How to prevent injury

- Ask for a nail gun with a sequential trigger mechanism.
- **NEVER** shoot towards yourself or a co-worker.
- Do not press the trigger unless the nose of the gun (contact element) is firmly pressed against the work material.
- **NEVER** walk around with your finger on the trigger.
- **NEVER** clean or clear jams or adjust a nail gun when it is connected to the air supply.
- Avoid nailing into knots and metal; nails are more likely to ricochet. Dense materials, like laminated beams, are also difficult to nail.
- **NEVER** remove or bypass safety devices, triggers, or contact springs.
- **NEVER** use a defective tool. If a tool is malfunctioning, it needs to be tagged and taken out of service.

To read stories about nail gun injuries and see photos, visit
www.cpwr.com/nailguns

To learn more about CPWR, visit
www.cpwr.com

For more safety and health information, visit
www.elcosh.org

CPWR
8484 Georgia Ave. Suite 1000
Silver Spring, MD 20910
301-578-8500

 Production of this card was supported by Grant OH008307 from the National Institute for Occupational Safety and Health (NIOSH). The contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.

HAZARD ALERT

Nail Guns

Serious – even fatal – injuries are happening to workers using these tools.

What's the problem?

Nail guns are popular for a reason. They get the job done in a blink of an eye.

But that rapid-fire action can work against you. In a split second, a nail can enter your finger, your hand, or worse.

Nail gun injuries are much more common than people think. Most injuries involve puncture wounds to hands or fingers, but serious, even fatal, injuries are also associated with the use of these tools.

How most nail gun injuries happen

- Accidental or unintended firing, often associated with recoil of the tool after firing
- Ricocheting nails
- Nail going through work surface
- Airborne nails
- By-passed safety features
- Unsafe work practices
- Holding finger on contact trigger

Basic information about nail guns

Although there are many types of nail guns (framing, finishing, flooring, etc.), there are two common triggers:

Contact trip trigger mechanisms allow the tool to fire anytime the trigger and the nose of the gun (contact element) are both depressed. Trigger can be held down to allow bump or bounce nailing.

Sequential triggers require the nose of gun (contact element) to be depressed before the trigger is pulled. That avoids inadvertent discharge of nails.

WARNING:
The two triggers look exactly alike. You will not be able to tell the difference!

If you can "bump nail" by holding the trigger down, and bouncing the nose against a nailing surface, that is a contact trigger gun.
Use extreme caution.

Why it's important:

1) The **contact trip trigger mechanism carries twice the risk** of the sequential trigger, even after considering experience and training.

2) Accidental firings are most common following recoil of tools with contact trip triggers.

3) If **you are not trained** in using either of these tools, you are at high risk of injury.

"Faster" trigger does not increase productivity

A recent study measuring productivity in construction found that the contact trip trigger showed no significant difference (less than 1 percent) in productivity than the sequential trigger. Also, there was no significant difference between the two tools in nail count and placement.

The study, which involved journeymen carpenters with an average of 13 years in the trade, found that the **difference in productivity was the worker**, not the tool.

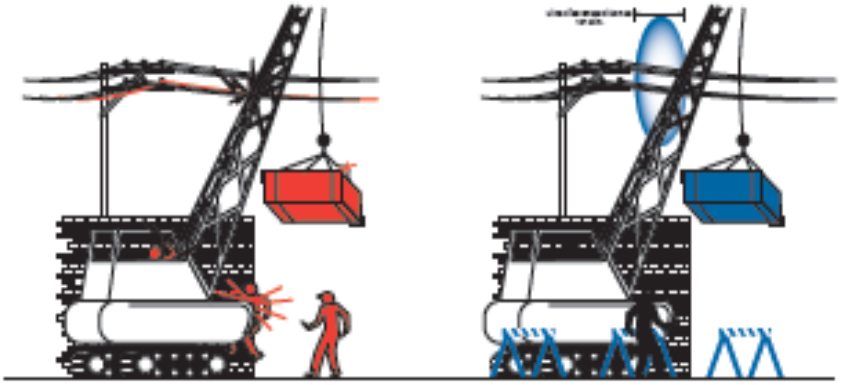
FOCUS

Cranes and rigging

Properly securing any load with appropriate rigging is crucial to any lifting being done by machinery on the job-site. If the rigging fails the results can cause serious injury and even death. Before any load is lifted all components of the rigging hardware should be evaluated to ensure they can withstand the forces of the load.

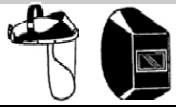
Follow these safe work practices

1. Guard all exposed gears, rotating shafts, pulleys, sprockets or other moving parts to prevent contact with employees.
2. Guard or block the swing radius of the crane to restrict and prevent employees from entering into and being struck by the machine.
3. Inspect all rigging equipment prior to each lift, this should include all slings, chains, ropes, and like materials used to support and lift materials.
4. Remove from service any defective equipment immediately.
5. Be sure to inspect all hooks, clamps, and other lifting accessories for their rated load.
6. Clearly communicate to all employees on site that no one is permitted to work under loads.
7. Be sure the person responsible for signaling the crane operator stays in visual contact with the operator and has been trained to use the correct signals.



