

OSHA- NDLON

BASIC ELECTRICITY SAFETY AND THE USE OF POWER TOOLS

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Objectives:

- To acquire basic knowledge about electricity, hazards associated with electric shock and means of prevention.
- To understand how severe electric shock is in the human body.
- To develop good habits when working around electricity.
- To recognize the hazards associated with the different types of power tools and the safety precautions necessary to prevent those hazards.

Introduction to Electricity

Electricity has become essential to modern life because of how practical and useful it is. Much of our daily work relies on electricity, whether at an office, retail, restaurant, construction site or any other industry and perhaps because it is so familiar to us, that oftentimes we tend to overlook the hazards associated with this source of energy. A lot of workers are killed or injured by electricity every year. It may be because of a lack of understanding of how electricity works or not being careful when working with electricity. Understanding the dangers of electricity, how to respond in an emergency and proper safety procedures will go a long way in preventing injury or death caused by this powerful force.

Definitions

Here are some terms you should know:

Current is the flow of electricity.

Voltage is the measurement of electric potential.

A *Circuit* is a network consisting of a closed loop, giving a return path for the current.

Alternating Current is the form in which electric power is delivered to businesses and residences.(such as the power from your wall outlet).

Direct Current the flow of electric charge is only in one direction (such as from a battery).

Conductor is an object or type of material that allows the flow of electricity.

Resistance is the capacity of a material to lower or stop electric current.

How Does Electricity Work?

The operation of the electric switch works the same as the tap water faucet. Behind the faucet (or switch) is a source of water (or electricity), a way of transporting it, and pressure to make it flow. The source of tap water is a reserve or pumping station. A pump provides enough pressure for water to flow through the pipeline. The source of the electrical switch is an electricity generating station. A generator provides the pressure so that the electrical current can travel through electrical wires or conductors. Here are the components:

- A **live wire** (also known as **phase, hot or active** contact) carries alternating current between the power grid (source) and the household.
- The **neutral wire** completes the electrical circuit by also carrying alternating current between the power grid and the household. The neutral is connected to the ground, and therefore has nearly the same electrical potential as the earth. This prevents the power circuits from rising beyond earth, such as when they are struck by lightning or become otherwise charged.
- The **earth wire** or **ground** connects cases of equipment to earth ground as a protection against faults (Electric Shock).

Note: It is important to understand that short of killing you, electric shock can cause burns as the current dissipates across your body's natural resistance (that is, your skin).

To understand how electricity works, let's take a look at static electricity. By a show of hands, who here has felt a shock when turning on a light switch or grabbing a doorknob? Do you know why you felt that shock?

Static Electricity is a very common form of electricity. Think about when you walk in a carpeted room and then touch a doorknob. Static electricity originates when two different materials are brought together, such as the soles of the shoes and the carpet. When they are separated, then two different types of electricity are produced (one on the carpet, one on the shoe soles) because they have different voltage or electric intensity. Both types of electricity attract each other and are trying to get back together to recombine. If they are not able to recombine where they originated and then you touch a doorknob or a light switch, then the electricity travels through your body to connect with the source you just touched. That's when you feel a shock, as the electricity leaves your body. The electricity is then gone from your body and you should not get another shock unless you generate more electricity. Can you give me another example of two things that can generate electricity? Give the example of the balloon.

Basically our bodies become conductors and electricity seeks the easiest and shortest path to the ground, which oftentimes that shortest path is a person. "Conductors" conduct electricity freely and in large amounts – all metals, water, humans and even non-metallic materials (trees, ropes etc.) can conduct electricity

depending on moisture content and surface contamination; that is why it is important to be extra careful when working with electricity.

Based on the information I have provided, can anyone tell me why birds that sit on electrical post wires do not get electrocuted? Give room for possible answers.

That is part of understanding what electricity is and how it works. Basically, a circuit consists of three essential elements: 1) the source of energy, which supplies the driving force or voltage to make the current flow; 2) the user of electricity, for example a light bulb; and 3) transmission lines or wires to conduct the electricity. For current to flow there must be a complete or closed circuit. If a wire is cut or disconnected somewhere forming an open circuit, charges will accumulate and stop the flow of current. Electricity wants nothing more than to go to ground and will always do so by the easiest most direct route. A bird on a wire doesn't give electricity anywhere to go but back to the wire – easier for the current to stay right where it is in the wire and continue on its way.

Developing Safe Practices Around Electricity

How Dangerous Is Electricity?

