Training Solutions, Delivered!

ELECTRICAL SAFETY

As Part of the OSHA 10 Hour Training for General Industry

Leader's Guide, Fact Sheet & Quiz

Item Number: 5060

This easy-to-use Leader's Guide is provided to assist in conducting a successful presentation.

PREPARING FOR THE MEETING

Here are a few suggestions for using this program:

a) Review the contents of the Fact Sheet that immediately follows this page to familiarize yourself with the program topic and the training points discussed in the program. The Fact Sheet also includes a list of Program Objectives that details the information that participants should learn from watching the program.

b) If required by your organization, make an attendance record to be signed by each participant to document the training to be conducted.

c) Prepare the area and equipment to be used for the training. Make sure the watching environment is comfortable and free from outside distractions. Also, ensure that participants can see and hear the TV screen or computer monitor without obstructions.

d) Make copies of the Review Quiz included at the end of this Leader's Guide to be completed by participants at the conclusion of the presentation. Be aware that the pages containing the answers to the quiz come *before* the quiz itself.

CONDUCTING THE PRESENTATION

a) Begin the meeting by welcoming the participants. Introduce yourself and give each person an opportunity to become acquainted if there are new people joining the training session.

b) Introduce the program by its title and explain to participants what they are expected to learn as stated in the Program Objectives of the Fact Sheet.

c) Play the program without interruption. Upon completion, lead discussions about your organization's specific policies regarding the subject matter. Make sure to note any unique hazards associated with the program's topic that participants may encounter while performing their job duties at your facility.

d) Hand out copies of the review quiz to all of the participants and make sure each one completes it before concluding the training session.

5060 ELECTRICAL SAFETY
As Part of the OSHA 10 Hour Training for General Industry
FACT SHEET

VIDEO LENGTH: 23 MINUTES COURSE DURATION: 1 HOUR

PROGRAM SYNOPSIS:
This program provides one hour of training on Electrical Safety, which is one of the six mandatory training topics selected by OSHA as part of its 10 Hour Training for General Industry Program. In addition to the six hours of training on required topics, OSHA requires four more hours of instruction on various elective topics. The combination of required training and elective training must total 10 hours. The 23-minute video presentation in this program, when combined with the included sectional review quiz questions, will provide approximately one hour of training on Electrical Safety.

The content in this program is not certified by OSHA, but may be used by an organization as part of a training curriculum which is equivalent to that provided in OSHA's 10 Hour General Industry Training.

Electricity is such a familiar part of our surroundings, that it is often is not treated with the respect it deserves. Complacency and a general lack of understanding about the dangers of electricity contribute to many electrical-related injuries and fatalities each year. Most of these incidents could have been prevented had electrical safe work practices been followed. As part of its various regulations and standards, OSHA requires electrical safety practices to be implemented in the workplace and that's the purpose of this program—to discuss how various electrical hazards are created and the procedures employees must follow to prevent these hazards from causing shocks and electrocutions.

Topics include how electricity works, circuit interrupters, Ohm's Law, conductors and insulators, using grounding to reduce shock, double-insulated tools and GFCIs, responding to electric shock and arc flash and burn hazards.

PROGRAM OBJECTIVES:
Upon completion of the program, viewers should be able to explain the following:
- How electric circuits are created and interrupted;
- What Ohm's Law is and how it relates to electrical safety;
- How insulators provide protection from shock hazards;
- What basic safe work practices to follow to avoid becoming part of an energized electric circuit;
- How to use grounding systems to reduce shock;
- How double-insulated tools and GFCI's provide shock protection.