WRONG WAY RIGHT WAY

PPE for Workers Checklist

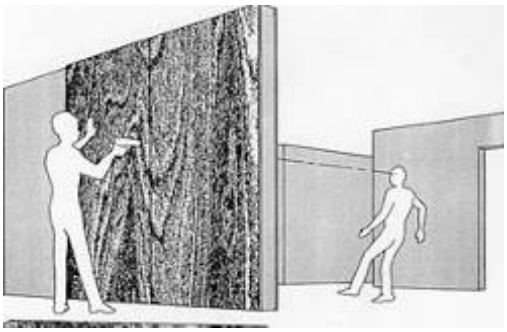
Protection	TYPICAL OPERATIONS OF CONCERN	YES	NO
EYE 	Sawing, cutting, drilling, sanding, grinding, hammering, chopping, abrasive blasting, punch press operations, etc.		
	Pouring, mixing, painting, cleaning, siphoning, dip tank operations, dental and health care services, etc.		
	Battery charging, installing fiberglass insulation, compressed air or gas operations, etc.		
	Welding, cutting, laser operations, etc.		
FACE 	Pouring, mixing, painting, cleaning, siphoning, dip tank operations, etc.		
	Welding, pouring molten metal, smithing, baking, cooking, drying, etc.		
	Cutting, sanding, grinding, hammering, chopping, pouring, mixing, painting, cleaning, siphoning, etc.		
HEAD 	Work stations or traffic routes located under catwalks or conveyor belts, construction, trenching, utility work, etc.		
	Construction, confined space operations, building maintenance, etc.		
	Building maintenance; utility work; construction; wiring; work on or near communications, computer, or other high tech equipment; arc or resistance welding; etc.		
FEET 	Construction, plumbing, smithing, building maintenance, trenching, utility work, grass cutting, etc.		
	Building maintenance; utility work; construction; wiring; work on or near communications, computer, or other high tech equipment; arc or resistance welding; etc.		
	Welding, foundry work, casting, smithing, etc.		
	Demolition, explosives manufacturing, grain milling, spray painting, abrasive blasting, work with highly flammable materials, etc.		
HANDS 	Grinding, sanding, sawing, hammering, material handling, etc.		
	Pouring, mixing, painting, cleaning, siphoning, dip tank operations, health care and dental services, etc.		
	Welding, pouring molten metal, smithing, baking, cooking, drying, etc.		
	Building maintenance; utility work; construction; wiring; work on or near communications, computer, or other high tech equipment; arc or resistance welding; etc.		
BODY 	Pouring, mixing, painting, cleaning, siphoning, dip tank operations, machining, sawing, battery charging, installing fiberglass insulation, compressed air or gas operations, etc.		
	Cutting, grinding, sanding, sawing, glazing, material handling, etc.		
	Welding, pouring molten metal, smithing, baking, cooking, drying, etc.		
	Pouring, mixing, painting, cleaning, siphoning, dip tank operations, etc.		
HEARING 	Machining, grinding, sanding, work near conveyors, pneumatic equipment, generators, ventilation fans, motors, punch and brake presses, etc. Samples shown are: ear muffs (left) and earplugs (right)		

NOTE: Pictures of PPE are intended to provide a small sample of what the protection gear may look like. They are not to scale nor are they inclusive of all protection gear required and/or that is available.

ACCIDENT REPORT
FATAL FACTS

ACCIDENT SUMMARY No. 2

Accident Type:	Struck by Nail
Weather Conditions:	N/A
Type of Company:	General Contractors
Size of Work Crew:	17
Union or Non-union:	Union
Worksite Inspection?:	No
Designated Competent Person on Site?:	No
Employer Safety and Health Program?:	No
Training and Education for Employees?:	No
Craft of Deceased Employee(s):	Carpenter
Age;Sex	22; Male
Time of the Job:	3:00 p.m.
Time at the Task	Unknown



BRIEF DESCRIPTION OF ACCIDENT

A carpenter apprentice was killed when he was struck in the head by a nail that was fired from a powder actuated tool. The tool operator, while attempting to anchor a plywood form in preparation for pouring a concrete wall, fired the gun causing the nail to pass through the hollow wall. The nail travelled some twenty-seven feet before striking the victim. The tool operator had never received training in the proper use of the tool, and none of the employees in the area were wearing personal protective equipment.

INSPECTION RESULTS

Section not listed on original

ACCIDENT PREVENTION RECOMMENDATIONS

_____
_____
_____
_____
_____
_____
_____
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_____
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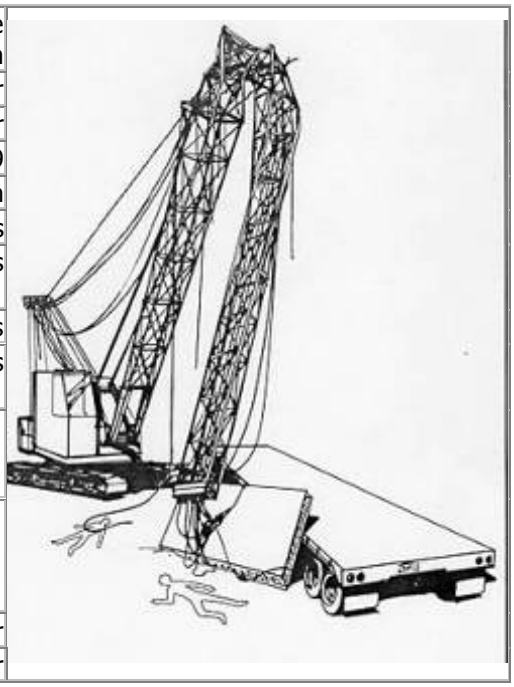
_____

