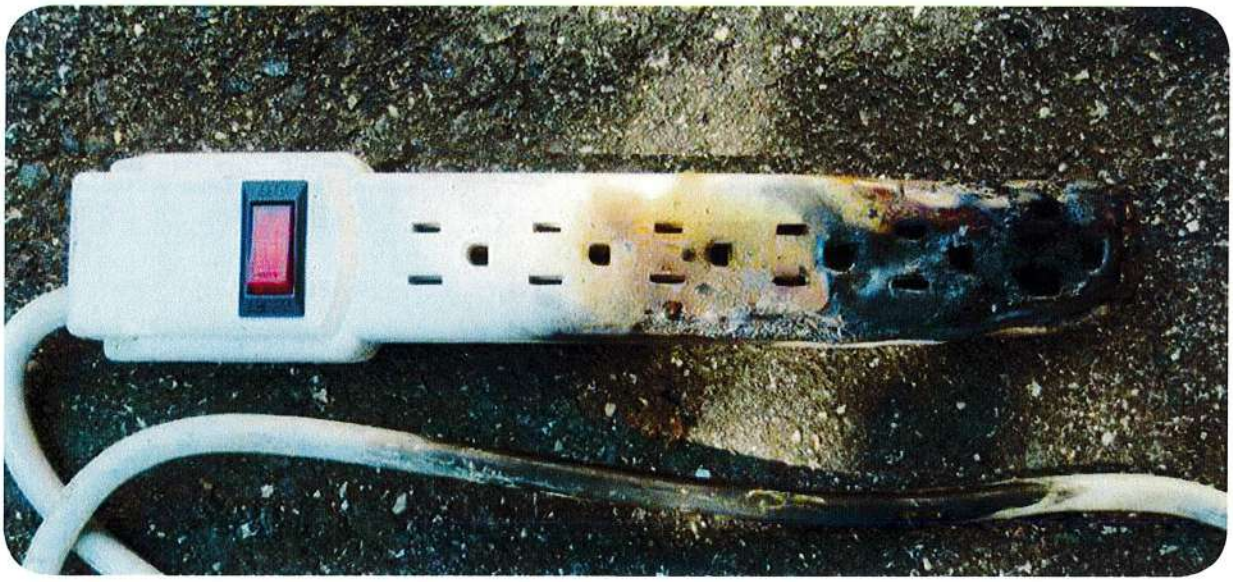
LESSON PURPOSE:

The purpose of this lesson is to provide you with information that enables you to recognize electrical hazards and how to eliminate them by adhering to OSHA standards.

LESSON OBJECTIVES:

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

- Identify major electrical hazards
- Describe types of electrical hazards
- List safety measures to protect yourself from electrical hazards
- Explain employer requirements to protect workers from electrical hazards



Any time you work with electricity in the workplace, there is potential for hazards, and you must be prepared to protect yourself.

Electrical Hazards Defined

OSHA defines electrical hazards as:

> "Dangerous situations in which a worker can make, or does make, electrical contact with energized equipment or conductors. When contact is made, whether directly or indirectly, workers are at risk of serious injury."

Electrical hazards are serious workplace hazards that expose workers to the following:

- **B**URNS
- **E**LECTROCUTION
- **S**HOCK
- **A**RC FLASH/ARC BLAST
- **F**IRE
- **E**XPLOSIONS

Note the first letter of these hazards. Together, they spell "Be Safe." Workers can "Be Safe" in the workplace by recognizing, avoiding, and protecting against electrical hazards.

Always remember to B.E. S.A.F.E. in the workplace.

Burns. Burns are the **most common electricity-related injury**. There are three types of burns:

- **Electrical burns**
  - Caused by heat generated by the flow of electric current. Tissue damage is common.
- **Arc/flash burns**
  - Caused by high temperatures produced by electric arcs or explosions close to the body.
- **Thermal contact burns**
  - Occurs when skin and/or clothing comes in contact with electric equipment.

Electrocution. Electrocution is fatal. It results when a person is exposed to a **lethal amount of electrical energy**.

Shock. Electrical shock is defined as a "reflex response to the **passage of electric current through the body**." This means that shock occurs when a human body becomes part of an electrical circuit. When this happens, electrical current enters the body at one point and leaves at another.

Arc Flash/Blast. An arc flash is the sudden **release of electrical energy through the air** when a high-voltage gap exists and there is a breakdown between conductors. An arc flash gives off thermal radiation (heat) and bright, intense light that can cause burns.

Fire. Most **electrical fires** result from "fixed wiring" problems such as faulty electrical outlets and old wiring. Another source of electrical fires includes problems with cords (such as extension and appliance cords), plugs, receptacles, and switches.

Explosions. An explosion can occur when **electricity ignites an explosive mixture** of material in the air. In an atmosphere that contains explosive gases, vapors, or combustible dust, even low levels of electricity can lead to violent explosions on the worksite.

Accidents caused by Electrical Hazards

Workers should always be prepared to protect themselves from electrical hazards.

