ELECTRICAL SAFETY:
What Everyone Should Know

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
When it comes to electricity, some hazards are pretty obvious. Then there are electrical hazards that we don’t recognize or choose to ignore until someone gets a painful or fatal shock. This program discusses three issues concerning electrical safety: how electricity works, what happens when the human body and electricity meet up and what we can do to make sure that we’re always using electricity safely.

Topics include how proper wiring controls electrical currents, the four main ways to prevent electrical shock, use of ground-fault circuit interrupters, various types of electrical shock injuries, how to ensure outlets aren’t overloaded and safe use of power and extension cords.

PROGRAM OUTLINE

HOW ELECTRICITY WORKS
• Electricity is produced at a variety of locations, such as power plants, hydroelectric dams, wind turbines and solar panels.

• Each of these methods of generating electricity gets tiny particles called electrons moving rapidly over the wires coming from where the electricity is generated to where the electricity is used.

• This flow of electrons is called electrical current. Electrical current is always headed in one direction, the path of least resistance to the earth or ground.

• The power company uses the earth to complete the circuit back to the point of generation. An electrical current will do just about anything to get into good old mother earth, including going through us if necessary.

• If we carefully guide the current during its journey, we can use electricity safely.

HOW PROPER WIRING CONTROLS ELECTRICAL CURRENTS
• Standard 120-volt circuits are wired with three wires: one is called hot, the second is called neutral and the third is the ground.

• Think of the hot wire just like a hot stove; you don’t want to touch it.

• If you look at a typical electrical outlet, you’ll see three openings that correspond with these wires. The left side or larger slot is neutral, the narrow slot is hot and the round hole on the bottom is the ground.

• Both the neutral wire and the ground wire are physically tied to earth back at the circuit breaker panel. The panel could be tied to a buried copper rod or to a water main.

• In a properly-wired device, electricity flows from hot to neutral. So when you plug in a tool, like a power drill, the electricity goes into the plug from the hot slot, flows through the hot wire to run the motor and then completes the circuit by going back through the neutral wire in the cord, the neutral side of the outlet and heads back to the circuit breaker.

• The circuit breaker directs the flow to the ground. This circuit continues as long as the switch is on.

IMPORTANCE OF THE GROUND WIRE
• The ground is a detour or an emergency exit wire. The ground wire is not intended to carry any current unless something goes wrong.

• If a hot wire in an electrical appliance gets loose or damaged and can’t connect properly with the neutral wire in the circuit, and if the equipment is made of metal, the appliance itself can become energized.

• If the ground wire was missing, anyone who touched the appliance could get a shock because they are physically coming between the hot wire and where the electricity is headed—the ground.

• In addition to giving you a shock if you get in the way, misrouted electricity can also start fires and damage equipment.
ELECTRICAL SHOCK INJURIES
• When we think of electrical shock injuries, many of us think about the obvious external burns, but injuries can go way beyond that.
• Our bodies are conductive with 50 to 60 percent made up of water. Because that water contains salts and minerals, we’re great conductors.
• Not only that, we generate electricity. Our bodies use small electrical currents to send signals to our hearts, brains, nerves and muscles.
• Any extra current can cause muscle spasms that can break bones and cause falls. The extra current can also cause paralysis of our chest and diaphragm muscles, so we stop breathing.
• It can burn internal organs and tissues. Of course, extra current disrupts the rhythm of the heart; when this happens, death can follow quickly.
• The extent of the injuries can vary greatly depending on the amount of current, the length of time the current is going through the body and where the current comes into and goes out of the body.
• Internal damage can be extensive even when burn marks on the outside of the body look very small. Every person receiving any kind of electric shock should get immediate medical attention.

PROTECTION FROM ELECTRICAL SHOCK
• There are many ways to protect yourself and others from electrical shocks and injuries. The four main ways are insulation, guarding, grounding and circuit protection devices.
• Insulators are materials that separate us from those things that are good conductors of electricity like copper, aluminum, iron and steel. Conductors let the electrons flow freely without resisting them much at all.
• Insulators resist electricity and keep it away from things like you and me. Common insulators are rubber, plastics and glass.
• Guarding simply keeps people physically away from electrical equipment.
• The third way to stay electrically safe is with grounding. Remember, grounding creates a direct detour to the ground to reduce or eliminate the current that might otherwise flow through you.
• Finally, we use circuit protection devices to keep our workplace safe. These devices are designed to automatically shut off the flow of electricity because of an overloaded circuit—too many devices asking for too much electricity or a short circuit in the wiring (current that makes a direct connection between the hot wire and the neutral or the ground wire without completing its intended path through the appliance.)
• Circuit breakers monitor the amount of current that a circuit is carrying. They automatically open or break to stop the flow of electricity when the level of current gets unsafe.
• These devices can protect your building or equipment, but won’t protect you from a shock.

