



Training Solutions, Delivered!

ARC FLASH FOR NON-ELECTRICIANS

**Leader's Guide, Fact Sheet
& Quiz**

Item Number: 4771

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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 page containing the answers to the quiz comes before the quiz itself, which is on the final page.

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.

4771 ARC FLASH FOR NON-ELECTRICIANS FACT SHEET

LENGTH: 16 MINUTES

PROGRAM SYNOPSIS:

Electricity—It's so common in our homes and workplaces that it's easy to take it for granted, and to forget about its hazards. But with more than a thousand people being killed every year in electrical accidents and about 30,000 being injured, electrical safety literally is a matter of life and death! Electricity poses two major hazards to those who work with or around it. The most intense is "arc flash", a sudden, violent release of electrical energy. Its powerful heat and blast effects can cause severe injuries and fatalities. The second is "shock". When electric current passes through a person's body, it can cause burns, internal injuries, cardiac arrest, even be fatal! Fortunately, there are practical ways to avoid these hazards. This program reminds employees of the dangers of arc flash and the importance of following safety measures to protect themselves from arc flash as well as prevent arc flashes from occurring.

PROGRAM OBJECTIVES:

After watching the program, the participant should:

- Understand the dangers of arc flash and electric shock.
- Understand what causes "arc flash" and "arc blast".
- Know what happens during an "arc flash" and "arc blast".
- Know specific procedures that can be used to avoid arc flash and electric shock.
- Understand how "arc rating" helps identify the appropriate protective equipment and clothing to wear in potential arc flash situations.
- Understand how to create an "electrically safe condition."

PROGRAM OUTLINE

TWO MAJOR HAZARDS OF ELECTRICITY

- **Electricity— it's so common in our homes and workplaces that it's easy to take it for granted, and to forget about its hazards.**
— But with more than a thousand people being killed every year in electrical accidents and about 30,000 being injured, electrical safety literally is a matter of life and death.
- **Electricity poses two major hazards to those who work with or around it.**
— The most intense of these is "arc flash", a sudden, violent release of electrical energy.
— Its powerful heat and blast effects can cause severe injuries and fatalities.
— The second is "shock", which occurs when electric current passes through your body.
— Shock can cause burns, internal injuries, cardiac arrest... even death.
- **Many people think that arc flash is just a type of shock, but it's not.**

SHOCK HAZARDS

- **It doesn't take much electricity to cause a shock.**
- Point-zero-six amps of electricity is just enough to make the filament in a holiday light bulb glow, for example.
- But the same number of amps passing through your heart is all it takes to "put your lights out", permanently.

We all encounter situations that can result in a shock.

- Fortunately, there are safe work practices we can follow to reduce our risk of being shocked in the workplace.
— They begin with keeping your eye out for hazards such as cracked wires and defective equipment.

You should always inspect tools and extension cords before plugging them in.

— If you see torn insulation or exposed wiring, don't use them.

This type of damage often results from "unsafe" work practices, such as:

- Picking up electric tools by their power cords
- "Unplugging" an extension by yanking on the cord instead of pulling the plug.

It's important to treat power tools and cords with respect.

- **Another problem can occur when someone removes the "ground" prong from a three-prong plug, so they can put it in a "two-prong" outlet.**
— Don't use any plug that has been altered in this way.
— Inform your supervisor immediately so it can be repaired or replaced.
- **Water conducts electricity and promotes "shock".**
— Whenever possible, avoid using power tools and equipment in wet conditions.
— Don't touch any electrical equipment that's wet.

- Make sure your hands are dry when you're working with electricity as well.
- **A metal ladder will behave just like a lightning rod around an electrical source.**
- Use a nonconductive fiberglass or wooden ladder instead.

LIGHTNING VS. MAN-MADE ARC FLASHES

- **While the potential for shock is all around us, and it can obviously be hazardous, shock seems "tame" compared to arc flash.**
- **Arc flashes are more common than you might think. Chances are you've witnessed them many times, without knowing it!**
- When you see a flash of lightning, you're seeing an arc flash.
- It gives off intense light and loud noise.
- **As lightning comes closer, you get a better idea of its violence and destructive power.**
- If it gets too close, you might not survive it.
- **While lightning occurs naturally, "man-made" arc flashes generally occur in high-energy electrical systems that provide power for business and industry.**
- **Arc flash events send a couple of thousand workers to burn units every year.**
- They cause disabling injuries.
- And they kill.

CHARACTERISTICS OF ARC FLASHES

- **Most of the time, energy moves safely through electrical systems, unless something happens to divert the power.**
- When diverted electricity jumps through the air from contact to contact or from a contact to "ground", that's an arc flash.
- This can occur spontaneously when corrosion or conductive dust builds up in equipment.
- But most arc flashes result from mistakes that are made when someone is working on or near an electrical system.
- **Touching a probe to the wrong circuit or dropping a metal tool into the system, even digging a backhoe into an underground cable, can all cause arc flash.**
- Like lightning, these types of arc flashes happen very quickly, and release huge amounts of light and heat energy.
- Temperatures can reach 35,000 degrees Fahrenheit, three and a half times hotter than the sun's surface.
- An arc flash instantly superheats the air and can vaporize nearby structures and equipment.
- **Another phenomenon that is often associated with an arc flash is "arc blast".**
- Basically, the equipment that is the source of the arc flash explodes.
- This can throw melted metal and debris outward at nearly the speed of sound.
- Workers lucky enough to survive a close encounter with an arc blast say it was like standing in front of a shotgun when it's fired.
- **"Arc flash trauma" is not a pleasant subject.**
- But by examining the physical hazards of arc flash, we can gain a better understanding of what we can and cannot do to protect ourselves from it, and what type of PPE should be used in arc flash situations.
- **The light released by an arc flash is literally blinding.**
- Its heat can cause first, second and third degree burns.
- It can make everyday clothing burst into flame, and cause some synthetic fibers to actually melt into your skin.
- When your clothes burn or melt, your body gets burned, too.
- The more of your body that gets burned, the more likely you are to die from your injuries.