INSTRUCTIONAL CONTENT:

SECTION 1: How Electricity Works
- Electricity is an essential part of our lives, both at home and on the job.
- Electricity is such a familiar part of our surroundings, that it is often is not treated with the respect it deserves.
- Complacency and a general lack of understanding about the dangers of electricity contribute to many electrical-related injuries and fatalities each year.
- According to US Bureau of Labor statistics, as many as 200 deaths and 2,000 injuries can be attributed to electrical-related incidents each year. Most of these incidents could have been prevented had electrical safe work practices been followed.
- The first step to remaining safe while near electricity, is understanding how electricity works, as well as its common terminology.
- Electricity can be confusing because there are multiple ways to measure and describe its properties. You may be familiar with the term voltage.
- You may have heard your car battery described as being 12 volts or your home's receptacles as being 120 volts.
- Voltage is a measurement of the potential difference in electric charge between two points in an electric field. Its unit of measure is the volt.
- When these two points are connected by a conductor, an electric current will flow from one point to the other.

- As voltage increases, so too does the amount of electric current which will flow through the conductor connecting the two points.
- The flow of electrical current through a conductor is measured in amperes, more commonly known as "amps."
- Two points in an electric field with enough voltage to cause current flow can also be referred to as a "power source." Examples of common power sources are batteries, generators or solar panels.

SECTION 2: The Electric Circuit

- When a conductor is connected to both points or "terminals" of a power source, electric current will flow, and an electric circuit has been created.
- It is this flow of electric current, measured in amps, which can be harnessed to do useful work by connecting the circuit to tools, motors, lights or other devices. These types of devices, when connected to a circuit, are referred to as a "load."
- When electricity flows through an electric circuit, the circuit is said to be completed. To control the flow of electric current, a switch can be added to an electric circuit.
- When the switch is closed the conductor is continuous and the circuit is complete, allowing current to flow.
- Opening the switch causes a break or interruption in the continuity of the conductor. When this occurs, the circuit is incomplete or interrupted and electric current will not flow.

SECTION 3: Circuit Interrupters

- You are certainly familiar with switches on the wall to control lights or on/off switches on tools or equipment. There are also other types of switches used to interrupt the flow of electric current.
- Fuses and circuit breakers are special types of switches, designed to open when the flow of electric current exceeds safe levels for the circuit or equipment involved.
- Fuses, circuit breakers and similar protective devices are often called circuit interrupters.
- One important electrical safety rule is to not continue to reset a tripping circuit breaker and do not replace blown fuses with ones rated for more amps.
- Tripped breakers and blown fuses indicate an overloaded circuit which is a fire hazard and can damage equipment.

SECTION 4: Ohm's Law and Electrical Safety

- As we have learned, an electric circuit requires a conductor, through which electric current flows. However, all materials do not make good conductors.
- Some materials are resistant to the flow of electric current. Materials that do not allow the flow of electric current are called insulators.
- Insulators, such as plastic and rubber, have very high resistance, while materials that make good conductors, like copper, aluminum and other metals, have very low resistance. Resistance is measured in Ohms.
- For a power source with a given voltage, the amount of current which will flow through an electric circuit depends on the resistance of the circuit.
- When resistance is low, more current will flow. When resistance is high, less current will flow. This relationship is known as "Ohm's Law."
- Now you may be asking, "Why is any of this is important?" This is important because almost all electrical safety principles are based on the concept of resistance and Ohm's Law.
- For example, water is a conductor. It has low resistance. The human body is largely made up of water so it's not surprising that the human body can also be a conductor.
- Like any other conductor, when our body becomes part of a completed electric circuit, current will flow through our body and we can be shocked or electrocuted.
- When electric current flows through the human body, nerves, tissue and muscle can be destroyed and it only takes a small amount of current, just .06 amps, or 60 milliamps, to stop your heart.
- Sixty milliamps is the same amount of current needed to light a small light bulb which helps illustrate just how easily a brief encounter with electricity can turn fatal.
- The severity of the electric shock we receive depends on the amount of current which flows through our body.
- As we have just learned, the amount of current which will flow through our body depends on the resistance of our body at that moment. In other words, the amount of shock we receive is governed by Ohm's Law.

• Electrical safety can be really be reduced down to two simple safety concepts, each based on Ohm's Law. One, prevent electric shock by not allowing our body to become part of an electric circuit; and two, reduce the amount of current flowing through our body should a shock occur.