GROUND-FAULT CIRCUIT INTERRUPTERS
• The most common form of electrical shock comes from ground fault. This happens when the electrical current can’t make its intended complete circuit, so the electricity has to go somewhere else to find ground.
• Ground faults often are caused by damaged insulation on wiring or getting electrical equipment wet.
• One of the best ways to prevent ground-fault shocks is by using a ground-fault circuit interrupter or a GFCI.
• The ground-fault circuit interrupter works by comparing the amount of current going into the electrical device and the amount returning from that device as it makes the electrical circuit. If the amount of current isn’t almost identical, then wayward current is probably looking for ground some other way, not a good thing.
• So when the amount going into the device is different from the amount coming out of it, the GFCI stops the current quickly, usually in about one-fortieth of a second.
• Ground-fault circuit interrupters are often used in wet locations, including bathrooms and kitchens. They are also used to protect outdoor circuits that could be wet or damp and at construction sites.
• GFCI’s are not invincible, however. Power surges and electrical storms can stop them from working properly; it’s a good idea to test them.
• Plug a light into a GFCI outlet and turn it on. Press the test button; the light should turn off. Press the reset button and the light should turn back on. If the light doesn’t turn off when you push the test button, stop using this outlet and call a qualified electrician to check things out.

HOW TO ENSURE OUTLETS AREN’T OVERLOADED
• We’ve all been told not to overload an outlet. Drawing too much power from a single outlet is dangerous and could lead to equipment damage or a fire.
• Every outlet is usually connected to a number of other outlets. This is called a circuit. You could have outlets in your work area on one circuit, lighting on another circuit and various pieces of equipment on their own circuits.

• You need to limit the amount of power used on a single circuit to what it can safely provide. To begin our calculations, you need to figure out how much power you are using.

• The amount of power that each device uses is measured in watts. This is the same measurement for 100-watt light bulbs to 1,500-watt hair dryers.

• When you start adding up the power needed to run all your equipment, lighting and tools, this can be a lot. The good news is that we don’t usually run everything at once.

• Next, you need to know how much electricity is available on the circuit. The amount of electricity available on a circuit is measured in amps.

• Most outlets are wired to 15 or 20-amp circuits. You can check this out by looking at the circuit breaker or fuse back at the circuit panel.

• General household current is 120 volts; 120 volts times the number of amps equals the watts that the circuit can handle.

• Generally, a 120-volt 15-amp circuit can provide 1,800 watts and a 20-amp circuit can provide 2,400 watts before the circuit breaker trips. If the power draw is continuous like lights or a heater, you need to keep the load to 80 percent of this amount—about 1,400 watts for a 15-amp circuit and 1,900 watts for a 20-amp circuit.

• If you have an outlet that trips the circuit breaker when you use a tool or appliance, try the tool in another outlet in a different part of the building to determine if the problem is with the outlet or with the equipment.

• If the new outlet trips, unplug the tool and take it to someone who is qualified to repair it. Do not use any electrical equipment that is malfunctioning.

• On the other hand, if the tool works in the new outlet, then there might be too many things plugged into the other circuit. Turn off or unplug anything on the circuit and try again.

• If nothing else is plugged in and running on that circuit, then there is probably a wiring problem with that outlet. Don’t just keep resetting the breaker; let your supervisor know so an electrician can check it out and get the circuit repaired.

USING POWER & EXTENSION CORDS

• We’ve got outlets and electrically-powered equipment. To get the power where we want it, we need a cord and plug or an extension cord.

• First, take a close look at every cord and plug you use. If the cord is cracked or damaged in any way, or if the plug is bent or damaged, don’t use it.

• Damaged cords and plugs can shock you; they can also start fires. Get it replaced or repaired.

• Make sure the ground prong is in place on every plug you use. Without this prong, your tools and equipment will not be grounded. If you have to use an extension cord, make sure it is UL-rated and only use the right cord for the job. If your tool or equipment has a three-prong plug, only use a three-prong extension cord and outlet. Also, match the extension cord to the tool or appliance.

