Avoiding Electrocution Hazards
Because electricity is such a familiar part of our daily life, many of us may not give a lot of thought to how much we depend on reliable sources of electricity. More importantly, we may overlook the hazards electricity poses and fail to take the necessary precautions to protect ourselves, our coworkers, and our patients.

In 2015, there were over 4300 electrical-related violations cited by OSHA in all workplace environments including healthcare environments.

Healthcare workers need to be prepared to recognize hazards associated with electricity. OSHA standards apply in any healthcare setting. All healthcare workers need training regarding electricity and electrocution hazards.
Here are a few terms associated with electricity:

- **Amperage**: Amperage, more commonly referred to as amps or milliamps, indicates the strength of an electrical current. Amperage is measured in units of Amperes, often called Amps or milliamps. (One amp is equal to 1,000 milliamps).
- **Conductor**: Conductor is defined as a material through which an electrical current easily moves. A conductor material allows a current flow.
- **Current**: Current that is electrical is defined as the movement of electrical charge. Current is measured in amps.
- **Deenergized**: Deenergized means that all energy sources to circuits and equipment has been turned off and any stored energy has been depleted from the system.
Introduction to Electrocution Hazards (cont.)

- **Energized**: Energized, also called live, or hot, means that a voltage is present and it can cause an electrical current. Any time an electrical current is present, there is a risk of being shocked.
- **Insulator**: Insulator, or insulation, is a material that does not easily conduct electricity. An insulator material resists current flow.
- **Shocking Current**: Shocking current is the electrical current that passes through a part of the body. In that case, we usually say that someone is shocked by electricity.
- **Voltage**: Voltage is a measure of electrical force. Voltage is measured in volts.

- The word *electricity* is used to describe current flow through a conductor in a closed circuit.
Introduction to Electrocution Hazards (cont.)

- Electrical current can easily move through a conductor; however, an insulator provides resistance to that movement.

- A few examples of conductors include:
  - Metals
  - body tissues
  - body fluids
  - and water

- A few examples of insulators include
  - Rubber
  - Plastic
  - Wood
  - Cloth
  - Glass
  - and the earth
Air, normally an insulator, can become a conductor, as occurs during an arc flash or lightning strike. Pure water is a poor conductor. But small amounts of impurities in water like salt, or chlorine, help water become a better conductor. Dry wood, for example, generally slows or stops the flow of electricity. But when saturated with water, wood turns into a conductor. The same is true of human skin. Dry skin has a fairly high resistance to electric current. But when skin is moist or wet, it acts as a conductor.
When electrical current is available, an electrical switch can be used to start or stop current flow through a circuit. An example is a light switch. Turn the switch on and electricity flows through the circuit to the light bulb.

There are two types of current; alternating current:
- (AC), provided by electric generators that supply current to an electric grid shared by everyone in the country
- direct-current (DC) provided by a battery.
- DC current is not an efficient way to provide electrical power across long distances, so AC current is used as a better source of power for lights, motors, machines, and other electrical devices.
In order for current to flow through a conductor, three things must be present:

1. A source of electrical current to flow -- AC electrical current comes from a power generating station, DC current comes from a battery. AC current cannot be stored in a battery like DC current, so there are electrical generators to replace current as it is used by consumers.

2. Something to transport the electrical current -- A conductor allows current to move through it. This statement applies to all current, whether it is AC or DC. An example is a metal wire.

3. Something that causes current to flow through the conductor. Voltage pushes current through metal wires in a circuit.

The voltage that pushes DC current depends on the size of materials in a battery. The voltage that pushes AC current depends on the electrical power plant, and can be very large.
An electric circuit is a closed loop in which electrons move from a power source, through a conductor, and back to the power source. We now have a new term—electron—to use when we think about "what" is actually moving through a circuit. We use the term "current" to describe the movement of electrons in an electric circuit, and electrons are charged particles capable of moving through conductors.

If we think of the human vascular system as a circuit, blood cells are like electrons, blood vessels carry blood cells like the metal wires that carry electrons, and the heart provides a force to push blood cells through the vascular system, just like voltage pushes electrons through an electrical circuit.
Electrical Circuit (cont.)

