Electrical Hazards (1)

Fasteners

When using powder-actuated tools to apply fasteners, there are some precautions to consider. Fasteners must not be fired into material that would let them pass through to the other side. The fastener must not be driven into materials like brick or concrete any closer than 3 inches to an edge or corner. In steel, the fastener must not come any closer than one-half inch from a corner or edge. Fasteners must not be driven into very hard or brittle materials which might chip or splatter, or make the fastener ricochet.

An alignment guide must be used when shooting a fastener into an existing hole. A fastener must not be driven into a spalled area caused by an unsatisfactory fastening.

Hydraulic Power Tools

The fluid used in hydraulic power tools must be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed.

The manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

Jacks

All jacks - lever and ratchet jacks, screw jacks, and hydraulic jacks - must have a device that stops them from jacking up too high. Also, the manufacturer's load limit must be permanently marked in a prominent place on the jack and should not be exceeded.

A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up.

Use wooden blocking under the base if necessary to make the jack level and secure. If the lift surface is metal, place a 1-inch-thick hardwood block or equivalent between it and the metal jack head to reduce the danger of slippage.

To set up a jack, make certain of the following:

- the base rests on a firm level surface,
- the jack is correctly centered,
- the jack head bears against a level surface, and
- the lift force is applied evenly.

Proper maintenance of jacks is essential for safety. All jacks must be inspected before each use and lubricated regularly. If a jack is subjected to an abnormal load or shock, it should be thoroughly examined to make sure it has not been damaged.

Hydraulic jacks exposed to freezing temperatures must be filled with adequate antifreeze liquid.

General Safety Precautions


Courtesy of Wikipedia

Employees who use hand and power tools and who are exposed to the hazards of falling, flying, abrasive and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases must be provided with the particular personal equipment necessary to protect them from the hazard.

All hazards involved in the use of power tools can be prevented by following five basic safety rules:

- Keep all tools in good condition with regular maintenance.
- Use the right tool for the job.
- Examine each tool for damage before use.
- Operate according to the manufacturer's instructions.
- Provide and use the proper protective equipment.

Employees and employers have a responsibility to work together to establish safe working procedures. If a hazardous situation is encountered, it should be brought to the attention of the proper individual immediately.

Wet conditions hazards

Working in wet conditions is hazardous because you may become an easy path for electrical current. If you touch a live wire or other electrical component—and you are well-grounded because you are standing in even a small puddle of water—you will receive a shock.

Damaged insulation, equipment, or tools can expose you to live electrical parts. A damaged tool may not be grounded properly, so the housing of the tool may be energized, causing you to receive a shock. Improperly grounded metal switch plates and ceiling lights are especially hazardous in wet conditions. If you touch a live electrical component with an uninsulated hand tool, you are more likely to receive a shock when standing in water. But remember: you don't have to be standing in water to be electrocuted. Wet clothing, high humidity, and perspiration also increase your chances of being electrocuted. ***You need to recognize that all wet conditions are hazards.***

All of these situations need to be recognized as hazards.

You need to be able to recognize that electrical shocks, fires, or falls result from these hazards:

- Inadequate wiring
- Exposed electrical parts
- Overhead powerlines
- Defective insulation
- Improper grounding
- Overloaded circuits
- Wet conditions
- Damaged tools and equipment
- Improper PPE

Safety Model Stage 2—Evaluating Hazards

How Do You Evaluate Your Risk?

After you recognize a hazard, your next step is to evaluate your risk from the hazard. Obviously, exposed wires should be recognized as a hazard. If the exposed wires are 15 feet off the ground, your risk is low. However, if you are going to be working on a roof near those same wires, your risk is high. The risk of shock is greater if you will be carrying metal conduit that could touch the exposed wires. You must constantly evaluate your risk.

Combinations of hazards increase your risk. Improper grounding and a damaged tool will greatly increase your risk. Wet conditions combined with other hazards also increase your risk. You will need to make decisions about the nature of hazards in order to evaluate your risk and do the right thing to remain safe. There are “clues” that electrical hazards exist. For example, if a GFCI keeps tripping while you are using a power tool, there is a problem. Don’t keep resetting the GFCI and continue to work. You must evaluate the “clue” and decide what action should be taken to control the hazard. There are a number of other conditions that indicate a hazard.

