ELECTRICAL SAFETY FOR EVERYONE

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

INTRODUCTION: A brief description of the program and the subject that it addresses.

PROGRAM OUTLINE: Summarizes the program content. If the program outline is discussed before the video is presented, the entire program will be more meaningful and successful.

PREPARING FOR AND CONDUCTING THE PRESENTATION: These sections will help you set up the training environment, help you relate the program to site-specific incidents, and provide program objectives for focusing your presentation.

REVIEW QUESTIONS AND ANSWERS: Questions may be copied and given to participants to document how well they understood the information that was presented. Answers to the review questions are provided separately.

INTRODUCTION

Because electricity is so important to our everyday lives, it is surprising that many of us know very little about it or the hazards it presents. Many workers don't understand the dangers of electricity and don't follow safe work practices when working with or around electricity or electrical equipment. You don't have to be a qualified electrical worker or electrician to have a need to understand electrical safety. In fact, all workers should know and practice basic electrical safety. This program provides viewers with a general understanding of how electricity works while showing them the actions they can take to prevent becoming part of an energized electrical circuit.

Topics include why electricity is dangerous, resistance and Ohm's law, two electrical safety concepts, grounding, avoiding electrical contact, safe work practices, use of double-insulated tools and GFCIs and response to a shock event.

PROGRAM OUTLINE

HOW ELECTRICITY WORKS

- 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.

- 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.

• 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.

RESISTANCE

• 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. 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.

TWO SAFETY CONCEPTS

• 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 this 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 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 we fail at safety rule number one.

GROUNDING

• 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."

AVOIDING CONTACT

- To avoid being shocked you must avoid contact with the hot conductor.

- 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 through 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.

- 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, 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.

- Avoid becoming part of the electric circuit by always staying at least 10 feet away from overhead conductors and other exposed live parts.

SAFETY TIPS

- Another way to maintain electric safety rule number one is to never work on energized electrical circuits and to 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 open electrical covers or doors; you should not reset circuit breakers or replace fuses; you should not remove switch or receptacle covers; you should not attempt to repair electrical tools or plugs; and, you should not repair lighting or replace light bulbs.

• In other words, 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.

• To recap electrical safety rule number one: 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.

REDUCING SHOCK THROUGH GROUNDING

• Let's now discuss electrical safety rule number two: reducing the amount of electric shock you receive should you fail at rule number one.

• 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 in 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 pin 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.

DOUBLE-INSULATED TOOLS

• 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.

GROUND FAULT CIRCUIT INTERRUPTER

• 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.

• So to recap electrical safety rule number two, 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, do not work with electricity while wet and use a GFCI on extension cords and tools, especially when working in damp areas.

RESPONDING TO A SHOCK EVENT

• 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.

• Send someone else to summon help if no phone service is available. 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.

PREPARE FOR THE SAFETY MEETING
Review each section of this Leader's Guide as well as the program. Here are a few suggestions for using the program:

Make everyone aware of the importance the company places on health and safety and how each person must be an active member of the safety team.

Introduce the program. Play it without interruption. Review the program content by presenting the information in the program outline.

Copy the review questions included in this Leader's Guide and ask each participant to complete them.

Make an attendance record and have each participant sign the form. Maintain the attendance record and each participant's test paper as written documentation of the training performed.

Here are some suggestions for preparing your video equipment and the room or area you use:

Check the room or area for quietness, adequate ventilation and temperature, lighting and unobstructed access.

Check the seating arrangement and the audiovisual equipment to ensure that all participants will be able to see and hear the program.

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

Explain that the primary purpose of the program is to provide viewers with a basic understanding of how electricity works while showing them the actions they can take to prevent becoming part of an energized electrical current.

Introduce the program. Play it without interruption. Review the program content by presenting the information in the program outline.

Lead discussions about specific job tasks at your facility that require employees to know and practice basic electrical safety to avoid being shocked.

After watching the program, the viewer will be able to explain the following:

- How electricity works and why it is dangerous;
- How resistance relates to the flow of electricity;
- What the two concepts of electrical safety are;
- How employees can avoid contacting energized conductors;
- How grounding, double-insulated tools and GFCI’s protect workers from electric shock;
- How to respond to a shock event.

ELECTRICAL SAFETY FOR EVERYONE
Review Quiz

Name_____Date_____

Please provide answers to the following to show how well you understand the information presented during this program.

1. The flow of electric current through a conductor is measured in _____.

a. Volts
b. Amps
c. Ohms

2. When electricity flows through an electric circuit, the circuit is said to be _____.

a. opened
b. interrupted
c. completed

3. Materials that do not allow the flow of electric current have very _____ resistance.

a. high
b. low

4. Current flow as little as 60 milliamps can stop a person's heart.

a. true
b. false

5. The side of the power source that is connected to the ground is often called the _____ side.

a. neutral
b. negative
c. grounded
d. all of the above

6. To avoid becoming part of an electric circuit, you must stay at least _____ away from overhead conductors or exposed live parts

a. 3 feet
b. 5 feet
c. 10 feet

7. How do qualified electrical workers ensure equipment remains de-energized while they are working on it?

a. they unplug it
b. they have a co-worker make sure no one turns on its power
c. they follow the company's lockout/tagout procedures

8. As long as the power cord you are using has a ground prong in place, you are at no risk of electric shock.

a. true
b. false

9. Double-insulated tools display a _____ symbol.

a. circle within a circle
b. square within a square
c. triangle within a triangle

10. What should you do if you are being shocked and are unable to release your grip on the object containing the electric circuit?

a. try to jump away from the object
b. try to fall backwards
c. try to allow your knees to collapse

ANSWERS TO THE REVIEW QUESTIONS

1. b
2. c
3. a
4. a
5. d
6. c
7. c
8. b
9. b
10. c