- The electrical circuit is accessed through receptacles. In other words, when medical tools or medical equipment wires are plugged into a wall socket, those tools and equipment become part of the circuit.
- When we plug in an electrical device, we are using the current of electrons that is generated at the power plants and placed onto the national electric power grid.
- People can become part of a circuit. When a person becomes part of an electrical circuit, that person can be shocked. A common example is the use of a defibrillator. Before the paddles are applied to the patient, the healthcare worker will say the word “clear” to indicate to others that anyone nearby needs to back away so as not to become part of the electrical circuit.
Becoming part of the circuit means that a person will be shocked – whether it is intentional for medical purposes or accidental. An unintentional shock may result in injury.

An electric shock can result in anything from a slight tingling sensation to immediate cardiac arrest. The severity depends on the:
- Amount of current flowing through the body.
- Current’s path through the body.
- Length of time the body remains in the circuit.
- Current’s frequency.
The acronym BE SAFE is a reminder of the most common types of hazards or injuries due to electricity.

An electrical hazard is defined as a serious workplace hazard that exposes workers to any of the following:

- Burns
- Electrocution
- Shock
- Arc flash
- Fire
- Explosions
The B in the BE SAFE acronym stands for BURNS. Burns are the most common electrical shock-related contact injury resulting from electrical shock, arc flash, or thermal (heat) energy.

There are three recognized levels of burns; each is summarized below:

1. First-degree burns involve the top layer of skin, or the epidermis. A mild sunburn is a common example of a first-degree burn. In general, the skin is red, painful to touch, and shows mild swelling. A treatment that consists of cool, wet compress, or cool water, plus over-the-counter pain medications is often enough to relieve the pain and swelling.

2. Second-degree burns involve the first two layers of skin, the epidermis and dermis. Blistering, reddening of the skin, pain, and fluid leaking from the blisters. These burns often require medical treatment by healthcare professionals.
3. Third-degree burns involve penetration of the entire thickness of the skin (epidermis, dermis, and hypodermis), and tissues (hair, nerves, and sweat glands) are often permanently damaged or destroyed. In addition, because electrical burns are deep, bone tissue may also be damaged. The skin is often permanently damaged or destroyed. The skin appears dry and leathery with the possibility of a charred appearance, or patches of white, brown, or black. Most electrical burns are third degree and must be treated by a trained healthcare professional.

- There are three common types of burns caused by electricity:
  - **Electrical burns** are among the most serious burns and require immediate medical attention. They occur when electric current flows through tissues or bone, generating heat, and causing damage.
Burns (cont.)

- **Entrance Wound:** Because skin is an insulator, it transforms electrical energy into heat, which produces burns around the entrance point (dark spot in center of wound).

- **Exit Wound:** Current flows through the body from the entrance point, until finally exiting where the body is closest to the ground. This foot suffered massive internal injuries, which weren't readily visible, and had to be amputated a few days later.

- **Arc or flash burns** result from high temperatures caused by an electric arc or explosion near the body.

- An example of an arc flash is a lightning bolt. The electrical current travels through air. This type of arc flash generates enough heat to melt metal. The same process can happen with any electrical device. In fact, cauterization tools are used to create arc flashes that the surgeon can use to intentionally fuse tissue. When an arc flash is not intended, a burn injury burn is the result.
Thermal contact burns are caused when the skin touches hot surfaces of overheated electric conductors, conduits, or other energized equipment. Thermal burns also can be caused when clothing catches on fire, as may occur when an electric arc is produced.
Electrocution

- The first E in the BE SAFE acronym stands for electrocution.
- Electrocution means to injure or kill with electricity and occurs when a person is exposed to harmful amount of electrical energy.
- Healthcare workers may treat individuals who have been electrocuted in industrial accidents. In 2014, 141 people died from electrocution. Construction workers have the highest risk for electrocution. While healthcare workers have a low risk of electrocution, there is always a risk of shock from electrically powered healthcare equipment used to treat patients.
The S in the BE SAFE acronym stands for shock. Electrical shock is the body’s reflex response when electric current passes through the human body. Electrical shock happens when electric current enters the body at one point and leaves through another.

While most healthcare professionals think of shock as a decrease in blood or fluid supply (hypovolemic shock) that renders the heart unable to pump enough blood through the body, shock can also refer to the physiological reaction or injury caused by electric current passing through the human body. Electric shock can have minimal effects or can be life threatening, depending on the amount of current encountered and the length of contact.

For the purposes of this module, when we refer to shock, it will be in reference to electrical contact rather than related to blood flow. Electricity travels in closed circuits, or loops, and normally through a conductor. Shock, from electricity, happens when the body becomes part of the electrical circuit.
Electrical Shock (cont.)

