# Quarterly Safety Meeting

## Meeting Title: Electricity is Shocking

Instructional Objectives:

The employee will demonstrate, by answering review questions, knowledge of :

* The written electrical safety regulations in the safety manual.
* The relationship of current (amps) and potential for injury in electrical shock.
* The relationship of voltage to shock hazard.
* The relationship between wet and dry skin and shock hazard.
* The appropriate way to call a Code Blue for electrical shock victims.
* The shock protection offered by three wire systems.

**Discussion Topics:**

The facts:

You get shocked when electricity uses your body as the wire. When you complete a circuit between a hot lead and ground, the electricity will flow through you and it can cause varying amounts of damage. The amount of damage is related to the amount of current flow which is measured in *amperes* (commonly called *amps*).

* You can feel 1 milliampere (0.001 amp) of current, but this is usually harmless.

* Five to 25 milliamperes is enough current to cause adults to lose control of their affected muscles. The victim may not be able to let go of the object shocking him.

* Currents of 25 to 75 milliamperes can be very painful and injurious. Even currents this small can cause death by paralyzing the muscles of the respiratory system.

* Receive 75- 300 milliamperes for even a quarter of a second and immediate death could occur. Can you spell **ventricular fibrillation**? When the muscle cells of the heart's ventricles twitch erratically instead of to the heart's rhythm, the heart doesn't pump. You better hope that somebody nearby knows CPR and can dial 911. Your only hope is defibrillation-- you've seen that on TV.

* Receive 2.5 or more amps and you're in the range of total stoppage of the heart, unconsciousness, respiratory paralysis and serious burns to skin and internal organs. This is not good and 911 might not be able to help you.

Won't the circuit breaker protect me?
Sorry, most circuits will trip the breaker when the current reaches 15 amps, well above the danger level. You'll be fried by then.

A modern device called a ground fault circuit interrupter (GFCI) will protect people from shock but these are only required for wet locations in new construction.

**Other factors that influence shock hazard:**

**Volts, Amps and Ohms:**
Thanks to the German physicist, Georg Simon Ohm we know that the amount of current (amps) that flows through a circuit depends on both the electrical potential (known as the *voltage)* and the *resistance* (measured in ohms) of the conductor.

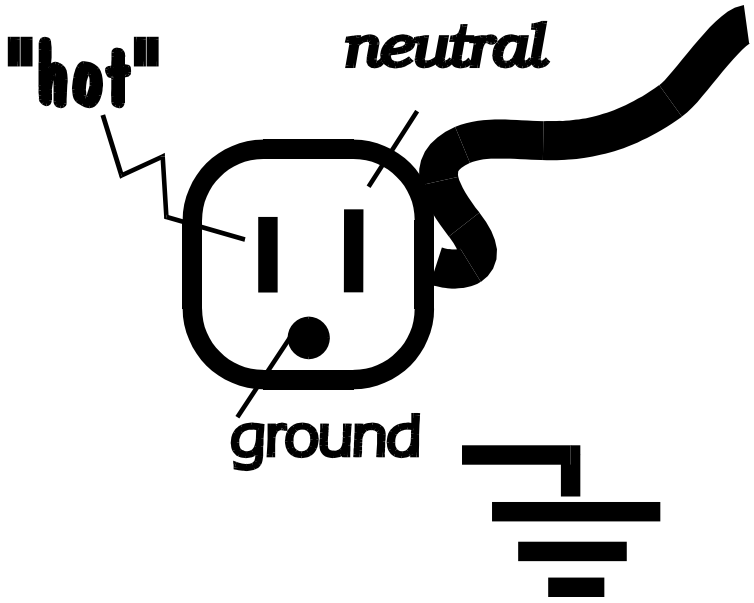
Put simply, if the voltage is very high, the risk of injury by shock is great--hence the sign: **Danger- High Voltage**. Low voltage presents low risk--that's why low voltage lighting for the yard is so popular. Resistance enters the equation by *resisting* the current . On one extreme, rubber is an excellent resistor and when wire is covered with rubber it is said to be *insulated*. Another material that acts as a resistor is wook. On the other extreme, copper is an excellent conductor and that's why most electrical wire is made of copper. Human bodies are pretty good conductors of electricity and while dry skin can sometimes prevent shock injury, wet human skin can conduct up to 10 times more electricity. Given the wet nature of laboratory analyzers, shock hazard is more significant in a lab.

The path that the electricity takes through your body has a lot to do with the net effect. Shocks that cross your heart are the most dangerous when it comes to ventricular fibrillation. Many service technicians are taught to handle live equipment with one hand behind their backs. This way, any accidental shock to the arm will seek ground down a leg and not across the chest.

**Third wire protection:**

Electric circuits that deliver power are made up of a "hot" wire , a neutral wire and a ground wire. The "hot" wire is hot with the electricity which enters the device and runs the motors, rings the bells and lights up the lights. After doing its work, the electricitly returns to the source in the second wire called the "neutral" wire.

The ground wire, which is the third wire in the system, directly connects the equipment's chassis and protective case to ground. This is important because if something in the equipment's circuitry fails, electricity can bypass its intended route and it will seek ground by the easiest route possible. This is called a *short circuit*. When the third wire is connected properly, shorts are safely and swiftly directed to ground. Without the third wire a short can make the protective case of the equipment "hot" (electrified). If somebody touches the case, the electricity will seek ground through the easiest route--their body.