NOTE: *The case here described was selected as being representative of fatalities caused by improper work practices. No special emphasis or priority is implied nor is the case necessarily a recent occurrence. The legal aspects of the incident have been resolved, and the case is now closed.*

ACCIDENT REPORT
FATAL FACTS

ACCIDENT SUMMARY No. 4

Accident Type:	Struck by Collapsing Crane Boom
Weather Conditions:	Clear
Type of Company:	General Contractor
Size of Work Crew:	9
Union or Non-union:	Union
Worksite Inspections Conducted:	Yes
Designated Competent Person on Site (1926.20(b)(2)):	Yes
Employer Safety Health Program:	Yes
Training and Education for Employees:	Yes
Craft of Deceased Employee(s):	3. Iron Worker 4. Management Trainee
Age & Sex	3. Ironworker-35; male 4. Management Trainee-26; male
Time on the Job:	1 hour
Time on Task:	1 hour



BRIEF DESCRIPTION OF ACCIDENT

A crew of ironworkers and a crane operator were unloading a 20-ton steel slab from a low-boy trailer using a 50-ton crawler crane with 90-foot lattice boom. The operator was inexperienced on this crane and did not know the length of the boom. Further, no one had determined the load radius. During lifting, the load moved forward and to the right, placing a twisting force on the boom. The boom twisted under the load, swinging down, under and to the right. Two employees standing 30 feet away apparently saw the boom begin to swing and ran. The boom struck one of the employees - an ironworker - on the head, causing instant death. Wire rope struck the other -- a management trainee -- causing internal injuries. He died two hours later at a local hospital.

INSPECTION RESULTS

Section not listed on original

ACCIDENT PREVENTION RECOMMENDATIONS

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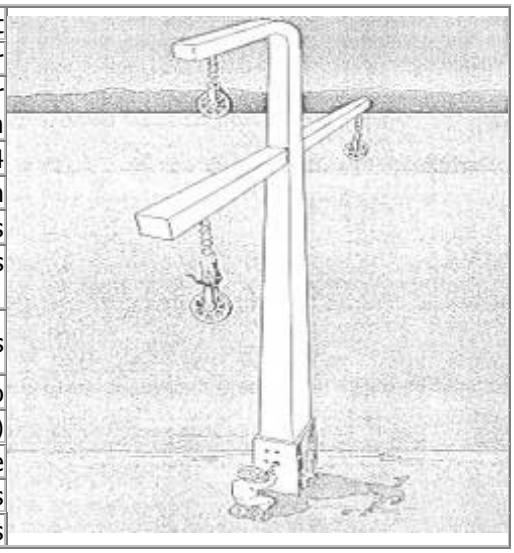
ACCIDENT REPORT
FATAL FACTS

ACCIDENT SUMMARY No. 8

Accident Type:	Struck by Falling Object
Weather Conditions:	Clear
Type of Operation:	Transmission Tower Construction
Size of Work Crew:	4
Union or Non-union	Union
Competent Safety Monitor on Site:	Yes
Safety and Health Program in Effect:	Yes
Was the Worksite Inspected Regularly:	Yes
Training and Education Provided:	No
Employee Job Title:	Groundman (Framer)
Age & Sex:	24-Male
Experience at this Type of Work:	2 Years
Time on Project:	3 Days



BRIEF DESCRIPTION OF ACCIDENT

Ball and socket connectors are used to attach conductor stringing blocks to insulators on the arms of 90 foot metal towers of electrical transmission lines. Normally stainless steel cotter keys secure the ball and socket connector in place. In this case, however, black electrical tape was wrapped around the socket to keep the ball in place rather than a cotter key. The tape apparently stretched and the ball came loose, dropping the stringing block approximately 90 feet onto the head of an employee below, one of a four-man erection crew.

INSPECTION RESULTS

As result of the its investigation, OSHA issued citations alleging three serious and two other-than-serious violations.

OSHA's construction safety standards include several requirements which, if they had been followed here, might have prevented this fatality.

ACCIDENT PREVENTION RECOMMENDATIONS

_____

_____

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_____

_____

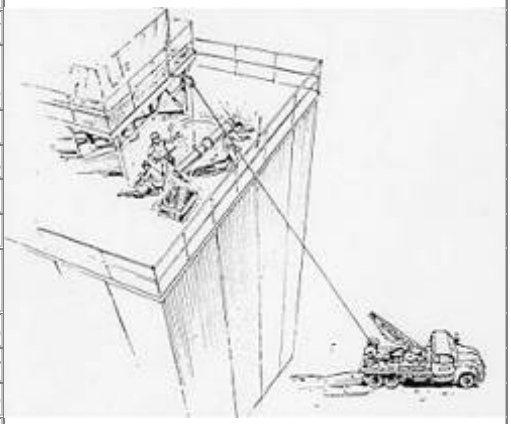
_____

NOTE: *The case here described was selected as being representative of fatalities caused by improper work practices. No special emphasis or priority is implied nor is the case necessarily a recent occurrence. The legal aspects of the incident have been resolved, and the case is now closed.*

