Training Solutions, Delivered!

ELECTRICAL SAFETY FOR QUALIFIED WORKERS

Leader's Guide, Fact Sheet & Quiz

Item Number: 4611

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.

4611 ELECTRICAL SAFETY FOR QUALIFIED WORKERS
FACT SHEET

LENGTH: 20 MINUTES **PRODUCTION YEAR: 2014**

Electricity is a powerful force that can cause serious injury and death. When it comes to electrical job tasks, it only takes an instant to turn a momentary mistake into a fatality. This is why qualified electrical workers must understand the hazards presented by exposed energized parts and know how to protect themselves through the use of safe electrical work practices. That's the purpose of this program—to explain the safety precautions these employees must always take to avoid needless tragedies while performing any type of electrical work.

Topics include the definition of a qualified worker, approach boundaries, the shock hazard of electricity, voltage-rated gloves and PPE, the arc flash boundary, PPE Levels of arc flash protection, creating and verifying an electrically safe work condition and exceptions when energized work is allowed.

PROGRAM OBJECTIVES:

After watching the program, the participant should be able to explain:

- How the term "qualified" is defined as it pertains to electrical workers;
- What is required when the Limited and Restricted approach boundaries are established;
- How electricity affects the human body when a person is shocked;
- What types of gloves and footwear should be worn to prevent direct contact with energized parts;
- What an arc flash and Arc Flash Boundary are;
- What arc flash protection is required by each PPE Level;
- How an electrically safe work condition is created and verified;
- When work on energized parts and equipment is permitted.

PROGRAM OUTLINE

THE QUALIFIED WORKER

- Workers whose job tasks may expose them to energized parts must be properly qualified. Of course, everyone likes to think they are qualified, but when it comes to electrical work the term "qualified" has a very important and specific meaning.
- "A qualified person is one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved."
- It's important for electrical workers to understand that the definition of "qualified" is very specific to the task being done and the equipment involved. This means that a worker may be qualified to perform a specific task on a certain piece of electrical equipment while remaining unqualified to perform the same task on a different piece of equipment.
- Many electrical injuries occur when workers attempt to work on equipment for which they are not qualified.
- If you have any doubts about the equipment you plan to service, stop and seek out all necessary information before proceeding.
- Of course, many well-qualified electrical workers have been injured or killed by needlessly working on energized equipment, failing to wear proper PPE or making assumptions about the equipment on which they work. When it comes to electricity, it only takes an instant to turn a momentary mistake into a fatality.

APPROACH BOUNDARIES

- When performing any type of electrical work, the number one goal is to avoid injury, not just to you, but to your co-workers and nearby pedestrians as well.
- One important way to help prevent injuries is to understand the various approach boundaries, which govern the qualifications, protective equipment and permits required as workers approach exposed energized parts.
- When exposed energized parts are present, safe electrical work practices require establishing two approach boundaries to prevent electric shock. Before crossing these boundaries and moving closer to energized parts, workers need increasing levels of qualifications, protective equipment and permits.
- The shock protection boundary farthest away from the energized part is the Limited Approach Boundary. Unqualified persons may not cross the Limited Approach Boundary unless briefed on the hazards and escorted by a qualified person.
- In addition, any tools which are carried inside the Limited Approach Boundary must be insulated.
- The shock protection boundary closest to the energized part is the Restricted Approach Boundary.
- Only qualified electrical workers may cross the Restricted Approach Boundary. Before doing so, workers must wear all required protective equipment, including voltage-rated gloves.

- Crossing the Restricted Approach Boundary is equivalent to performing "live work" and all applicable safe work practices for performing live work must be followed.

SHOCK HAZARD OF ELECTRICITY

- These approach boundaries, and the requirements to cross them, have been created to prevent workers from being shocked by coming into contact with energized parts. Always following these requirements is critical to your safety because it only takes a few milliamps to stop your heart.
- When electricity flows through the human body, our nerves are painfully stimulated and our muscles can involuntarily begin to convulsively contract.
- As electricity flows through the resistance of the human body, damaging heat is produced. Victims of electric shock often suffer serious burn injuries; these burns can be both external and internal.
- Electricity will travel along any path with a difference in electric potential. When your body provides that path, electric current will flow and your body will become a conductor.
- Most people will begin to feel the effects of an electric shock between 10 and 20 milliamps. The sensation is described as a painful jolt.
- Between 20 and 75 milliamps, muscle control will be lost. This may result in the inability to let go of an energized conductor. The ability to breathe will also be impaired, which may cause a loss of consciousness.
- At 100 milliamps, ventricular fibrillation begins. Ventricular fibrillation is the uncoordinated contraction of the cardiac muscles leading to ineffective blood circulation.
- Electric shock victims suffering from ventricular fibrillation will die if they do not receive prompt, emergency medical attention.
- The resistance of a typical human body measured from hand to hand is about 1,000 Ohms. Using Ohm's law, we can easily see that becoming part of a 120 volt circuit will allow 120 milliamps to flow through the body, more than enough to cause ventricular fibrillation and death.
- When the skin is wet, the resistance of the human body is reduced significantly, which greatly increases the risk of death from electric shock.
- Because every encounter with electricity has the potential to be fatal, qualified electrical workers must take every precaution to avoid being shocked.