Even if you are not an electrician, bets are you will work with or around electricity, and therefore you can be exposed to electrical hazards. In each workplace, there are a lot of different tools and materials, as well as a lot of activities happening at the same time. The dangers are also increased by the use of power tools.

Effects Of Electric Shock

As we have learned earlier, a closed circuit is essential for the safety of anyone that comes in contact with electricity. Contact with electric voltage can cause the current to flow through the body, which can then result in electric shock, burns and even death. This can happen in different scenarios or situations. If two cables have different voltage, the current can flow through them if they are connected. If you touch both cables at the same time, then your body becomes a conductor and the current of electricity will pass through your body. Also, if you touch a cable that has current flow and also touch an electric connection that is grounded, then you become the easiest path for electricity to go to the ground.

The severity of the injuries caused by an electric shock varies depending on the voltage and the time that the current takes to pass through your body. The amount of current a person can tolerate and still be able to control his or her hand and arm muscles is less than 10 mA.

Like mentioned before, the damage that the current of electricity can do depends on different factors: the intensity of the voltage, the length of the exposure, the muscle structure of the individual, and other different conditions. People with less muscular tissue are usually affected at lower levels of electric current.

Electric shocks, depending on certain conditions, can be fatal, even at relatively low voltages. The amount of time that an electrical current lasts has a great influence in the severity of the injuries. If the electric current has a short duration, then it may just cause pain. If the electric shock is longer, then it can be fatal, even if the voltage is not very high.

Another factor that influences how dangerous electric shock can be is resistance. Resistance blocks the current. Working conditions in environments that are wet will reduce the resistance dramatically. We know that the human body is an excellent conductor for electricity and that electricity is always looking for a quick and simple path to the ground. Because about 70 percent of a human body is made up of water, it's extremely easy for electricity to course through you in a matter of seconds.

The journey the electric current takes through the body also influences the severity of the shock. The currents that pass through the heart or nervous system are the most dangerous. If your head makes contact with a live wire, it is very likely that your nervous system will be affected. If a hand comes in contact with an electrical component with current (and at the same time the other side of your body makes a path to the ground), this will make the current pass through your chest and possibly produce injuries to the heart and lungs.

At a minimum, electric shock can cause:

- Headache
- Muscle fatigue or spasms
- Temporary unconsciousness
- Temporary breathing difficulty

Some of the more serious and possibly fatal side effects of electrical shock are:

- Severe burns at point of contact and along the electricity's course through the body
- Vision loss
- Hearing loss
- Brain damage
- Respiratory arrest or failure
- Cardiac arrest (heart attack)
- Death

It is also important to note that high voltage can cause additional injuries. For example, if you are working at an elevated surface and get shocked, the shock can

cause violent muscle cramps, which might make you lose your balance and thus fall. Severe burns are also an aftermath of electrical current flowing through the body.

An intense shock can cause more serious damage than it is possible to see. A person may suffer internal bleeding and destruction of tissues, nerves and muscles. Sometimes, death may occur subsequently due to the hidden wounds caused by electric shocks.

How Much Is Too Much?

Most resistance in your body is in your skin. If your skin is wet or damp, that resistance is lowered. If you handle an electrical device with damp hands, even low voltages might be sufficient to do you serious damage. The current coming out of your electrical outlet is more than enough to kill you.

A lot of us use batteries around our household for different tools. Four AA batteries, for example, don't have a high voltage output, but if they are not working properly, they can generate a lot of heat to destroy the battery and possibly burn you. If you feel heat coming from your circuit or the batteries, you might have a short-circuit or a component inserted the wrong way. Turn it off and let things cool down; then check to see what's causing the problem.

As stated before, there are many factors that can affect the way electric current can hurt you. There is no rule as to what level of voltage will kill or seriously injure a person because of all the variables, so it is always important to be careful when working with electricity.

Regardless of how much voltage you work with, develop safe work habits now.

How Can I Protect Myself From Getting Shocked?

It's common sense that you should not stick your finger into an electrical outlet, but there are other good practices that can protect you from turning your body into a current conductor.

Take off all jewelry!

Metal is an excellent conductor. It is not a very smart idea to wear rings or other metal jewelry around electricity. This is because body's resistance can be very low when your skin is surrounded by metal. Another good reason to avoid jewelry is that it can get stuck on things like machinery or a breadboard filled with wires and tiny components.

Stay dry!