SECTION 5: Hazards of the Hot Conductor

• In order to maintain electrical safety rule number one, not becoming part of a circuit, it's important to understand that electrical systems connect one terminal of the power source directly into the ground.
• This is commonly achieved by driving a grounding rod into the ground and connecting one side of the power source to it.
• The side of the power source connected to the ground is often called the neutral, negative or grounded side. The ungrounded side of the power source is often called the positive or hot side.
• This creates a condition which allows the electric circuit to be completed anytime a conductor, such as the human body, comes into contact with the hot conductor and the ground at the same time.
• In other words, if you are grounded and come into contact with the hot conductor you will get shocked. This is the meaning behind the expression "electricity always seeks a path to ground."
• To avoid being shocked you must avoid contact with the hot conductor.

SECTION 6: Insulators Provide Protection

• When using extension cords, power tools and other devices you are protected from contact with conductors by the rubber insulation on the power cord.
• Recall that insulators such as rubber have very high resistance and Ohm's Law does not allow electric current to pass thru them; however, power cords with damaged, cracked or cut insulation may expose the copper conductors leading to electric shock.
• Power tools or equipment with damaged casings or missing covers may also allow contact with exposed conductors leading to electric shock.
• This is why you must inspect tools, cords and extension cords prior to use and never use damaged electrical tools or equipment.
• When using any type of power tool or extension cord, care should be taken not to damage the tool or cord while in use or during transport.
• Always pull the plug from the outlet; don't pull on the cord to unplug it. And also, don't carry a tool by its cord.
• It's also important to select the correct tool or cord for the job.
• Always select the right extension cord for the power tool you are using, take note how much current the tool draws.
• A cord that is too small to carry enough current to run the tool can overheat and start a fire.
• Another good insulating material protecting you from electric shock is air. Air does a good job resisting the flow of electricity.
• This is why many electrical conductors suspended in the air do not have protective insulation; however, air is not a perfect insulator and allowing a conductive object to come too close to an overhead conductor can allow electric current to flow through the air, or arc, completing the circuit and causing an electrocution.
• This is why you, and all conductive objects you may be carrying, must remain at least 10 feet away from any overhead conductors or exposed live parts.
• Be vigilant in checking for overhead conductors when using metal ladders, pool cleaning equipment, elevating work platforms or other conductive objects.

SECTION 7: Safe Electrical Work Practices

• Another way to maintain electric safety rule number one and avoid becoming part of an energized electric circuit is to never work on electrical circuits while they are energized and never attempt to perform electrical work for which you are not qualified.
• To perform electrical tasks at your facility, you must be a qualified electrical worker. Qualified electrical workers are familiar with the equipment on which they work and have been trained to recognize and avoid the hazards involved in the work to be done.
• Whenever possible, qualified electrical workers de-energize electrical circuits prior to working on them and ensure they remain de-energized by following the company's lockout tagout procedures.

- If you are not a qualified electrical worker, you should not perform any workplace task which could expose you to energized electrical conductors or parts.
- Of course, when working at home you may find yourself performing some type of minor electrical work. Here are some safety tips to keep in mind to avoid becoming part of an energized circuit.
- Turn off the circuit breaker powering the circuit you are working on and place a locking device on the breaker, so no one inadvertently turns it back on.
- Remember that water conducts electricity and greatly increases the shock hazard. Never plug in cords that are wet or touch electrically powered equipment if your hands are wet.
- Never use aluminum or metal ladders near power lines or while performing any type of electrical work. Metal ladders are conductive and can easily lead to an electric shock. Use a fiberglass ladder instead.
- Watches and rings are also conductive and should be removed before you work around sources of electricity.