• A polarized plug does not have a ground prong and is found on newer tools. It’s important that the wide prong goes into the wide slot of the outlet or extension cord. They only go in one way; don’t force the plugs to fit.

• Extension cords come in different sizes or gauges. The smaller the gauge, the bigger the wires inside the cord and the more current they can safely handle. For example, a 12-gauge cord can handle more load than a 16-gauge cord.

• Look at the ratings on the appliance and the cord. The cord should have the same or higher rating. If a cord is warm to the touch, you are putting too much load on it.

• Extension cords are for temporary use and never more than 90 days. If you need to use an extension cord all the time in the same place, or if you have to string several cords together, talk to your supervisor about getting your work space rearranged.

• Keep some slack in your extension cords so they don’t pull on the outlets, which can damage the outlet, plug and cord.

• Only use cords and equipment the way they are supposed to be used. If something is labeled for indoor use only, then it probably can’t handle the water, dirt, heat and cold that come from being outside and could be easily damaged or expose you to a potential shock.
• If your tool has a power cord, make sure there is adequate protection where the cord enters the tool. The cord protector prevents the cord from sharp bends that can cause wires inside the cord to fatigue and break; if one of these wires is a ground, and there is a short circuit in the tool, the electricity could go through you.

• Most cords are not designed to be driven over or walked on, on a regular basis. Talk to your supervisor about getting cord protectors or redesigning the work space.

OTHER ELECTRICAL SAFETY TIPS
• Treat electrically-powered equipment with respect. Don’t yank on the cords or drop your tools and don’t haul tools up a ladder by the cord; you can damage the insulation or the wiring connections.

• Stay dry. The human body is a great conductor of electricity. When your skin gets wet, even just damp hands when plugging a cord into an outlet, your body quickly gains superstar conductivity status.

• It’s not an honor you want to have. So stay smart about water and electricity. Keep absolutely everything electrical away from water.

• If you have to work in areas that could get wet, make sure that all of your equipment is plugged into a GFCI that has been tested.

• There are other potential exposures you need to be aware of. If you can see a bare wire or energized conductor and you can come in contact with it, that means trouble.

• Look for broken outlet covers or electrical boxes or have the knockouts missing.

• When you open up a circuit breaker panel, every hole needs to be occupied with a circuit breaker or be covered.

• Make sure that electrical conduits and junction boxes are in good repair and the wiring is not exposed.

• Watch out for outlets that are wearing out. If the plug won’t stay in the outlet, the prongs can become exposed. Remember, the prong is hot; get the outlet replaced.

• Be sure you’re not entering an area that may be unsafe because service, installation or maintenance work is being performed. If electricians are working on open panels or have areas blocked off, stay clear and stay safe.
PREPARE FOR THE SAFETY MEETING
Review each section of this Leader's Guide as well as the video. 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 show viewers how they can protect themselves and their co-workers from basic electrical hazards in the workplace.

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

Lead discussions about specific electrical hazards that are present at your facility and the safe work practices employees must follow to protect themselves from them. Use the review questions to check how well the program participants understood the information.

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

• How proper wiring controls electrical currents;
• What happens when electricity flows through the human body;
• What four methods are used for protection from electrical shock;
• How ground-fault circuit prevent shocks;
• How to ensure outlets aren’t overloaded;
• How to use power and extension cords safely.
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REVIEW QUIZ

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

1. Which opening of a typical electrical outlet is designated for the neutral wire of a standard 120-volt circuit?
   a. the left (or larger slot)
   b. the narrow slot
   c. the round hole on the bottom

2. Our bodies are conductive, with ____________ percent made up of water.
   a. 20 to 30
   b. 50 to 60
   c. 70 to 80

3. Circuit breakers provide protection from electrical shock.
   a. true
   b. false

4. The amount of electricity that is available on a circuit is measured in ________________.
   a. watts
   b. volts
   c. amps

5. If the power draw on a circuit is continuous like lights or a heater, the load wattage should be kept at 90 percent of the amount of volts multiplied by the number of amps.
   a. true
   b. false

6. The smaller the gauge of an extension cord, the ___________ current it can safely handle.
   a. more
   b. less

7. Extension cords should never be used in the same place for more than ___________ days.
   a. 30
   b. 60
   c. 90

8. When you open a circuit breaker panel, every hole needs to be occupied with a circuit breaker or be covered.
   a. true
   b. false
ANSWERS TO THE REVIEW QUESTIONS

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