With the third wire in place, shorts will usually result in the tripping of the breaker. Repeated tripping is a danger signal-- so heed it and call service. Ground wires are very important safety devices and they must never be bypassed or tampered with. Your equipment will operate without the third wire. But you will be at risk and it's just not worth it.

**Insulation failure:**

The flow of electricity always results in the generation of some heat--however small. Eventually, the heat, along with oxidation, UV radiation and mechanical damage, will break down the insulation and that's why the insulation on old wiring becomes cracked and fails. Safety inspectors must look for cracked insulation and frayed wiring. Old wiring can and must be replaced. Just put in a work order.

**On the Use of Extension Cords:**

Extension Cords that are routinely used could present a dangerous situation especially if the cord is overrated. There was an incident in one of our areas in which an overrated extension cord was in in use and a fire did indeed ignite causing a potentially very dangerous situation!

| | |
|---|---|
| Rule No.1: | Avoid using extension cords for routine use! If one is currently in use, put in a work order to have the electricity routed properly to the equipment. |
| Rule No.2: | Keep extension cords secure in the supervisor's care for emergency use only. |
| Rule No.3: | Be certain that the cords have been inspected and are up to code! |

**Safe work practices:**

Always turn equipment off and unplug it at the source before servicing. Remember that most equipment contains both high voltage and low voltage circuits. The trained service people know which is which and that's why you sometimes see them working with the equipment plugged in, with power switch on. Don't follow their example -- you aren't trained.

Make sure that your skin is dry and the surrounding environment is dry before servicing equipment. Remember that moisture makes you ten times more vulnerable to harmful shock.

A tripped breaker is a warning signal. It could mean that the current drawn by the equipment exceeds the rating of the breaker. But it could indicate a short circuit. So if the breaker trips more than once, call the electrician.

Wearing rings and other metal conductors is like attaching wires to you. So remove all jewelry before working on equipment.

If you have to "wiggle" or "seat" boards or connectors with the power on, work with one hand behind your back. Don't take a shock across the chest.

Finally, learn CPR and remember how to call a code BLUE-- **Cardiac arrest phone 2-5000** . The hearts of shock victims will not defibrillate on their own.

**NAME:_____DATE:_____**

**LAB/CAMPUS:_____**

# "Electricity is Shocking" Test

_____1. Written electrical safety regulations may be found in:
- a. the dictionary under the word "electricity".
- b. the laboratory procedure manual.
- c. the laboratory safety manual.
- d. on a note pad by each electrical outlet.

_____2. An electrical shock can be felt with an amperage of:
- a. 1 milliampere
- b. 5-25 milliamperes
- c. 25-75 milliamperes
- d. greater than 2.5 amps

_____3. Most circuits will trip the breaker when the current reaches:
- a. 5 milliamperes
- b. 25 milliamperes
- c. 5 amps
- d. 15 amps

_____4. Wet human skin can conduct up to :
- a. 2 times more electricity.
- b. 5 times more electricity.
- c. 10 times more electricity.
- d. 20 times more electricity.

_____5. The seriousness of the injury due to electrical shock has a lot to do with the path of the current. The most dangerous path causing ventricular fibrillation is:
- a. shock across your heart.
- b. shock to left arm and down left leg.
- c. shock to right arm and down right leg.
- d. direct shock to the heart.

_____6. Electrical circuits that employ the “third wire protection” are made up of:
- a. Hot, Neutral and Cold wires
- b. Ground, Neutral and Hot wires
- c. Neutral Ground, Cold and Hot Ground
- d. Bypass, Hot and Ground wires

_____7. The “third wire” in an electric circuit
- a. is unecessary
- b. is required by the AARP
- c. provides extra electricity if a wire should break
- d. directs any leaked electricity harmlessly to ground

8. If cardiac arrest occurs, this is known as a code (a.)_____ and the number to call is (b.)_____.

_____9. Medical devices included under the Safe Medical Device Act are:
a. Bandages and syringes
b. In vitro diagnostic kits/reagents
c. Cat Scanners
d. All of the above

_____10. FDA Medical Device Reporting program is called:
a. Medline
b. Medsearch
c. Medwatch
d. Medreport

_____11. Malfunctions in devices are reported if it:_____
a. Causes injury/death to patients
b. Causes injury/death to employees
c. Causes injury/death because of user error
d. All of the above

_____12. Safe Medical Device Act was developed to:_____
a. Protect the public from malfunctioning medical devices
b. Protect manufacturers from malfunctioning medical devices
c. Protect engineers from malfunctioning medical devices
d. All of the above

**TRUE OR FALSE:**

1. _____ Old wiring should be fixed by taping it with duct tape.

2. _____ Always turn equipment off and unplug it at the source before servicing.

3. _____ Your skin and the surrounding environment should be dry before servicing equipment.

4. _____ If the breaker trips more than once, call the electrician.

5. _____ Although rings and other metal jewlery are conductors of electricity, it is not necessary to remove them before servicing equipment.

6. _____ Extension cords may be used for routine use.

Score: _____ correct out of possible 20

Remedial action for missed questions:_____