ACCIDENT REPORT
FATAL FACTS

ACCIDENT SUMMARY No. 51

Accident Type:	Struck By
Weather Conditions:	Clear/Cool/Windy
Type of Operation:	Construction Maintainence
Size of Work Crew:	3
Collective Bargaining	Yes
Competent Safety Monitor on Site:	No
Safety and Health Program in Effect:	No
Was the Worksite Inspected Regularly:	Inadequate*
Training and Education Provided:	No
Employee Job Title:	Laborer
Age & Sex:	33-Male
Experience at this Type of Work:	18 Weeks
Time on Project:	1 Day



BRIEF DESCRIPTION OF ACCIDENT

Employees were dismantling grain spouts at a grain elevator. Sections of the spout were connected by collars. A ten foot section of a spout weighing 600 pounds was being pulled through a vent hole by a 5-ton winch. As the spout was being pulled through the opening to the outside, the spout became wedged at the point where the collar was to pass through. Several employees used pry bars to free the collar which was under tension. The spout popped out of the vent striking and killing an employee who was standing beside the spout. * Employer provided but did not require use of hard hats.

INSPECTION RESULTS

As a result of its investigation, OSHA issued two citations alleging serious violations. The employee should have been able to recognize that this situation was hazardous. Additionally, the investigation revealed that this employee was not wearing personal protective equipment in this hazardous situation. Had he been wearing a hard hat this death might have been prevented.

ACCIDENT PREVENTION RECOMMENDATIONS

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NOTE: *The case here described was selected as being representative of fatalities caused by improper work practices. No special emphasis or priority is implied nor is the case necessarily a recent occurrence. The legal aspects of the incident have been resolved, and the case is now closed.*

UNITED STATES
DEPARTMENT OF LABOR

Worker Safety Series
Warehousing

Think Safety

- More than 145,000 people work in over 7,000 warehouses.
- The fatal injury rate for the warehousing industry is higher than the national average for all industries.
- Potential hazards for workers in warehousing:
  - Unsafe use of forklifts;
  - Improper stacking of products;
  - Failure to use proper personal protective equipment;
  - Failure to follow proper lockout/tagout procedures;
  - Inadequate fire safety provisions; or
  - Repetitive motion injuries.

Think Safety Checklists

The following checklists may help you take steps to avoid hazards that cause injuries, illnesses and fatalities. As always, be cautious and seek help if you are concerned about a potential hazard.

General Safety

- Exposed or open loading dock doors and other areas that employees could fall 4 feet or more or walk off should be chained off, roped off or otherwise blocked.
- Floors and aisles are clear of clutter, electrical cords, hoses, spills and other hazards that could cause employees to slip, trip or fall.
- Proper work practices are factored into determining the time requirements for an employee to perform a task.
- Employees performing physical work have adequate periodic rest breaks to avoid fatigue levels that could result in greater risk of accidents and reduced quality of work.
- Newly-hired employees receive general ergonomics training and task-specific training.
- The warehouse is well ventilated.
- Employees are instructed on how to avoid heat stress in hot, humid environments.
- Employees are instructed on how to work in cold environments.
- The facility has lockout/tagout procedures.

Materials Handling Safety

- There are appropriately marked and sufficiently safe clearances for aisles and at loading docks or passageways where mechanical handling equipment is used.
- Loose/unboxed materials which might fall from a pile are properly stacked by blocking, interlocking or limiting the height of the pile to prevent falling hazards.

- Bags, containers, bundles, etc. are stored in tiers that are stacked, blocked, interlocked and limited in height so that they are stable and secure to prevent sliding or collapse.
- Storage areas are kept free from accumulation of materials that could lead to tripping, fire, explosion or pest infestations.
- Excessive vegetation is removed from building entrances, work or traffic areas to prevent possible trip or fall hazards due to visual obstructions.
- Derail and/or bumper blocks are provided on spur railroad tracks where a rolling car could contact other cars being worked on and at entrances to buildings, work or traffic areas.
- Covers and/or guardrails are provided to protect personnel from the hazards of stair openings in floors, meter or equipment pits and similar hazards.
- Personnel use proper lifting techniques.
- Elevators and hoists for lifting materials/ containers are properly used with adequate safe clearances, no obstructions, appropriate signals and directional warning signs.

Hazard Communication Safety

- All hazardous materials containers are properly labeled, indicating the chemical's identity, the manufacturer's name and address, and appropriate hazard warnings.
- There is an updated list of hazardous chemicals.
- The facility has a written program that covers hazard determination, including Material Safety Data Sheets (MSDSs), labeling and training.
- There is a system to check that each incoming chemical is accompanied by a MSDS.
- All employees are trained in the requirements of the hazard communication standard, the chemical hazards to which they are exposed, how to read and understand a MSDS and chemical labels, and on what precautions to take to prevent exposure.
- All employee training is documented.
- All outside contractors are given a complete list of chemical products, hazards and precautions.
- Procedures have been established to maintain and evaluate the effectiveness of the current program.
- Employees use proper personal protective equipment when handling chemicals.
- All chemicals are stored according to the manufacturer's recommendations and local or national fire codes.