*Any of these conditions, or **“clues,”** tells you something important: there is a risk of fire and electrical shock. The equipment or tools involved must be avoided. You will frequently be caught in situations where you need to decide if these clues are present. A maintenance electrician, supervisor, or instructor needs to be called if there are signs of overload and you are not sure of the degree of risk. Ask for help whenever you are not sure what to do. By asking for help, you will protect yourself and others.*

- Tripped circuit breakers and blown fuses show that too much current is flowing in a circuit. You need to determine the cause in order to control the hazard.
- An electrical tool, appliance, wire, or connection that feels warm may indicate too much current in the circuit or equipment. You need to evaluate the situation and determine your risk.
- An extension cord that feels warm may indicate too much current for the wire size of the cord. You must decide when action needs to be taken.
- A cable, fuse box, or junction box that feels warm may indicate too much current in the circuits.
- A burning odor may indicate overheated insulation.
- Worn, frayed, or damaged insulation around any wire or other conductor is an electrical hazard because the conductors could be exposed. You need

to evaluate the seriousness of any damage you find and decide how to deal with the hazard.

- A GFCI that trips indicates there is current leakage from the circuit. First, you must decide the probable cause of the leakage by recognizing any contributing hazards. Then, you must decide what action needs to be taken.

An 18-year-old male worker, with 15 months of experience at a fast food restaurant, was plugging a toaster into a floor outlet when he received a shock. Since the restaurant was closed for the night, the floor had been mopped about 10 minutes before the incident. The restaurant manager and another employee heard the victim scream and investigated. The victim was found with one hand on the plug and the other hand grasping the metal receptacle box. His face was pressed against the top of the outlet. An employee tried to take the victim's pulse but was shocked. The manager could not locate the correct breaker for the circuit. He then called the emergency squad, returned to the breaker box, and found the correct breaker. By the time the circuit was opened (turned off), the victim had been exposed to the current for 3 to 8 minutes. The employee checked the victim's pulse again and found that it was very rapid.

The manager and the employee left the victim to unlock the front door and place another call for help. Another employee arrived at the restaurant and found that the victim no longer had a pulse. The employee began administering CPR, which was continued by the rescue squad for 90 minutes. The victim was dead on arrival at a local hospital.

Later, two electricians evaluated the circuit and found no serious problems. An investigation showed that the victim's hand slipped forward when he was plugging in the toaster. His index finger made contact with an energized prong in the plug. His other hand was on the metal receptacle box, which was grounded. Current entered his body through his index finger, flowed across his chest, and exited through the other hand, which was in contact with the grounded receptacle. To prevent death or injury, you must recognize hazards and take the right action.

Safety Model Stage 3—Controlling Hazards: Safe Work Environment

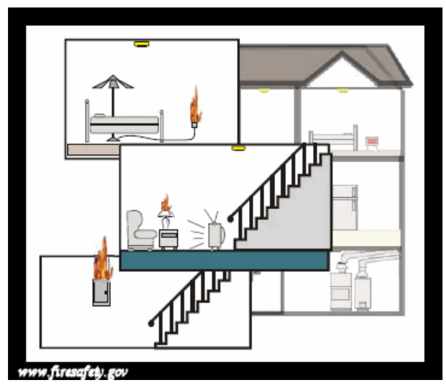
How Do You Control Hazards?

In order to control hazards, you must first create a safe work environment then work in a safe manner. Generally, it is best to remove the hazards altogether and create an environment that is truly safe.

When OSHA regulations and the NEC are followed, safe work environments are created. But, you never know when materials or equipment might fail. Prepare yourself for the unexpected by using safe work practices. Use as many safeguards as possible. If one fails, another may protect you from injury or death.

How Do You Create a Safe Work Environment?

A safe work environment is created by controlling contact with electrical voltages and the currents they can cause. Electrical currents need to be controlled so they do not pass through the body. In addition to preventing shocks, a safe work environment reduces the chance of fires, burns, and falls.



You need to guard against contact with electrical voltages and control electrical currents in order to create a safe work environment. Make your environment safer by doing the following:

- Treat all conductors—even "de-energized" ones—as if they are energized until they are locked out and tagged.
- Lock out and tag out circuits and machines.
- Prevent overloaded wiring by using the right size and type of wire.
- Prevent exposure to live electrical parts by isolating them.
- Prevent exposure to live wires and parts by using insulation.

- Prevent shocking currents from electrical systems and tools by grounding them.
- Prevent shocking currents by using GFCI's.
- Prevent too much current in circuits by using overcurrent protection devices.

Lock out and tag out circuits and equipment

Create a safe work environment by locking out and tagging out circuits and machines. Before working on a circuit, you must turn off the power supply. Once the circuit has been shut off and de-energized, lock out the switchgear to the circuit so the power cannot be turned back on inadvertently. Then, tag out the circuit with an easy-to-see sign or label that lets everyone know that you are working on the circuit. If you are working on or near machinery, you must lock out and tag out the machinery to prevent startup. Before you begin work, you must test the circuit to make sure it is de-energized.