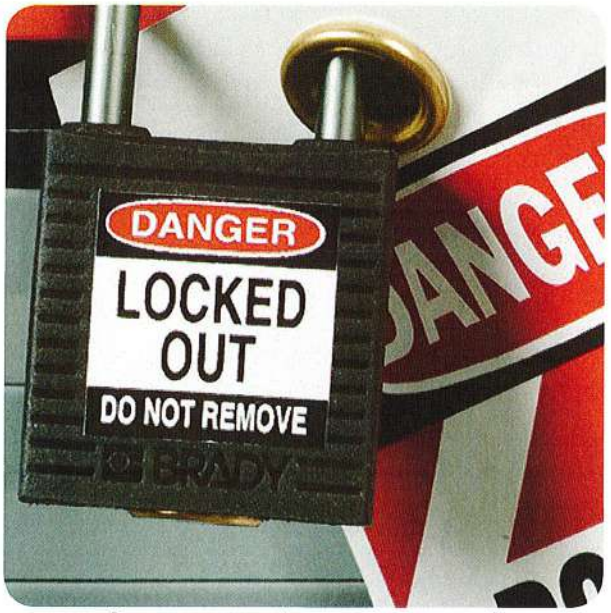
Working with or near electricity presents a variety of risks. Workers should always be prepared to protect themselves from electrical hazards. Although many assume that it will never happen to them, injuries and fatalities caused by electricity are common in the workplace.

Lockout/tagout procedures

The control of hazardous energy, by locking out or tagging out equipment, is one of the most frequently violated OSHA standards. Accidents related to improper lockout/tagout procedures are preventable.

REMEMBER

Remaining alert for hazards and adequately preparing yourself for each new task can help ensure that you do not contribute to electrical injury statistics in the workplace.



[insert caption about Lockout/tagout]

The following is a six-step process for lockout/tag out procedures:

1. **Plan and prepare for shutdown** by locating and identifying all energy sources and notifying all appropriate personnel
2. **Shut down** all equipment using proper procedure
3. **Isolate energy** by separating the equipment from external energy sources
4. **Apply locks and tags** on each device as required
5. **Control stored energy** by discharging any energy stored in the equipment
6. **Verify isolation of energy**

Types of Electrical Hazards

Learn how to protect yourself from many types of electrical hazards you'll face in the workplace.

Each year, approximately 4,000 workers suffer from electricity-related injuries, many which can be avoided if proper precautions are taken.

Common examples of electrical hazards, and ways to avoid these hazards, are explained below:

- Contact with power lines
  - Receive proper training
  - Wear proper protection
  - Work safely
  - Do not make contact, directly or indirectly, with live power line
- Contact with energy sources
  - All live parts of electrical equipment that operate at 50 volts or more must be guarded.
  - Electrical outlets, switches, and junction boxes must have covers.
  - Electrical panels must have a dead front, which separates live wires from a person and prevents them from getting shocked.
  - Four of the most common energized sources that can lead to injuries and accidents include **light fixtures, improper wiring, water, and failure to lock out and tag out**.
- Improper use of power cords
  - Normal wear and tear on extension and flexible cords can loosen or expose wires, causing potential danger.

Types of electrical injuries

Electrical hazards can lead to various injuries, ranging from minor discomfort to death.

CURRENT	REACTION
Below 1 milliampere	Generally not perceptible
1 milliampere	Faint tingle
5 milliamperes	Slight shock felt; not painful but disturbing. Average individual can let go. Strong involuntary reactions can lead to other injuries.
6-25 milliamperes (women)	Painful shock, loss of muscular control
9-30 milliamperes (men)	The freezing current of "let go" range. Individual cannot let go, but can be thrown away from the circuit if extensor muscles are stimulated.
50-150 milliamperes	Extreme pain, respiratory arrest, severe muscular contractions. Death is possible.
1,000-4,300 milliamperes	Rhythmic pumping action of the heart cease. Muscular contraction and nerve damage occur, death likely.
10,000 milliamperes	Cardiac arrest, severe burns; death probably

This chart details the body's reaction to varying levels of electric shock.

The severity of electrical shocks and burns can depend on a variety of factors:

- The pathway through the body
- The amount of current flowing through the body
- The length of time of exposure
- Whether or not the skin is wet or dry.

Important electrical current terminology:

- Amp/Amperage: The strength of an electrical current. 1 amp is equal to 1,000 milliamps.
- Ohm (Ω): A unit of measurement for electrical resistance.
- Resistance: The ability of a material to decrease or stop electrical current.

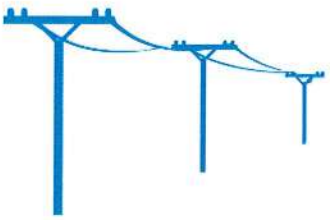
REMEMBER

Following the appropriate steps when working with electricity can protect you from these injuries.

Protecting Yourself from Electrical Hazards

Learn how to protect yourself from the risks posed by electrical hazards.

There are a variety of strategies to protect yourself from electrical hazards in the workplace.



When working with **power lines**, remember to...