Forklift Safety

- Powered industrial trucks (forklifts) meet the design and construction requirements established in American National Standard for Powered Industrial Trucks, Part II ANSI B56.1-1969.
- Written approval from the truck manufacturer has been obtained for any modifications or additions that affect the capacity and safe operation of the vehicle.
- Capacity, operation and maintenance instruction plates, tags or decals are changed to specify any modifications or additions to the vehicle.
- Nameplates and markings are in place and maintained in a legible condition.
- Forklifts that are used in hazardous locations are appropriately marked/approved for such use.
- Battery charging is conducted only in designated areas.
- Appropriate facilities are provided for flushing and neutralizing spilled electrolytes, for fire extinguishing, for protecting charging apparatus from damage by trucks and for adequate ventilation to disperse fumes from gassing batteries.
- Conveyors, overhead hoists or equivalent materials handling equipment are provided for handling batteries.
- Reinstalled batteries are properly positioned and secured.

- Carboy tilters or siphons are used for handling electrolytes.
- Forklifts are properly positioned and brakes applied before workers start to change or charge batteries.
- Vent caps are properly functioning.
- Precautions are taken to prevent smoking, open flames, sparks or electric arcs in battery charging areas and during storage/changing of propane fuel tanks.
- Tools and other metallic objects are kept away from the top of uncovered batteries.
- Concentrations of noxious gases and fumes are kept below acceptable levels.
- Forklift operators are competent to operate a vehicle safely as demonstrated by successful completion of training and evaluation conducted and certified by persons with the knowledge, training and experience to train operators and evaluate their performance.
- The training program content includes all truck-related topics, workplace related topics and the requirements of 29 CFR 1910.178 for safe truck operation.
- Refresher training and evaluation is conducted whenever an operator has been observed operating the vehicle in an unsafe manner or has been involved in an accident or a near-miss incident.
- Refresher training and evaluation is conducted whenever an operator is assigned to drive a different type of truck or whenever a condition in the workplace changes in a manner that could affect safe operation of the truck.
- Evaluations of each operator's performance are conducted at least once every three years.
- Load engaging means are fully lowered, with controls neutralized, power shut off and brakes set when a forklift is left unattended.
- Operators maintain a safe distance from the edge of ramps or platforms while using forklifts on any elevated dock, platform or freight car.
- There is sufficient headroom for the forklift and operator under overhead installations, lights, pipes, sprinkler systems, etc.
- Overhead guards are provided in good condition to protect forklift operators from falling objects.
- Operators observe all traffic regulations, including authorized plant speed limits.
- Drivers are required to look in the direction of and keep a clear view of the path of travel.
- Operators run their trucks at a speed that will permit the vehicle to stop in a safe manner.
- Dock boards (bridge plates) are properly secured when loading or unloading from dock to truck.
- Stunt driving and horseplay are prohibited.
- All loads are stable, safely arranged and fit within the rated capacity of the truck.
- Operators fill fuel tanks only when the engine is not running.
- Replacement parts of trucks are equivalent in terms of safety with those used in the original design.
- Trucks are examined for safety before being placed into service and unsafe or defective trucks are removed from service.

Full document available at: **https://www.osha.gov/Publications/warehousing.html**

Name: _____ Date: _____

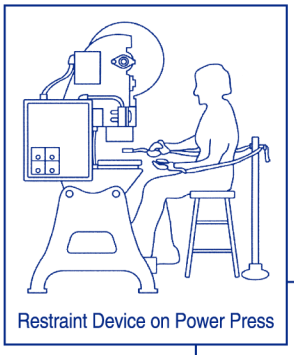
Knowledge Check: Materials Handling, Storage, Use, and Disposal

1. How old do you have to be to operate a forklift, regardless of training?
    a. 16 years old
    b. 18 years old
    c. 21 years old
    d. 25 years old

2. One good way to prevent materials handling hazards is to _____.
    a. refuse to allow personnel to ride equipment without a seat and seatbelt
    b. report all damaged equipment immediately
    c. operate within manufacturer's specifications
    d. All of these

3. Which of the following is a method for eliminating or reducing crane operation hazards?
    a. Operators should know how much they are lifting as well as the rated capacity of the crane.
    b. A competent person should visually inspect the crane once a year.
    c. Never exceed the load limit by more than 10%.
    d. All of these.

4. Employers must comply with OSHA standards related to materials handling, including training and _____.
    a. equipment
    b. operations
    c. inspection
    d. All of these



Restraint Device on Power Press

OSHA FACT Sheet

Amputations

What are the sources of amputations in the workplace?

Amputations are some of the most serious and debilitating workplace injuries. They are widespread and involve a variety of activities and equipment. Amputations occur most often when workers operate unguarded or inadequately safeguarded mechanical power presses, power press brakes, powered and non-powered conveyors, printing presses, roll-forming and roll-bending machines, food slicers, meat grinders, meat-cutting band saws, drill presses, and milling machines as well as shears, grinders, and slitters. These injuries also happen during materials handling activities and when using forklifts and doors as well as trash compactors and powered and non-powered hand tools. Besides normal operation, the following activities involving stationary machines also expose workers to potential amputation hazards: setting-up, threading, preparing, adjusting, cleaning, lubricating, and maintaining machines as well as clearing jams.

What types of machine components are hazardous?