- Typically, electrical shock may occur when a person makes contact with a circuit in one of three ways:
  - Both wires of an energized circuit. For example, when a second person touches the skin as a defibrillator is applied.
  - One wire of an energized circuit and the ground. Examples: Incorrectly applied muscle stimulation electrodes, unknowingly holding an exposed wire from a cord in a medical device, or pulling an electrical cord from a receptacle by holding an area of the cord with insulation damage and exposed wiring – even when there are very small pieces of missing or damaged insulation.
  - A metallic part in contact with an energized wire while the person is also in contact with the ground. Example: A surgeon is using a cauterization tool and does not realize that the casing and insulation is damaged.
Arc Flash

- The A in the BE SAFE acronym stands for arc flash. An arc flash is the sudden release of electrical energy through the air that gives off thermal energy, or heat, and bright, intense light that can cause burns. Temperatures have been recorded as high as 35,000 °F. A lightning bolt is an example of an arc flash. Let’s now look at examples of where you might encounter arc flashes in a healthcare setting.

- Two sources of an arc flash in a hospital setting are; the circuit breaker box, and a medical cauterization device.
Arc Flash (cont.)

- **Circuit Breaker Boxes:** There are multiple circuits within a building and each of those circuits can be deenergized by turning off the corresponding switch in a breaker box. The breaker switches can turn off, or trip to the off position, if there is an electrical problem in the circuit. An overload on the circuit is an example.
  - If a circuit is tripped in the breaker box, DO NOT attempt to reset it – rather, immediately contact a supervisor to report that situation. If a switch is flipped to the off position, someone may be working on an electrical device located in that specific circuit, or there may be an electrical short or exposed wire that could potentially create an arc flash. To avoid accidental electrocution, never attempt to open a breaker box, always contact a supervisor.

- Later in this module, in the lockout/tagout procedure, you will see how to avoid accidental electrocution caused by miscommunications about wires being energized or deenergized.
Electrocautery Devices: Background Information:
Electrocautery devices generate an arc flash to cauterize, or fuse, tissue. Cauterization helps control bleeding during surgery.

- There are two types of cauterization tools; one that operates in a monopolar mode and another that operates in a bipolar mode. In a monopolar mode, there is a single electrode, or prong, on the cauterization tool and the arc flash can move through the patient. A grounding pad is used beneath the patient to ground the electricity, or provide another path to exit. The bipolar mode, on the other hand, contains the arc flash between two probes and it is grounded so a patient grounding pad is not necessary.

- More accidental injuries from electrical shock are reported for the monopolar than for the dipolar tool, partly because of the patient grounding pad that is necessary to ground electrical current.
An arc flash is a hot, loud, bright blast of energy with a large amount of outward directed force. There are three kinds of energy released during an arc flash and each of these pose electricity hazards:

- **Thermal Energy:** An arc flash gives off a lot of thermal energy, and intense light; that can cause burns. Additionally, a high-voltage arc can also cause many of the copper and aluminum components in electrical equipment to melt.
  - Metal can melt and be thrown distances greater than 10 feet.
  - Serious burns to skin can result, and clothing may catch fire—even at a distance of 10 feet or more.
  - Reaching temperatures of up to 35,000 degrees Fahrenheit, an arc flash can vaporize copper metal.

- **Acoustic Energy**
  - Part of the energy is carried as a sound wave, called an acoustic wave.
  - As the acoustic wave moves through the air, we hear a sound.
Arc Flash (cont.)

- **Pressure Wave**: A high-voltage arc can produce a considerable pressure wave blast.
  - A person 2 feet away from a 25,000-amp arc feels a force of about 480 pounds on the front of the body.
  - A concussion can occur, resulting in serious ear damage and memory loss.
  - The pressure wave created from an arc flash can throw a victim several feet, causing serious physical injury.
  - In some cases, the pressure wave has enough force to snap off the heads of steel bolts and knock over walls.
The F in the BE SAFE acronym stands for Fire. Fire can be caused by fixed wiring—electrical wires inside the walls of buildings—especially when the wires are old or the outlets are faulty. Fire can also be caused by flexible wiring such as extension cords, appliance cords, or by plugs, receptacles, and switches.