- Always keep a safe distance away – at least 10 feet - from overhead power lines
- Ensure the lines have been de-energized and grounded
- Use only nonconductive tools and materials

The use of **ground-fault circuit interrupters (GFCIs)** can greatly improve the safety for those working with electricity in the workplace. A GFCI detects ground faults and interrupts the flow of the electric current to prevent or lessen the effect of an electric shock. GFCIs should be tested at least once a month and especially after a blackout or power failure.

The three types of GFCIs include:

- Receptacle: able to fit into a standard outlet box
- Portable: designed for easy transport by way of an extension cord
- Circuit breaker: controls an entire circuit and is installed as a replacement for a circuit breaker on the main circuit board.

Power cords must be inspected prior to use to ensure that they are in good operating conditions. When inspecting and using flexible extension cords, you should:

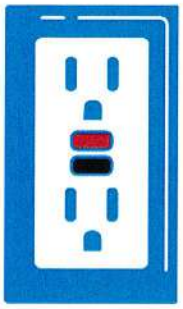
- Ensure that the cord rating matches the specified need for durability
- Check for cord damage, which can expose electrical conductors and the associated hazards.

When using **powered tools** and equipment in the workplace, it is important to use them only as they have been designed:

Always	Never
• Disconnect tools when not in use • Make sure your working area is well lit • Wear appropriate clothing/ equipment • Use double-insulated tools • Ensure cords do not cause a tripping hazard	• Carry a tool by the cord • Yank a cord to disconnect it • Hold tools in a way that could cause accidental starting • Use or store tools in wet/ damp environments • Place cords near heat, oil, or sharp edges

Protecting Yourself from Electrical Hazards

Learn how to protect yourself from the risks posed by electrical hazards.



Guarding can help prevent employees from accidentally contacting energized equipment. Guarding involves moving or enclosing electric equipment with doors, fences, or other types of barriers to prevent accidental contact with live parts.

Grounding prevents the buildup of voltages that could cause an electrical hazard. When you ground a tool or electrical system, you are intentionally creating a low-resistance path that connects to the earth. Grounding does not guarantee that a worker won't be shocked by an electrical current, but it will substantially reduce the risk, especially when used along with other safety measures.

Insulators, like glass, mica, rubber, and plastic, help reduce or stop the flow of electrical current. Insulation is used to coat metals and other conductors to help prevent shock, fires, and short circuits. All **conductors** used for general wiring must be insulated unless otherwise permitted by OSHA electrical regulations. The conductor insulation must be of a type that is approved for the voltage, operating temperature, and location of use.

A **disconnecting means** is a switch that is used to disconnect the conductors of a circuit from the source of electric current. These switches are important because they allow the flow of electricity to be stopped, which can protect workers and equipment.

When dealing with disconnecting means, pay attention to the following:

1. Each disconnect switch and circuit must be legibly marked.
2. These markings shall be of sufficient durability to withstand weather, chemicals, heat, corrosion, or any other environment.
3. Each disconnect switch or overcurrent device required for a circuit must be clearly labeled to indicate the circuit's function.

Common Personal Protective Equipment (PPE) when working with or near electricity includes the following:

- Safety glasses
- Face shields
- Hard hats
- Safety shoes
- Insulating rubber gloves
- Insulating sleeves
- Flame-resistant clothing

REMEMBER

Correctly following **lockout/tagout procedures** when working with electrical equipment is another way that workers can protect themselves from electrical hazards. Compliance with lock out/tag out procedures prevents an estimated 120 fatalities and 50,000 injuries each year.

Employer Responsibilities

Employers must take certain steps to ensure the safety of workers.

It is the employer's responsibility to ensure their workplace complies with OSHA standards and requirements for electrical hazards.

Because injuries involving electricity can be serious, or sometimes fatal, workers must be properly trained before they can work with electricity.

Employers must protect their employees from electrical hazards in the following ways:

- Ensure that workers maintain a safe distance from lines and have the power company de-energize, ground, and properly insulate lines.
- Enforce the isolation of electrical parts by making sure all pull boxes, junction boxes and fittings are covered, and all metal covers are grounded.
- Ensure that every electric utilization system and all utilization equipment installed, majorly modified, or replaced after March 15, 1972, complies with the standards for electricity set by the National Fire Protection Association, which have been adopted by OSHA.
- Enforce the use of ground-fault circuit interrupters (GFCIs)

Employers and employees must cooperate in order to maintain a safe working environment.

- Establish an Assured Equipment Grounding Conductor Program (AEGCP), which covers all cord sets, receptacles that are not a part of the permanent wiring of a building or structure, and any equipment connected by a cord and plug made available for use by employees.
- Make sure that all moving electrical equipment on the job site is barricaded, all power tools being used are kept in safe working condition, and that all lockout/tagout practices on the job site are being enforced.
- Implement a first-aid system that is readily available for use
  - If a worker is shocked, it is imperative that victims are attended to as quickly as possible since brain damage, or even death, can occur if blood flow is not reestablished within four minutes.