The following types of mechanical components present amputation hazards:

- **Point of operation**—the area of a machine where it performs work on material.
- **Power-transmission apparatuses**—flywheels, pulleys, belts, chains, couplings, spindles, cams, and gears in addition to connecting rods and other machine components that transmit energy.
- **Other moving parts**—machine components that move during machine operation such as reciprocating, rotating, and transverse moving parts as well as auxiliary machine parts.

What kinds of mechanical motion are hazardous?

All mechanical motion is potentially hazardous. In addition to in-running nip points ("pinch points")—which occur when two parts move together and at least one moves in a rotary or circular motion that gears, rollers, belt drives, and pulleys generate—the following are the most common types of hazardous mechanical motion:

- **Rotating**—circular movement of couplings, cams, clutches, flywheels, and spindles as well as shaft ends and rotating collars that may grip clothing or otherwise force a body part into a dangerous location.
- **Reciprocating**—back-and-forth or up-and-down action that may strike or entrap a worker between a moving part and a fixed object.
- **Transversing**—movement in a straight, continuous line that may strike or catch a worker in a pinch or shear point created between the moving part and a fixed object.
- **Cutting**—action generated during sawing, boring, drilling, milling, slicing, and slitting.
- **Punching**—motion resulting when a machine moves a slide (ram) to stamp or blank metal or other material.
- **Shearing**—movement of a powered slide or knife during metal trimming or shearing.
- **Bending**—action occurring when power is applied to a slide to draw or form metal or other materials.

Are there any OSHA standards that cover amputation hazards in the workplace?

Yes. The Occupational Safety and Health Administration (OSHA) has the following standards in *Title 29 of the Code of Federal Regulations* (*CFR*) to protect workers from amputations in the workplace:

- 29 *CFR* Part 1910 Subparts O and P cover machinery and machine guarding.
- 29 *CFR* 1926 Subpart I covers hand tools and powered tools.
- 29 *CFR* Part 1928 Subpart D covers agricultural equipment.
- 29 *CFR* Part 1915 Subparts C, H, and J; 29 *CFR* Part 1917 Subparts B, C, and G; and 29 *CFR* Part 1918 Subparts F, G, and H cover maritime operations.

Amputations

What can employers do to help protect workers from amputations?

You should be able to recognize, identify, manage, and control amputation hazards commonly found in the workplace such as those caused by mechanical components of machinery, the mechanical motion that occurs in or near these components, and the activities that workers perform during mechanical operation.

Work practices, employee training, and administrative controls can help prevent and control amputation hazards. Machine safeguarding with the following equipment is the best way to control amputations caused by stationary machinery:

- **Guards** provide physical barriers that prevent access to hazardous areas. They should be secure and strong, and workers should not be able to bypass, remove, or tamper with them. Guards should not obstruct the operator's view or prevent employees from working.
- **Devices** help prevent contact with points of operation and may replace or supplement guards. Devices can interrupt the normal cycle of the machine when the operator's hands are at the point of operation, prevent the operator from reaching into the point of operation, or withdraw the operator's hands if they approach the point of operation when the machine cycles. They must allow safe lubrication and maintenance and not create hazards or interfere with normal machine operation. In addition, they should be secure, tamper-resistant, and durable.

You are responsible for safeguarding machines and should consider this need when purchasing machinery. New machinery is usually available with safeguards installed by the manufacturer. You can also purchase appropriate safeguards separately or build them in-house.

Are certain jobs particularly hazardous for some employees?

Yes. Under the *Fair Labor Standards Act*, the Secretary of Labor has designated certain non-farm jobs as especially hazardous for employees under the age of 18. These workers generally are prohibited from operating band saws, circular saws, guillotine shears, punching and shearing machines, meatpacking or meat-processing machines, paper products machines, woodworking machines, metal-forming machines, and meat slicers.

How can I get more information?

You can find more information about amputations, including the full text of OSHA's standards, on OSHA's website at **www.osha.gov**. In addition, publications explaining the subject of amputations in greater detail are available from OSHA. *Concepts and Techniques of Machine Safeguarding* (OSHA 3067) and *Control of Hazardous Energy (Lockout/Tagout)* (OSHA 3120) are available on OSHA's website. For other information about machine guarding see http://www.osha-slc.gov/SLTC/machineguarding/index.html.

A Guide for Protecting Workers from Woodworking Hazards (OSHA 3157) is available either on OSHA's website at **www.osha.gov** or from the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954, or phone (202) 512-1800, or online at http://bookstore.gpo.gov/index.html.

To file a complaint by phone, report an emergency, or get OSHA advice, assistance, or products, contact your nearest OSHA office under the "U.S. Department of Labor" listing in your phone book, or call us toll-free at **(800) 321-OSHA (6742)**; teletypewriter (TTY) number is (877) 889-5627. To file a complaint online or obtain more information on OSHA federal and state programs, visit OSHA's website at **www.osha.gov**.