SECTION 8: Grounding to Reduce Shock

- Let's now discuss electrical safety rule number two: reducing the amount of electric shock received by someone who does become part of an energized circuit.
- You may have noticed that many power cords, but not all, have a ground prong. If your cord is designed to have a ground prong it must be present and in good condition.
- The ground prong is an important part of a larger system designed to protect you from electric shock. Many power tools and electric equipment have outer frames or other parts made of conductive materials such as aluminum or steel.
- It's possible that internal damage to the tool or some type of malfunction may allow the hot conductor inside the tool or equipment to contact the metal frame.
- This can create a very dangerous condition which allows anybody who touches the frame of the tool or piece of equipment to be shocked or electrocuted.
- This potential hazard is reduced by connecting the equipment frame directly to the grounded side of the power source via a grounding conductor.
- This grounding conductor is connected through the cord via the ground prong.
- When this grounding system is intact and the frame of the tool becomes energized, Ohm's Law dictates that a large amount of current will flow through the very low-resistance grounding conductor directly back to the power source.
- This large flow of current will typically trip the circuit breaker and stop the flow of electric current.
- Using a power cord with the ground prong removed or damaged interrupts the continuity of the grounding conductor, leaving the user at risk of shock or electrocution should the tool's frame become energized.
- Even with the ground prong in place, this is not a perfect system. Circuit breakers can be slow to trip and depending on the resistance of the person involved; enough current can still flow through them and into the ground to receive an electric shock.
- To reduce the amount of shock received in a situation like, this you must increase your resistance.
- You can increase resistance and reduce shock by wearing footwear with thick rubber soles to provide insulation from the ground and by remaining dry while working with electricity.
- Electrical workers often wear rubber gloves and special di-electric shoes for this purpose.
- The absolute worst thing you can do is to use electric tools while wet and barefoot. This situation makes you the best conductor possible, maximizes the amount of shock you will receive and is just asking for trouble.

SECTION 9: Double-Insulated Tools and GFCIs

- To provide even better protection from electric shock many power tools are double-insulated. Double-insulated tools protect the frame of the tool from contact with conductors by means of a special insulating system.
- These tools are labeled double-insulated and also display a "square within a square" symbol.
- Double-insulated tools do not have a grounded frame and their cords do not have ground prongs; however, the tool itself and its cord must still be inspected and verified to be in good condition before use.
- One of the best ways to reduce the amount of current flowing through your body during a shock event is to use a ground fault circuit interrupter.
- Ground fault circuit interrupters, or GFCIs as they are commonly known, provide an increased level of protection from shock and are mandatory at many workplaces and construction sites, especially when power tools and cords must be used in damp or wet environments.

- The ground fault circuit interrupter constantly compares the amount of current flowing in both the hot and neutral conductors.
- Any difference in these current flows represents the amount of ground fault current flowing through a shock victim's body and into the ground.
- When a difference of just five milliamps or .005 amps is detected the GFCI will quickly trip, interrupting the circuit and stopping the flow of current. Five milliamps is below the threshold for a person to feel an electric shock.
- In other words, the GFCI will trip before you can even perceive that a problem exists. This is why GFCIs are so popular and required by many work places anytime an extension cord or corded power tool is used.
- GFCIs also exist in the home. They are commonly built into receptacles located in kitchens, bathrooms and other areas which may become wet.
- If your home isn't protected by a GFCI in these areas, you should consider asking an electrician to install them for you.
- You should also purchase a portable GFCI for your home and use it on your extension cords or power tools, especially when working in damp areas.

SECTION 10: Responding to Electric Shock

- When you witness someone being shocked, don't panic and rush into action. You must take the time to access the situation to avoid being electrocuted yourself.
- If the victim has fallen clear of the energized circuit and is no longer being shocked, immediately call for emergency medical assistance. The quicker the response, the better the chance for the victim to survive.
- If the person is still being shocked, your first instinct may be to grab him or her and pull them away for the circuit but don't do it!
- The victim may still be holding onto an energized object involuntarily and contacting them will cause you to be shocked also.
- If possible, shut off the power to the energized object and call for help immediately.
- If you can't turn the power off, try to find a non-conductive item and push the person away from the energized circuit.
- Some examples of non-conductive items are a dry wooden board or broom handle, a fiberglass ladder or a piece of PVC pipe.
- Once the victim is free, immediately call for assistance and try to keep the person calm and still until help arrives.
- If you are the one being shocked, be aware that electrical current can cause involuntary contractions of your muscles causing you to be unable to release your grip.
- To overcome this, try to allow your knees to collapse. Your body weight may be enough to pull you away from the energized circuit.
- When electricity flows through your body it is often hard to tell the extent of the damage because only the entrance and exit points are visible.
- There may be significant internal damage. Always seek medical attention after an electric shock.