Don't work in a wet environment (like outdoors if it's raining, wet lawns, damp garages, etc.). Also, make sure your body is completely dry before working with electricity, this includes sweat. This might seem like common sense, but oftentimes we do not consider things like having drinks around our workspace, which can spill

and cause accidents. You need to become super careful about anything wet or moist in or near your work area.

Look Up!

Always be aware of overhead wires. Take extra care when working near overhead power lines; make sure you maintain a safe distance from overhead power lines.

Ladders- Remember that electricity wants a conductor. Metal is an excellent conductor, so make sure not to use metal ladders around overhead power lines (beware that even wood ladders might contain metal parts). Be safe, electricity can jump and often does when a potential conductor like a metal ladder comes within certain proximity. Keep away from overhead power lines (at least 10 feet).

Trimming trees- A rule should be to always plant trees away from power lines. However, if you have a tree that has grown into power lines DO NOT attempt to trim it yourself. Remember, electricity does not need metal to flow, water will be just fine. The moisture in the tree and in you will be a great conductor. Call the Department of Power for assistance.

Note: Never climb Electrical Utility poles or towers.

Look Down!

There may be power wires underground. If you plan to excavate, call 811 first to make sure there are no power lines or other utilities that can get damaged.

Stay away from pad mount transformers (green metal boxes that contain the above ground portion of an underground electrical installation). These transform high voltage electricity to low voltage electricity, which is then carried in insulated underground power lines to your home. Always stay away from these boxes.

Never touch a downed wire. Keep at least 10 meters away from fallen wires and call the Department of Power to notify them of any downed lines

Always respect electricity!

The main rule when working with or around electricity is NEVER touch a component in a circuit that has power. Turn off all power sources or remove the source from the circuit entirely before touching it. Note that even if the source of current is eliminated, some electricity might remain. For that reason, it is always important to test the circuit before touching it to make sure no energy remains. Also, never take someone's word that the power is off, you should always check it yourself.

If you are not a trained/certified electrician, you should never do electric work.

First Aid

If someone nearby has contact with a live electric current and receives an electrical shock, DO NOT touch the person. If you touch him or her, the electricity can move from that person's body into yours, shocking you both in the process.

Electrical shocks always need emergency medical attention, even if the person seems to be fine afterward. Here are some steps you can take to help a victim:

1. Separate the Person From Current's Source

To turn off power:

- Unplug an appliance if plug is undamaged or shut off power via circuit breaker, fuse box, or outside switch.

If you can't turn off power:

- Stand on something dry and non-conductive, such as dry newspapers, telephone book, or wooden board.
- Try to separate the person from current using non-conductive object such as wooden or plastic broom handle, chair, or rubber doormat.

If high voltage lines are involved:

- The local power company must shut them off.
- Do not try to separate the person from current if you feel a tingling sensation in your legs and lower body. Hop on one foot to a safe place where you can wait for lines to be disconnected.
- If a power line falls on a car, instruct the passengers to stay inside unless explosion or fire threatens.

2. Do CPR, if Necessary

When you can safely touch the person, do CPR if the person is not breathing or does not have a pulse. Only a person that knows CPR should do it.

3. Check for Other Injuries

- If the person is bleeding, apply pressure and elevate the wound if it's in an arm or leg.
- There may be a fracture if the shock caused the person to fall.

4. Wait for 911 to Arrive

Recommendation: Be really careful before making the decision to help a victim of an accident because you may unintentionally hurt that person even more. Remember that the injuries may be internal. It's best to wait for a qualified person's help. If it is essential for you to help and the victim is conscious, ask him or her if it is ok to help him or her. This will prevent you from being sued in the future for additional injuries caused by the assistance you provided.

The Use of Power Tools

The use of power tools has become an essential part of work. Power tools help us perform those jobs that would otherwise be very difficult or impossible to do, in a fairly simple and fast manner. However, while power tools can make a project easier, faster, and more enjoyable, they can also be the cause of serious injuries, especially when workers are not trained on how to use them and/or the power tools are maintained improperly. It is very important for workers to be knowledgeable of the hazards associated with the use of power tools and the precautions necessary to prevent accidents and injuries. So before you turn that power tool on, consider the following:

1. Start with your workspace: Make sure you have a safe and clean work environment:

- Make sure to keep your work areas clean and well lit. Poor lighting and cluttered spaces are potential hazards.
- Avoid using power tools in dangerous environments such as damp or wet locations, and workplaces where there are flammable liquids, gases or any other materials that can ignite.
- Always make sure there are no bystanders or other workers near you when using power tools. You will not be able to hear them and might get distracted and cause an accident.
- Never leave a power tool running if you're not using it. Make sure it stops completely before leaving the workspace. If it has a safeguard, make sure it is on.