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2002

Name: _____ Date: _____

Knowledge Check: Tools – Hand and Power

1. Which of the following is an example of an unsafe practice regarding the use of tools?
    a. Keeping cutting tools sharp
    b. Wearing eye and face protection while operating a grinder
    c. Using a screwdriver to carve or cut wood
    d. Following manufacturer's instructions when using a tool

2. Which term describes a tool that is powered by compressed air?
    a. Hydraulic
    b. Powder-actuated
    c. Electrical
    d. Pneumatic

3. Which of the following actions may expose workers to electrical shock hazards and should be avoided?
    a. Removing the grounding pin on a three-prong plug
    b. Using double-insulated tools
    c. Using a grounded adaptor to accommodate a two-prong receptacle
    d. Removing damaged tools from service and tagging them "Do Not Use"

4. Which of the following statements about guarding techniques is true?
    a. Guard the point of operation, in-running nip points, and rotating parts of tools.
    b. Remove guard from tool while it is in use, then replace when the job is completed.
    c. Adjust guard on abrasive wheel to allow maximum exposure of the wheel surface.
    d. Wear PPE because guards will not protect operator from flying chips and sparks or moving parts of tools.

5. Employers must satisfy all of the following requirements, except:
    a. Provide PPE necessary to protect employees who are operating hand and power tools and are exposed to hazards.
    b. Comply with OSHA training and inspection standards related to hand and power tools.
    c. Determine which manufacturer's requirements and recommendations for a tool shall be followed or ignored.
    d. Do not issue or permit the use of unsafe hand tools.

General Rules for Construction Electrical Safety

MAJOR PROTECTIVE METHODS FROM ELECTRICAL HAZARDS

Protection from electrical hazards generally includes the following methods:

1. **DISTANCE:** Commonly used with regard to power lines.
2. **ISOLATION AND GUARDING:** Restricting access, commonly used with high voltage power distribution equipment.
3. **ENCLOSURE OF ELECTRICAL PARTS:** A major concept of electrical wiring in general, e.g., all connections are made in a box.
4. **GROUNDING:** Required for all non-current carrying exposed metal parts, unless isolated or guarded as above. (However, corded tools may be either *grounded* **OR** be *double-insulated*.)
5. **INSULATION:** Intact insulation allows safe handling of everyday electrical equipment, including corded tools. Category also includes insulated mats and sleeves.
6. **DE-ENERGIZING AND GROUNDING:** Protective method used by electrical utilities and also in conjunction with electrical lockout/tagout.
7. **PERSONAL PROTECTIVE EQUIPMENT (PPE):** Using insulated gloves and other apparel to work on energized equipment, limited to qualified and trained personnel working under very limited circumstances.

Effects of Electric Current in the Human Body

Current / Reaction *(1,000 milliamperes = 1 amp; therefore, 15,000 milliamperes = 15 amp circuit)*
Below 1 milliampere Generally not perceptible
1 milliampere Faint tingle
5 milliampere Slight shock felt; not painful but disturbing. Average individual can let go. Strong involuntary reactions can lead to other injuries.
6-25 milliamperes (women) Painful shock, loss of muscular control
9-30 milliamperes (men) The freezing current or " let-go" range. Individual cannot let go, but can be thrown away from the circuit if extensor muscles are stimulated.
50 150 milliamperes Extreme pain, respiratory arrest, severe muscular contractions. Death is possible.
1,000 - 4,300 milliamperes Rhythmic pumping action of the heart ceases. Muscular contraction and nerve damage occur; death likely.
10,000 milliamperes Cardiac arrest, severe burns; death probable

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Construction Focus Four: Electrocution
Directorate of Training and Education
2020 S. Arlington Heights Rd.
Arlington Heights, IL 60005

Some content adapted from: Central New York COSH, 2007, Construction Safety & Health Electrocution hazards Grantee module, Grant Number SH-16586-07-06-F-36 from OSHA.

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Construction Focus Four: Electrocution

Safety Tips for Workers

Contents:

Electrical Safety Overview

1. **CORD AND PLUG OPERATED** electric tools with exposed metal parts must have a *three-prong grounding plug* – **AND** *be grounded* – or else be *double-insulated.*

2. **EQUIPMENT GROUNDING** *only works when there is a permanent and continuous electrical connection between the metal shell of a tool and the earth.*

3. **PROPER POLARITY IN ELECTRICAL WIRING IS IMPORTANT:** *hot to hot, neutral to neutral, equipment ground to equipment ground. Polarized plugs have a wider neutral blade to maintain correct polarity.* ***Reversed polarity can kill.***

4. **CIRCUITS MUST BE EQUIPPED WITH FUSES OR CIRCUIT BREAKERS** *to protect against dangerous overloads. Fuses melt, while circuit breakers trip to turn off current like a switch.* ***Overcurrent protection devices protect wiring and equipment from overheating and fires.*** *They may, or may not, protect you.*

5. **MOST 120 VOLT CIRCUITS** *are wired to deliver up to 15 or 20 amps of current. Currents of* ***50 – 100 milliamperes*** *can kill you. (1 mA = 1/1,000 of 1 Amp.)*

6. **WET CONDITIONS LOWER SKIN RESISTANCE,** *allowing more current to flow through your body. Currents* ***above 75 milliamps*** *can cause* ***ventricular fibrillation,*** *which may be fatal. Severity of a shock depends on: path of current, amount of current, duration of current,* voltage level, moisture and your general health.

7. **A GROUND FAULT CIRCUIT INTERRUPTER (GFCI)** protects from a ground-fault, the most common electrical hazard. GFCIs detect differences in current flow between hot and neutral. They trip when there is current leakage – such as through a person – of about 5 milliamperes and they act within 1/40 of a second. Test a GFCI every time you use it. It must "Trip" and it must "Reset."