VOLTAGE-RATED GLOVES AND PPE

- Rubber insulating gloves and their leather protectors are some of the most important safety items used by electrical workers to prevent being shocked.
- Many shock injuries and fatalities occur when workers inadvertently contact energized parts with their hand or fingers. Wearing voltage-rated, rubber-insulating gloves will prevent this common source of electric shock.
- For voltage-rated gloves to be effective, they must be protected from damage. This is why you should always wear leather protectors over your voltage-rated gloves.
- When not in use, your rubber insulating gloves should be stored in an approved storage device
- Always inspect your gloves for damage before each use. Look for cracks, cuts, holes or other damage.
- Capture air into the glove and hold it near your cheek. Your cheek is sensitive enough to feel any air escaping from a hole that may be too small to see.
- Electric gloves that will be reused must be tested and recertified by an approved testing laboratory every six months. Make sure the test date stamped onto your gloves is not older than six months.
- Another way to avoid being shocked is to prevent making a solid connection to ground. At a minimum, all electrical workers should wear safety shoes or boots with non-conductive soles.
- You should frequently inspect your footwear to ensure the soles are in good condition.
- For electric workers with a higher risk of exposure to shock, a higher level of protective footwear may be required. This can be achieved with Electric Hazard, or EH, rated footwear or Dielectric Rated footwear.
- In addition to voltage-rated gloves and proper footwear, there are many other types of insulating devices and tools designed to prevent you from contacting live parts.
- Make sure your work plan includes these items when needed and make sure you have them on hand before beginning work.

ARC FLASH HAZARD OF ELECTRICITY

- Adhering to the requirements of the Limited and Restricted Approach boundaries will prevent you from being shocked; however, qualified workers must understand that being shocked is not the only hazard presented by electricity.
- Electrical workers must also protect themselves from electricity's other hazard, an arc flash. An arc flash is a violent eruption of energy from an electrical source.
- Tasks that open, close or ground an electrical circuit increase the chance for an electric arc to occur.
- Electric arcing is extremely hot and can ignite combustible particles in the air around the arc into a large, powerful fireball called an arc blast.

- The heat of an arc blast at any given distance from the arc source is referred to as the “incident energy level” and is measured in calories per square centimeter.
- Many arc blast victims suffer severe burn injuries when the intense heat of the arc blast causes their clothing to catch on fire. The clothing will then continue to burn even after the arc is extinguished.
- This is why electrical workers who may be exposed to an arc flash must wear arc-rated clothing. Arc-rated clothing is designed to withstand both the intense heat and force of an arc blast without breaking open or bursting into flames.

THE ARC FLASH BOUNDARY

- To protect workers from the intense heat of an arc flash, the Arc Flash Boundary must be established. The Arc Flash Boundary is established at the distance from a potential arc source where an unprotected worker will receive a second-degree burn on exposed skin.
- In most instances, the Arc Flash Boundary is the outermost of all approach boundaries and should be marked with hazard signage.
- Any worker crossing the Arc Flash Boundary must be briefed on the hazards and dressed in appropriate arc flash protection.
- Qualified workers must be able to determine the appropriate Arc Flash Boundary for the equipment on which they intend to work.
- This information can be looked up in approved reference tables or your organization may have determined its own Arc Flash Boundary requirements based on engineering studies of the electrical system and equipment. Oftentimes, this important information can be found on equipment labels.

ARC FLASH PROTECTION

- To help electrical workers select appropriate arc flash protection, job tasks that expose workers to the risk of an arc flash will be assigned a required PPE Level. The required PPE Level of any particular job task is based on the incident energy level to which a worker would be exposed should an arc flash occur.
- There are four PPE levels related to arc flash protection, each requires a specific level of protection, measured in calories per square centimeter.
- When no arc hazards exist, electrical workers may wear long sleeves and long pants made from non-melting natural fiber clothing such as 100 percent cotton or wool. This clothing may be worn under any required layers of arc-rated protection.
- PPE Level One requires a worker to wear arc-rated clothing of at least four calories per square centimeter, a voltage rated hard hat and an arc-rated face shield or arc-rated flash suit hood.
- PPE Level Two requires a worker to wear arc-rated clothing of at least eight calories per square centimeter, a voltage rated hardhat and an arc-rated face shield combined with an arc-rated balaclava. If desired, an arc-rated flash suit hood may be used instead of the face shield and balaclava.
- PPE Level Three requires a worker to wear arc-rated clothing of at least 25 calories per square centimeter and an arc-rated flash suit hood.
- PPE Level Four requires a worker to wear arc-rated clothing of at least 40 calories per square centimeter and an arc-rated flash suit hood.
- In addition to the required arc-rated clothing and voltage-rated hardhat, electrical workers must also wear safety glasses, earplugs, proper foot wear and arc-rated gloves or voltage-rated gloves with leather protectors.
- The required PPE Level is often listed on equipment labels, but may also be looked up in approved reference tables.
- Make sure you understand how to determine the appropriate arc flash protection for the task you intend to perform. If you are not sure, ask.