Real life scenario: About 3 o’clock this morning, firefighters responded to a hospital fire. While the fire was limited to one room and there were no injuries, there was about $5,000 worth of damage to structures. It was determined that electrical wiring from the mini-refrigerator to the wall receptacle was the cause of the fire.
Explosions

- The second E in the BE SAFE acronym stands for explosions. Explosions can occur when electricity ignites explosive gases in the air, such as pure oxygen, methane or natural gas. Oxygen is flammable and oxygen tanks can explode if the gas is ignited.
- In one case, an oxygen tank exploded in a hospital and the sound of the blast was heard up to three floors away. A nurse was critically injured, and at least two patients were treated for smoke inhalation and other injuries.
Employers Protecting Workers

- OSHA has standards and regularly inspects workplace environments for violations of those standards. Employers are required to follow standards in order to protect workers from electrocution.

- Consider all the exposed or operating elements in an electric installation:
  - Lighting found throughout the healthcare environment.
  - Equipment such as electric hand tools in a dental office or an oxygen machine that checks blood pressure, pulse, and oxygen saturation.
  - Motors found in patient lifts, beds, or in a laboratory centrifuge.
  - Machines such as mobile X-ray, ultrasound devices, autoclaves, etc.
  - Appliances such as freezers or refrigerators used in clinical practice for ice therapy, etc.
  - Switches used with the hospital generator.
  - Controls on equipment and machinery in the healthcare environment.
  - Enclosures or boxes found in specialty areas such as emergency.
Employers Protecting Workers (cont.)

- There are biomedical equipment technicians whose job is to work on healthcare equipment and machines. They have been trained in the safety aspects of the equipment and are responsible for their maintenance and replacement. As a healthcare employee, one must be aware of the risks associated with medical equipment.
Contact with Power Lines and Energized Source

- People who come in contact with high voltage power lines can be injured and may die due to electrocution. Healthcare workers, such as first responders, are most likely to face these types of hazards as they work in the field.
- Some overhead power lines have a protective covering that protects power lines from exposure to the elements. However, the covering does not protect workers from electrocution. If you touch a power line, covered or bare, death is probable.
- Touching or grabbing powerlines, even downed power lines, is not safe. If death does not result from touching a powerline, severe injuries are probable.
Many accidents occur because workers fail to lockout/tagout equipment properly. Lockout/tagout is an essential safety procedure that protects workers from injury while working on or near electrical circuits and equipment:

- Locks the device or power source and prevents anyone from turning on the hazardous power sources while someone is performing maintenance or servicing work.
- Requires workers to place a tag on the locked device indicating that it should not be turned on. When using a tag, other energy isolation techniques may be necessary to maintain worker safety.
- Prevents contact with operating equipment parts such as, blades, gears, shafts, etc.
- Prevents the unexpected release of hazardous gases, fluids, or solid matter in areas where workers are present.
Lockout/Tagout (cont.)

- When performing lock-out/tag-out on circuits and equipment, use the following checklist. Remember---these procedures are used ONLY by trained electricians. As a healthcare worker, you only need to be aware of this information, for your safety and the safety of others.
  - Identify all sources of electrical energy for the equipment or circuits in question.
  - Disable backup energy sources such as generators and batteries.
  - Identify all shut-offs for each energy source.
  - Notify all personnel that equipment and circuitry must be shut off, locked out, and tagged out. (Simply turning a switch off is NOT enough.)
  - Shut off energy sources and lock switchgear in the OFF position. Each worker should apply his or her individual lock. Do not give your key to anyone.
Lockout/Tagout (cont.)

- Test equipment and circuitry to make sure they are deenergized. This must be done by a qualified person.
- Deplete stored energy (for example, in capacitors) by bleeding, blocking, grounding, etc.
- Apply a tag to alert other workers that an energy source or piece of equipment has been locked out.
- Make sure everyone is safe and accounted for before equipment and circuits are unlocked and turned back on.

- Note that only a qualified person may determine when it is safe to re-energize circuits. OSHA defines a “qualified person” as someone who has received mandated training on the hazards and on the construction and operation of equipment involved in a task.
OSHA standards and recommendations for safety around electricity, have been instrumental in reducing the number of individuals injured from electric shock over the past 20 years.

Injury or death from electrical shock is devastating to everyone involved. It must, therefore, to be taken very seriously by anyone who works around any type of electrical devices.

Healthcare workers must be able to recognize and to understand basic information about an electrical device called a Ground Fault Circuit Interrupter (GFCI).