SECTION 11: Arc Flash and Burn Hazard

- Another hazard associated with electricity is the risk of burns due to direct contact with electricity or by exposure to an electric arc, often called an arc flash or an arc blast.
- During an arc flash event a large amount of thermal energy is released which can severely burn any exposed, unprotected workers.
- An arc flash can also cause clothing to ignite and burn, significantly worsening the burn injury.
- Qualified electrical workers establish boundaries that prevent unqualified persons from coming too close to a potential arc flash hazard and any exposed energized parts.
- Qualified electrical workers also wear arc-rated clothing and PPE appropriate for the amount of energy present in the equipment and circuit on which the work is performed.
- Arc-rated clothing is designed to withstand the intense heat of an arc flash without breaking open or bursting into flames.
- Do not cross any approach boundary related to electrical equipment unless you are qualified and have donned all appropriate shock and arc flash protective equipment and clothing.

SECTION 12: Conclusion

- As we have learned in this program, electricity presents a hazard that all workers must be aware of and take specific actions to protect themselves from.
- Make sure you do not become part of the electric circuit by inspecting the insulation on cords and tools prior to use, maintaining a 10-foot distance from exposed conductors, never performing work on an energized circuit and by not performing any electrical work for which you are not qualified.
- To reduce the amount of current flow during a shock event, make sure grounding prongs are in place and in good condition, wear rubber soled shoes and do not work with electricity while wet, AND use a GFCI on extension cords and tools, especially when working in damp areas.
- As part of its various regulations and standards, OSHA requires electrical safety practices to be implemented in the workplace.
- Make sure you know, understand and follow your organization's practices and procedures in regard to electrical safety.

ELECTRICAL SAFETY

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ANSWERS TO THE REVIEW QUIZ

SECTION 1: How Electricity Works

1. a
2. b
3. b

SECTION 2: The Electric Circuit

1. a
2. b

SECTION 3: Circuit Interrupters

1. a
2. c
3. b

SECTION 4: Ohm's Law and Electrical Safety

1. b
2. a
3. a
4. b

SECTION 5: Hazards of the Hot Conductor

1. d
2. a

SECTION 6: Insulators Provide Protection

1. a
2. b
3. a
4. a

SECTION 7: Safe Electrical Work Practices

1. b
2. a
3. c

SECTION 8: Grounding to Reduce Shock

1. a
2. a
3. b

SECTION 9: Double-Insulated Tools and GFCIs

1. b
2. b
3. a
4. a

Section 10: Responding to Electric Shock

1. a
2. b
3. b

SECTION 11: Arc Flash and Burn Hazard

1. a
2. a
3. b

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REVIEW QUIZ

The following questions are provided to determine how well you understand the information presented in this program.

Name_____Date_____

SECTION 1: How Electricity Works

1. Complacency and a general lack of understanding about the dangers of electricity contribute to many electrical-related injuries and fatalities each year.

a. True
b. False

2. The flow of electrical current through a conductor is measured in _____.

a. Volts
b. Amps
c. Ohms

3. Two points in an electric field with enough voltage to cause current flow is referred to as a _____.

a. Conductor
b. Power Source
c. Circuit

SECTION 2: The Electric Circuit

1. When a conductor is connected to both terminals of a power source, electric current will flow and an electric circuit has been created.

a. True
b. False

2. When a switch on an electric circuit is _____, the conductor is continuous and the circuit is complete, allowing current to flow.

a. Opened
b. Closed

SECTION 3: Circuit Interrupters

1. Fuses and circuit breakers are special types of switches designed to open when the flow of electric current exceeds safe levels for the circuit or equipment involved.