Lock-Out/Tag-Out Checklist

Lock-out/tag-out is an essential safety procedure that protects workers from injury while working on or near electrical circuits and equipment. Lock-out involves applying a physical lock to the power source(s) of circuits and equipment after they have been shut off and de-energized. The source is then tagged out with an easy-to-read tag that alerts other workers in the area that a lock has been applied.

In addition to protecting workers from electrical hazards, lock-out/tag-out prevents contact with operating equipment parts: blades, gears, shafts, presses, etc. Also, lock-out/tag-out prevents the unexpected release of hazardous gasses, fluids, or solid matter in areas where workers are present.

At about 1:45 a.m., two journeyman electricians began replacing bulbs and making repairs on light fixtures in a spray paint booth at an automobile assembly plant. The job required the two electricians to climb on top of the booth and work from above. The top of the booth was filled with pipes and ducts that restricted visibility and movement. Flashlights were required. The electricians started at opposite ends of the booth. One electrician saw a flash of light, but continued to work for about 5 minutes, then climbed down for some wire. While cutting the wire, he smelled a burning odor and called to the other electrician. When no one answered, he climbed back on top of the booth. He found his co-worker in contact with a single-strand wire from one of the lights. Needle-nose wire strippers were stuck in the left side of the victim's chest. Apparently, he had been stripping insulation from an improperly grounded 530-volt, single-strand wire when he contacted it with the stripper. In this case, the electricians knew they were working on energized circuits. The breakers in the booth's control panel were not labeled and the lock used for lock-out/tag-out was broken. The surviving electrician stated that locating the means to deenergize a circuit often takes more time than the actual job. The electrician would be alive today if the following rules had been observed.

- Always shut off circuits—then test to confirm that they are de-energized—before starting a job.
- Switchgear that shuts off a circuit must be clearly labeled and easy to access.
- Lock-out/tag-out materials must always be provided, and lock-out/tag-out procedures must always be followed.

When performing lock-out/tag-out on circuits and equipment, you can use the checklist below.

- 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.

- Test equipment and circuitry to make sure they are de-energized. This must be done by a qualified person.*
- Deplete stored energy 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.*

Control inadequate wiring hazards

Electrical hazards result from using the wrong size or type of wire. You must control such hazards to create a safe work environment. You must choose the right size wire for the amount of current expected in a circuit. The wire must be able to handle the current safely. The wire's insulation must be appropriate for the voltage and tough enough for the environment. Connections need to be reliable and protected.

Control hazards of fixed wiring

The wiring methods and size of conductors used in a system depend on several factors:

- Intended use of the circuit system
- Building materials
- Size and distribution of electrical load
- Location of equipment (such as underground burial)
- Environmental conditions (such as dampness)
- Presence of corrosives
- Temperature extreme

Fixed, permanent wiring is better than extension cords, which can be misused and damaged more easily. NEC requirements for fixed wiring should always be followed. A variety of materials can be used in wiring applications, including nonmetallic sheathed cable (Romex®), armored cable, and metal and plastic conduit. The choice of wiring material depends on the wiring environment and the need to support and protect wires.

Aluminum wire and connections should be handled with special care. Connections made with aluminum wire can loosen due to heat expansion and oxidize if they are not made properly. Loose or oxidized connections can create heat or arcing. Special clamps and terminals are necessary to make proper connections using aluminum wire. Antioxidant paste can be applied to connections to prevent oxidation.

Control hazards of flexible wiring – Corresponds to NEC Article 490

Electrical cords supplement fixed wiring by providing the flexibility required for maintenance, portability, isolation from vibration, and emergency and temporary power needs. Flexible wiring can be used for extension cords or power supply cords. Power supply cords can be removable or permanently attached to the appliance.