A Ground Fault Circuit Interrupter (GFCI) is designed to
- Protect people from severe and sometimes fatal electrocution by Monitoring for electrical leakage to ground.
- Detect when the current leakage is greater than 5 mA.
Using Ground Fault Circuit Interrupters (cont.)

- Interrupt the flow of electric current by tripping quickly enough to prevent electrocution from leakage.
- In a case where electrical current leakage from the circuit occurs, the GFCI would:
  - Sense the current flowing through the client/patient worker.
  - Trip the circuit.
  - Cut off the electricity.

- Healthcare professionals should test GFCI's monthly using the "test" button.
- Although they occur infrequently, serious injuries and death to children due to electrocution from medical devices during hospitalization have been reported. The most frequent cause of patient electrocution in the healthcare workplace has been due to connecting the lead wires of electrodes, and other medical devices, into energized sources like extension cords or other equipment, rather than into the appropriate device.
**GFCI**

- A ground-fault occurs when there is a break in the low-resistance grounding path from a tool or electrical system. The electrical current may then take an alternative path to the ground through the user, resulting in serious injuries or death. The ground-fault circuit interrupter, or GFCI, is a fast-acting circuit breaker designed to shut off electric power in the event of a ground-fault within as little as 1/40 of a second. It works by comparing the amount of current going to and returning from equipment along the circuit conductors. When the amount going differs from the amount returning by approximately 5 milliamps, the GFCI interrupts the current.

- The GFCI is rated to trip quickly enough to prevent an electrical incident. If it is properly installed and maintained, this will happen as soon as the faulty tool is plugged in. If the grounding conductor is not intact or of low voltage, the GFCI may not trip until a person provides a path. In this case, the person will receive a shock, but the GFCI should trip so quickly that the shock will not be harmful.
The GFCI will not protect you from line contact hazards (i.e. a person holding two "hot" wires, a hot and a neutral wire in each hand, or contacting an overhead power line). However, it protects against the most common form of electrical shock hazard, the ground-fault. It also protects against fires, overheating, and destruction of wire insulation.
What protection does insulation provide?
- Insulators such as glass, mica, rubber, or plastic used to coat metals and other conductors help stop or reduce the flow of electrical current. This helps prevent shock, fires, and short circuits.
- To be effective, the insulation must be suitable for the voltage used and conditions such as temperature and other environmental factors like moisture, oil, gasoline, corrosive fumes, or other substances that could cause the insulator to fail.
- Insulation is found on flexible wiring, electrical cords, and various medical devices used during surgery or patient treatment.

What is grounding and what protection does it offer?
- “Grounding” a tool or electrical system means intentionally creating a low-resistance path that connects to the earth. This prevents the buildup of voltages that could cause an electrical accident.
Grounding is normally a secondary protective measure to protect against electric shock. It does not guarantee that you won’t get a shock or be injured or killed by an electrical current. It will, however, substantially reduce the risk, especially when used in combination with other safety measures.

An equipment ground helps protect the equipment operator. It furnishes a second path for the current to pass through from the tool or machine to the ground.

This additional ground safeguards the operator if a malfunction causes the tool’s metal frame to become energized. The resulting flow of current may activate the circuit protection devices.

Examples of grounded equipment used in a healthcare setting are; motors found in patient’s beds and other medical equipment like cauterization devices.
What are circuit protection devices and how do they work?

What we do at home is not appropriate for the workplace. For example, if we are using a hair dryer at home, if the GFCI trips, we simply re-set it. However, if any switch or circuit protection device is tripped in the workplace, do not attempt to re-set the switch. Circuit protection devices limit or stop the flow of current automatically in the event of a ground fault, overload, or short circuit in the wiring system. Well-known examples of these devices are fuses, circuit breakers, ground-fault circuit interrupters, and arc-fault circuit interrupters.

Fuses and circuit breakers open or break the circuit automatically when too much current flows through them. When that happens, fuses melt and circuit breakers trip the circuit open.
Fuses and circuit breakers are designed to protect conductors and equipment. They prevent wires and other components from overheating and open the circuit when there is a risk of a ground fault. NEVER attempt to modify a fuse or circuit breaker; leave that task for the trained electricians.

In healthcare, ground-fault circuit interrupters, or GFCIs, are used in wet locations, and other high-risk areas, like whirlpool therapeutic stations. GFCIs interrupt the flow of electricity within as little as 1/40 of a second to prevent electrocution.