ARC-RATED CLOTHING & PPE

- **This is why electrical workers always put on "arc-rated" protective clothing and equipment when they approach a potential arc flash source.**
- The "arc rating" describes how much heat the protection can resist without damage.
- **To calculate the arc rating you need for a particular task, you determine how many units of heat you would receive where you are working if an arc flash occurred in that equipment.**
- You then can choose clothing with an arc rating that meets or exceeds the protection level for that amount of heat.
- Other arc-rated PPE, such as gloves, safety glasses, or face shields, is selected in the same way.
- **But the heat energy generated by an arc flash is not the only hazard. There is also the "arc blast" to consider.**
- It can throw you across the room, causing additional injuries such as a concussion and broken bones.
- It can rupture your eardrums as well as collapse your lungs.
- It can throw equipment fragments just like shrapnel from a grenade.
- **The unpleasant truth is that even arc-rated clothing and PPE cannot provide much protection from the violence of an arc blast.**
- **Protective clothing and PPE are your last lines of defense against an arc flash and arc blast.**
- They provide as much protection as possible when an accident happens.
- But real safety comes from preventing the arc flash in the first place.

CREATING AN ELECTRICALLY SAFE WORKING CONDITION

- **The best way to reduce the risk of arc flash is to create an "electrically safe working condition" before any electrical work begins.**
 - This starts with powering down, or "de-energizing" the equipment to be worked on, but there is more to it than that.
 - Preventing electrical accidents also requires stringent adherence to safe work practices in every step of the work that is being done.
- **For example, the equipment to be disconnected may be located at some distance from, even out of sight of, its power control system.**
 - Once the energy has been turned off, it is all too easy for someone who can't see people working on the equipment to turn the electricity back on unexpectedly.
 - That's why the power control system must be locked-out and tagged after being turned off.
 - This physically prevents the equipment from being re-energized.
- **The equipment must still be treated as if it's energized, and a potential arc flash hazard, until it has been tested to make sure the power really is off.**
 - Electrical workers who are servicing the equipment must continue to adhere to safe work practices and wear protective clothing and PPE when they conduct the test.

ESTABLISHING AN ARC FLASH BOUNDARY

- **Another important step in creating an "electrically safe working condition" is establishing an "Arc Flash Boundary."**
 - To determine where this boundary should be, you calculate at what distance from the equipment the "incident energy" of an arc flash would equal 1.2 calories of heat per square centimeter.
 - "1.2 calories per square centimeter" is the "heat value" that will cause a second-degree burn on unprotected skin.
 - This "second-degree burn distance" is where the Arc Flash Boundary will be set up.
- **The boundary must be clearly labeled and must physically restrict access to the area.**
 - Unqualified electrical service personnel and other workers may not cross the Arc Flash Boundary.
 - Even qualified electrical workers can't cross the boundary unless they are wearing appropriate protective clothing and PPE with the right arc rating.
- **Once these precautions have been taken, the equipment can be tested.**
 - Only when it is verified that the power is off, does an "electrically safe working condition" exist.
 - That's when actual maintenance or repair of the equipment can begin, without any risk of arc flash or electric shock.

SAFE WORK PRACTICES

- **While preventing arc flash in your facility largely depends on the safe work practices of the qualified electrical workers who are servicing the equipment, there are things that other employees can do to keep safe around potential arc flash situations as well.**
 - First, if you're not qualified and authorized to operate or work on electrical equipment, you shouldn't try.
 - Small mistakes with high voltage can have big consequences.
- **It's also a good habit to stay clear of electrical equipment and potential arc flash sources under any circumstances.**
 - Warning labels make arc flash sources easy to recognize so you can keep your distance.
- **If electrical work is being done in your facility, you should keep in mind that "turning off the power" may not always be an option.**
 - You should always assume that the work is being performed on live, energized circuits, and use all the caution that this type of situation demands.
- **If an electrical worker has set up an Arc Flash Boundary to protect you from arc flash, don't cross it!**

ARC FLASH FOR NON-ELECTRICIANS

ANSWERS TO THE REVIEW QUIZ

1. b

2. c

3. a

4. b

5. a

6. b

ARC FLASH FOR NON-ELECTRICIANS
REVIEW QUIZ

Name _____ Date _____

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

1. "Shock" is the most intense and violent type of electrical hazard.
 - a. True
 - b. False

2. "Arc flashes" occur naturally in _____.
 - a. Sea water
 - b. Electrical equipment
 - c. Thunderstorms

3. The heat generated by an arc flash can make everyday clothing burst into flames.
 - a. True
 - b. False

4. The most effective way to reduce the risk of an arc flash is to turn off the power before starting work on electrical equipment.
 - a. True
 - b. False

5. The "arc rating" of clothing or equipment is measured in _____ per square centimeter.
 - a. Calories
 - b. Milligrams
 - c. Roentgens

6. Electrical equipment should not be considered to be safely de-energized until it has been _____.
 - a. Disassembled
 - b. Tested
 - c. Shut off