a. True
b. False

2. Fuses, circuit breakers and similar protective devices are often called _____.

a. Circuit suspenders
b. Circuit disconnectors
c. Circuit interrupters

3. Blown fuses should be replaced with ones rated for the same or more amps.

a. True
b. False

SECTION 4: Ohm's Law and Electrical Safety

1. Materials that do not allow the flow of electric current are called _____.

a. Resistors
b. Insulators
c. Conductors

2. When resistance of a circuit is low, _____ current will flow.

a. More
b. Less

3. It only takes a small amount of current, just .06 amps, or 60 milliamps, to stop your heart.

a. True
b. False

4. The human body is NOT a good conductor of electricity.

a. True
b. False

SECTION 5: Hazards of the Hot Conductor

1. The side of a power source connected to the ground is often called the _____ side.

a. Neutral
b. Negative
c. Grounded
d. All of the above

2. If you are grounded and come into contact with a hot conductor, you will get shocked.

a. True
b. False

SECTION 6: Insulators Provide Protection

1. When using extension cords, power tools and other devices you are protected from contact with conductors by the rubber insulation on the power cord.

a. True
b. False

2. You should only pull the cord on a power tool to unplug it from an outlet when the power switch on the tool is turned off.

a. True
b. False

3. Air is a good insulating material for protection from electric shock, but it is not a perfect insulator.

a. True
b. False

4. You must remain at least _____ away from any overhead conductors or exposed live parts.

a. 10 feet
b. 15 feet
c. 20 feet

SECTION 7: Safe Electrical Work Practices

1. Any worker can perform electrical tasks at your facility as long as the electrical circuits to be worked on have been de-energized.

a. True
b. False

2. When performing minor electrical work around your home, you should turn off the circuit breaker powering the circuit you are working on and place a locking device on the breaker so no one inadvertently turns it back on.

a. True
b. False

3. You should never use _____ ladders near power lines or while performing any type of electrical work.

a. Fiberglass
b. Wooden
c. Aluminum

SECTION 8: Grounding to Reduce Shock

1. If a cord you are using is designed to have a ground prong, it must be present and in good condition.

a. True
b. False

2. Using a power cord with the ground prong removed or damaged interrupts the continuity of the grounding conductor, leaving you at risk of shock or electrocution should the tool's frame become energized.

a. True
b. False

3. While operating an electric tool, the absolute worst thing you can do is use it _____.

a. While on a ladder
b. While wet and barefoot
c. Without wearing rubber gloves

SECTION 9: Double-Insulated Tools and GFCIs

1. Double-insulated tools display a _____ symbol.

a. Circle within a circle
b. Square within a square
c. Triangle within a triangle

2. Since they don't have a ground prong or grounded frames, double-insulated tools don't need to be inspected before use.

a. True
b. False

3. A ground fault circuit interrupter constantly compares the amount of current flowing in both the hot and neutral conductors.

a. True
b. false

4. When a difference of just _____ is detected the GFCI will quickly trip, interrupting the circuit and stopping the flow of current.

a. 5 milliamps
b. 10 milliamps
c. 50 milliamps

Section 10: Responding to Electric Shock

1. If a shock victim has fallen clear of the energized circuit and is no longer being shocked, you should immediately call for emergency medical assistance.

a. True
b. False

2. If a person is being shocked and you cannot turn off the power to the energized circuit, you should _____.

a. Grab the victim and pull him away from the circuit
b. Use a non-conductive item to push the person away from the circuit
c. Use a cutting tool to sever the power cord to the source of the energized circuit

3. You only need to seek medical attention after an electrical shock if you suspect you have significant internal damage to your body.

a. True
b. False

SECTION 11: Arc Flash and Burn Hazard

1. During an arc flash event, a large amount of thermal energy is released which can severely burn any exposed, unprotected workers.

a. True
b. False

2. Qualified electrical workers establish boundaries that prevent unqualified persons from coming too close to a potential arc flash hazard and any exposed energized parts.

a. True
b. False

3. Unqualified workers can cross approach boundaries related to electrical equipment as long as they have donned all appropriate shock and arc flash protective equipment and clothing.

a. True
b. False