GFCIs compare the amount of current going into electric equipment to the amount of current returning from it along the circuit conductors. If the difference is greater than 5 milliamperes, current is leaking and the device automatically shuts off the electric power.
What work practices help protect you against electrical hazards?

- Electrical accidents are largely preventable through safe work practices. Examples of these practices include the following:
  - Deenergizing electric equipment before inspection or repair.
  - Inspecting medical devices for damage.
  - Using equipment that is provided to meet OSHA standards.
  - Removing cords from receptacles by pulling on the plugs, not the cords.
  - Inspecting three prong plugs to ensure that the third prong – the ground prong – is not damaged or missing.
  - Standing on dry floors while using any electrical device.
Protect Yourself and Others from Electrocuton Hazards (cont.)

- Inspecting flexible wiring and extension cords for any damaged or missing insulation.
- Using dry hands when handling electrical equipment or any electrical cords.
- Exercising caution when working near energized lines.
- Using appropriate protective equipment.

How can you protect yourself against metal parts that become energized?

◦ A break in a medical tool’s insulation can cause its metal parts to become “hot” or energized, meaning that they conduct electricity. Touching these energized parts can result in an electrical shock, burn, or electrocution.
The best way to protect yourself when using electrical tools or machines is to establish a low-resistance path from the device’s metallic case to the ground. The electrical equipment should be electrically grounded.

A properly installed grounding conductor has a low resistance to ground and greatly reduces the amount of current that passes through your body. Cord and plug equipment with a three-prong plug is a common example of equipment incorporating this ground conductor.

Examples of tools that may electrocute or burn unintended contact include: surgical tools, laser scalpels, and cauterizing tools.
How can you prevent an accidental or unexpected equipment startup?

- Proper lockout/tagout procedures protect you from the dangers of the accidental or unexpected startup of electrical equipment. These procedures ensure that electrical equipment is deenergized before it is repaired or inspected and protects you against electrocution or shock.

- Only qualified electricians who have been trained in safe lockout procedures should maintain electrical equipment.
What special training do employees need?

All employees should be trained to be thoroughly familiar with the safety procedures for their particular jobs and the equipment they may use. Moreover, good judgment and critical thinking are essential for preventing electrical accidents. When working on electrical equipment, for example, some basic procedures to follow are:

- deenergize the equipment
- use lockout/tagout procedures to ensure that the equipment remains deenergized
- use insulating protective equipment
- maintain a safe distance from energized parts
Protect Yourself and Others from Electrocution Hazards (cont.)

What’s the value of a safety and health program in controlling electrical hazards?

◦ Every good safety and health program provides measures to control electrical hazards. The measures suggested in this module should be helpful in such a program.

◦ A health and safety coordinator is responsible for developing and implementing policies and procedures about potential electrical hazards according to OSHA standards.

◦ Everyone has the right to work in a safe environment. Safety and health add value to the workplace. Through cooperative efforts, employers and employees can learn to identify and eliminate or control electrical hazards.
Inspected Power Cords, Extension Cords, and Portable Tools

- Here are some descriptions for inspecting power cords, including those on portable tools, and extension cords:
  - **Overloads**: Do not overload circuits.
  - **Check switches and insulation**: Tools and other equipment must operate properly. Make sure that switches and insulating parts are in good condition.
  - **Three-prong Plugs**: Never use a three-prong grounding plug with the third prong broken-off. When using tools that require a third-wire ground, use only three-wire extension cords with three-prong grounding plugs and three-hole electrical outlets. Never remove the grounding prong from a plug! You could be shocked or expose someone else to a hazard. If you see a cord without a grounding prong in the plug, remove the cord from service immediately.
Inspecting Power Cords, Extension Cords, and Portable Tools (cont.)

- **Cords**: Remove cords from receptacles by pulling on the plugs, not the cords.
- **Extension Cords**: Use extension cords properly. If an extension cord must be used, choose one with sufficient ampacity for the tool being used. An undersized cord can overheat and cause a drop in voltage and tool power. Make sure the insulation is intact. To reduce the risk of damage to a cord's insulation, use cords with insulation marked "S" (hard service) rather than cords marked "SJ" (junior hard service). Make sure the grounding prong is intact. In damp locations, make sure wires and connectors are waterproof and approved for such locations. Do not create a tripping hazard.