DO NOT use flexible wiring in situations where frequent inspection would be difficult, where damage would be likely, or where long-term electrical supply is needed. Flexible cords cannot be used as a substitute for the fixed wiring of a structure. Flexible cords must not be:

- Run through holes in walls, ceilings
- Run through doorways, windows, or similar openings (unless physically protected);
- Attached to building surfaces (except with a tension take-up device within 6 feet of the supply end);
- Hidden in walls, ceilings, or floors, or

A 29-year-old male welder was assigned to work on an outdoor concrete platform attached to the main factory building. He wheeled a portable arc welder onto the platform. Since there was not an electrical outlet nearby, he used an extension cord to plug in the welder. The male end of the cord had four prongs, and the female end was spring-loaded. The worker plugged the male end of the cord into the outlet. He then plugged the portable welder's power cord into the female end of the extension cord. At that instant, the metal case around the power cord plug became energized, electrocuting the worker. An investigation showed that the female end of the extension cord was broken. The spring, cover plate, and part of the casing were missing from the face of the female connector. Also, the grounding prong on the welder's power cord plug was so severely bent that it slipped outside of the connection. Therefore, the arc welder was not grounded. Normally, it would have been impossible to insert the plug incorrectly. But, since the cord's female end was damaged, the "bad" connection was able to occur. Do not let this happen to you. Use these safe practices:

- Thoroughly inspect all electrical equipment before beginning work.
- Do not use extension cords as a substitute for fixed wiring. In this case, a weatherproof receptacle should have been installed on the platform.
- Use connectors that are designed to stand up to the abuse of the job. Connectors designed for light-duty use should not be used in an industrial environment.

- Hidden in conduit or other raceways

The size of wire in an extension cord must be compatible with the amount of current the cord will be expected to carry. The amount of current depends on the equipment plugged into the extension cord Current Ratings (how much current a device needs to operate) are often printed on the nameplate. If a power rating is given, it is necessary to divide the power rating in watts by the voltage to find the cur-rent rating. For example, a 1,000-watt heater plugged into a 120-volt circuit will need almost 10 amps of current. Let's look at another example: A 1-horsepower electric motor uses electrical energy at the rate of almost 750 watts, so it will need a minimum of about 7 amps of current on a 120-volt circuit. But, electric motors need additional current as they startup or if they

stall, requiring up to 200% of the nameplate current rating. Therefore, the motor would need 14 amps. Add to find the total current needed to operate all the appliances supplied by the cord. Choose a wire size that can handle the total current.

American Wire Gauge (AWG) – Corresponds to NEC Articles 200-285

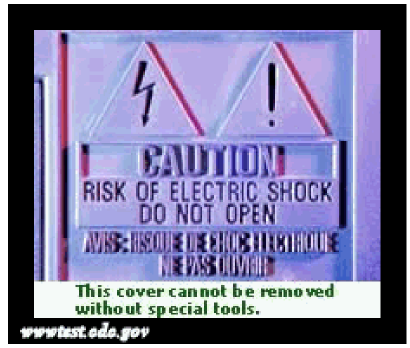
Remember: The ***larger*** the gauge number, the ***smaller*** the wire! The length of the extension cord also needs to be considered when selecting the wire size. Voltage drops over the length of a cord. If a cord is too long, the voltage drop can be enough to damage equipment. Many electric motors only operate safely in a narrow range of voltages and will not work properly at voltages different than the voltage listed on the nameplate. Even though light bulbs operate (somewhat dimmer) at lowered voltages, do not assume electric motors will work correctly at less-than-required voltages. Also, when electric motors start or operate under load, they require more current. The larger the size of the wire, the longer a cord can be without causing a voltage drop that could damage tools and equipment. The grounding path for extension cords must be kept intact to keep you safe. A typical extension cord grounding system has four components:

- a third wire in the cord, called a ground wire;
- a three-prong plug with a grounding prong on one end of the cord;
- a three-wire, grounding-type receptacle at the other end of the cord; and
- a properly grounded outlet.

Control hazards of exposed live electrical parts: isolate energized components

Electrical hazards exist when wires or other electrical parts are exposed. These hazards need to be controlled to create a safe work environment. Isolation of energized electrical parts makes them inaccessible unless tools and special effort are used. Isolation can be accomplished by placing the energized parts at least 8 feet high and out of reach, or by guarding. Guarding is a type of isolation that uses various structures—like cabinets, boxes, screens, barriers, covers, and partitions—to close-off live electrical parts.

Take the following precautions to prevent injuries from contact with live parts:



- Immediately report exposed live parts to a supervisor or teacher. As a student, you should never attempt to correct the condition yourself without supervision.
- Provide guards or barriers if live parts cannot be enclosed completely.
- Use covers, screens, or partitions for guarding that require tools to remove them.
- Replace covers that have been removed from panels, motors, or fuse boxes.
- Even when live parts are elevated to the required height (8 feet), care should be taken when using objects (like metal rods or pipes) that can contact these parts.
- Close unused conduit openings in boxes so that foreign objects (pencils, metal chips, conductive debris, etc.) cannot get inside and damage the circuit.