ELECTRICALLY SAFE WORKING CONDITION

- Qualified electrical workers must understand the hazards presented by energized parts. They must also understand that the best way to eliminate those hazards is to de-energize the equipment or circuit to be serviced.
- De-energizing equipment to eliminate electrical hazards is commonly referred to as creating an “electrically safe condition” or creating a “zero energy state.”
- In fact, safe electrical work practices require creating an electrically safe condition whenever it is feasible to do so. With very few exceptions, there is no reason to perform work on energized equipment.
- Part of being qualified means understanding how to safely de-energize any equipment you plan to service. The definition of an electrically safe working condition is "a state in which an electrical conductor or circuit part has been disconnected from energized parts, locked and tagged in accordance to established standards; tested to ensure the absence of voltage and grounded if necessary.”
- To create an electrically safe work condition, first determine all possible sources of electrical supply to the equipment.
- Next, disconnect any active loads; then open the disconnecting device for each source of electric power.
- Visually verify, if possible, that all blades of disconnecting devices are fully open or that draw out type circuit breakers are withdrawn to the fully disconnected position.

- Then, apply company approved locks and tags to the open disconnecting devices in accordance with your facility's lockout tagout procedures.
- The next step is to test that no voltage exists.

VERIFYING AN ELECTRICALLY SAFE WORKING CONDITION

- When testing to confirm that an electrically safe working condition has been created, you must treat the circuit as if it is still energized until it is confirmed otherwise.
- This means that all approach boundaries and the arc flash boundary must be maintained and anyone crossing these boundaries, to perform voltage testing must wear voltage-rated PPE and appropriate arc flash protection.
- Before testing for the absence of voltage, you must first test the meter on a known voltage source.
- When testing for voltage, test each phase conductor or circuit part both phase to ground and phase to phase, for all phases.
- You should then test your meter again on a known voltage source.
- Once it is verified that no voltage is present, the final step is to apply protective grounds if necessary.
- Installing or removing grounds is considered live work and voltage-rated tools and equipment must be used and safe work practices must be followed.
- When grounding is required, all grounding conductors must be installed before the system can be considered de-energized.
- Once it is confirmed that an electrically safe work condition has been created, shock protection and arc flash protection are no longer necessary and may be removed. In addition, other workers may now enter the area as needed to perform work.

EXCEPTIONS TO ALLOW ENERGIZED WORK

- There are a few exceptions to the requirement to de-energize equipment prior to performing work. These exceptions include visual inspections, if the restricted approach boundary is not crossed, testing, circuit identification and troubleshooting.
- Energized work may be performed under the following limited conditions:

-When de-energizing introduces additional or increased hazards;
-When the voltage is less than 50 volts and it is determined that there is no increased exposure to electric burns or arcs;
-When it can be demonstrated that the task to be performed is infeasible in a de-energized state due to equipment design or operational limitations.

ANSWERS TO THE REVIEW QUIZ

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

ELECTRICAL SAFETY FOR QUALIFIED WORKERS

REVIEW QUIZ

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

Name_____Date_____

1. A worker may be qualified to perform a specific task on a certain piece of electrical equipment while remaining unqualified to perform the same task on a different piece of equipment.

a. True
b. False

2. Unqualified workers may cross the Restricted Approach Boundary if they have been briefed on the hazards and are accompanied by a qualified person.

a. True
b. False

3. Most people will begin to feel the effects of an electric shock _____.

a. Between 10 and 20 milliamps
b. Between 25 and 75 milliamps
c. At 100 milliamps

4. Voltage-rated gloves that will be reused must be tested and certified by an approved laboratory every _____.

a. 6 months
b. 12 months
c. 2 years

5. Tasks that _____ an electric circuit increase the chance for an electric arc to occur.

a. Open
b. Close
c. Ground
d. All of the above

6. The Arc Flash Boundary is established at the distance from a potential arc source where an unprotected worker will receive a _____ burn on exposed skin.

a. First-degree
b. Second-degree
c. Third-degree

7. Which PPE Level requires a worker to wear arc-rated clothing of at least 40 calories per square centimenter?

a. PPE Level Two
b. PPE Level Three
c. PPE Level Four

8. With very few exceptions, there is no reason to perform work on energized equipment.

a. True
b. False

9. Once it is confirmed that an electrically safe work condition has been created, shock protection and arc flash protection are no longer necessary and may be removed.

a. True
b. False

10. Exceptions to the requirement to de-energize equipment include _____.

a. Visual inspections
b. Testing
c. Circuit identification
d All of the above