2. Always make your personal safety a priority:

- Dress properly. Never wear baggy clothing because it can be snagged or become tangled in the power tool. If you have long hair you should tie it back so that it doesn't make contact with the power tool. The same is true of jewelry and anything else that dangles loose from the body.
- To ensure safety, clothes should cover the whole body. When appropriate, hard hats, dust masks and other protective gear should be used. Work boots or steel-toe boots should be worn as appropriate as well. Heavy, durable gloves will minimize the risk of hand injuries too.
- Always wear personal protective equipment according to the type of job and tool you are going to be using. Always wear eye protection, such as safety goggles or glasses with side shields. Minimize the damage to your hearing by investing in a pair of earplugs. Even the best power tools can be loud, especially in a garage or workshop environment. Also a dust mask, non-skid safety shoes, a hard hat, and must be used when needed.
- Guard against electric shock by preventing contact with grounded surfaces (pipes, radiators, ranges, and refrigerator enclosures). If you have to work in damp or wet ground, always use rubber gloves and non-skid footwear, but

remember that it is not recommended to work in such conditions. A Ground Fault Circuit Interrupter protected power line must be used for these conditions.

- Watch what you are doing. Always stay alert and if something seems too dangerous to do, don't do it! Do not operate a power tool when you are tired or under the influence of drugs or alcohol.
- Keep hands away from rotating or moving parts. Sounds like common sense, but we often forget this simple rule.
- As we know, working on ladders and elevated platforms is very dangerous in general. If you have to use a power tool while on a ladder or elevated platform, then the risk is even greater. Keep proper footing and balance at all times. Do not overreach!
- Never keep your finger positioned on the on/off button. You can accidentally press it and cause an accident or injury. If the power tool has a safety lock or safeguard, then you should always put it on when the tool is not in use.

3. Before using a power tool you should always:

- Pick the right tool for the job you have to do. Do not force the tool to do a job that it is not intended to do, or use a small power tool for large jobs. Also, use only accessories recommended by the tool manufacturer. Accessories that may be suitable for one tool may become hazardous when used on another tool.
- Read the instructions really well. Even if you have experience using a power tool, do not start using it before knowing all the specifications of that particular tool. There could be variations in the use of an electric power tool, as opposed to a gas power tool. Also, it is important to know your tool like the back of your hand. By reading the user manual or instructions, you will learn all the parts, functions, usage tips and relevant information about that particular tool.
- Inspect the power tool to make sure it is not damaged. If you notice any cracks, parts misaligned, dangling pieces or screws, rusty, dull or blunt blades and other damages do not use that tool until it has been repaired. A damaged or malfunctioning power tool can be dangerous.
- When cutting or drilling a work piece with a power tool, the piece should be secured with a clamp. For example, a piece of wood should be completely secured before it is worked on with a table saw. Similar precautions should be taken when using power belt sanders, nail guns, and miter saws. If a piece is not secured, it could ricochet and cause serious injuries. A blade might not move in the correct way, or a nail gun could misfire. Securing a piece only takes a few seconds; it is safer than using your hand and it frees both hands to operate the tool.
- Check that the power source has enough voltage to support the amount needed by the tool you are going to be using. A power source with voltage greater than that specified for the tool can result in serious injury to the user, as well as damage to the tool.

- Keep handles dry, clean and free from oil and grease so that the power tool does not slide from your hand.

4. When you are done using the power tool:

- Wait for any moving parts to stop before cleaning up waste from the work area.
- When not in use, power tools should be disconnected. Power tools should also be unplugged whenever they are serviced or when parts or accessories are being replaced. When it is unplugged, a power tool can't accidentally turn on and cause injuries.
- Store the tool when you are done using it. Make sure it is out of harms way and that no one who is not authorized and/or trained to use it can have access to it.

5. Additional recommendations:

- Never carry a tool by the cord or hose.
- Never yank the cord or hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil and sharp edges.
- Disconnect tools from the power source before servicing or changing accessories.
- Remove all damaged portable electric tools from use and tag "Do Not Use."

Contacting OSHA

If you identify a hazard at your job, please report it!

To report an emergency, file a complaint or seek OSHA advice, assistance or products, call (800) 321-OSHA or contact your nearest OSHA regional or area office.

This material was adapted from material produced by the NIOSH, OSHA, The Power Tool Institute and other sources.