8. **EXTENSION CORD WIRES MUST BE HEAVY ENOUGH** for the amount of current they will carry. For construction, they must be UL approved, have strain relief and a 3-prong grounding plug, be durable, and be rated for hard or extra-hard usage.

9. **OVERHEAD POWER LINES CAN KILL.** The three major methods of protection are: maintaining a *safe distance, de-energizing AND grounding lines,* having the power company install *insulating sleeves.* Have a power company rep on the site.

10. **UNDERGROUND POWER LINES CAN KILL.** Call before you dig to locate all underground cables. Hand dig within three feet of cable location!

General Rules for Electrical Work

- ***Non-conductive PPE is essential for electricians. NO METAL PPE! Class B hard hats provide the highest level of protection against electrical hazards, with high-voltage shock and burn protection (up to 20,000 volts). Electrical hazard, safety-toe shoes are nonconductive and will prevent the wearers' feet from completing an electrical circuit to the ground.***
- ***Be alert to electrical hazards,*** especially when working with *ladders, scaffolds and other platforms.*
- ***Never bypass electrical protective*** systems or devices.
- ***Disconnect cord tools*** when not in use and when changing blades, bits or other accessories.
- ***Inspect all tools*** before use.
- ***Use only grounded extension cords.***
- ***Remove damaged*** tools and damaged extension cords from use.
- ***Keep working spaces and walkways clear*** of electrical cords.

RULES FOR TEMPORARY WIRING AND LIGHTING

- ***Use Ground Fault Circuit Interrupters (GFCIs)*** on all 15-Amp and 20-Amp temporary wiring circuits.
- ***Protect temporary lights*** from contact and damage.
- ***Don't suspend temporary lights by cords,*** unless the temporary light is so designed.

Condensed Electrical Glossary

AMPERE OR AMP: The unit of electrical *current* (flow of electrons). • One *milliamp (mA)* = 1/1,000 of 1 Amp.

CONDUCTORS: Materials, such as metals, in which electrical current can flow.

ELECTRICAL HAZARDS can result in various effects on the body, including: • SHOCK – The physical effects caused by electric current flowing in the body. • ELECTROCUTION – Electrical shock or related electrical effects resulting in death. • BURNS – Often occurring on the hands, thermal damage to tissue can be caused by the *flow of current* in the body, by *overheating* of improper or damaged *electrical components,* or by an *arc flash.* • FALLS – A common effect, sometimes caused by the body's reaction to an electrical current. A non-fatal shock may sometimes result in a fatal fall when a person is working on an elevated surface.

EXPOSED LIVE PARTS: Energized electrical components not properly enclosed in a box or otherwise isolated, such that workers can touch them and be shocked or killed. Some of the common hazards include: missing knockouts, unused openings in cabinets and missing covers. Covers must not be removed from wiring or breaker boxes. Any missing covers must be replaced with approved covers.

INSULATORS: Materials with high electrical resistance, so electrical current can't flow.

LOCKOUT/TAGOUT: The common name for an OSHA standard, *"The control of hazardous energy (lockout /tagout)."* ***Lockout*** is a means of controlling energy during repairs and maintenance of equipment, whereby energy sources are *de-energized, isolated,* and then *locked out* to prevent unsafe start-up of equipment which would endanger workers. *Lockout* includes – but is not limited to – the control of electrical energy. ***Tagout*** means the placing of warning tags to alert other workers to the presence of equipment that has been locked out. Tags alone DO NOT LOCK OUT equipment. ***Tagout is most effective when done in addition to lockout.***

OHM or Ω: The unit of *electrical resistance* (opposition to current flow).

OHM'S LAW: A mathematical expression of the relationship among *voltage* (volts), *current* (amps) and *resistance* (ohms). This is often expressed as: $E = I \times R$. In this case, E = volts, I = amps and R = ohms. (The equation, Amps = Volts/Ohms, as used in this curriculum, is one form of Ohm's Law.)

VOLT: The unit of *electromotive force (emf)* caused by a *difference in electrical charge or electrical potential* between one point and another point. **The presence of voltage is necessary before current can flow in a** *circuit* (in which *current* flows from a *source* to a *load* – the equipment using the electricity – and then back to its source).

WET CONDITIONS: Rain, sweat, standing in a puddle – all will decrease the skin's electrical resistance and increase current flow through the body in the event of a shock. **Have a qualified electrician inspect any electrical equipment that has gotten wet before energizing it.**

Focus Four [Electrocution] Toolbox Talks 1:

What increases your risk of electrocution?

[Ask the following questions and give time for answers.]

What are the hazards? Bodily contact with electricity

What are the results? Shock, fire, burns, falls or death

What should we look for? Damaged equipment, faulty wiring, improper cord use, no GFCIs, wet conditions, reverse polarity, potential arc flash areas, lack of assured equipment grounding conductor program

[Relate this incident or, better, one you know.]

Actual Incident: A 40-year-old male plumber died after lying on his work light while installing plumbing under a house being remodeled. The victim was crawling under the house carrying the work light with him. The wire inside the work light's conduit became bare and energized the light's housing. Investigation of the incident showed a damaged work light was used with no GFCI. Also, the home's electrical system was not properly grounded.

[Ask the following question and ensure every item is covered.]

How do we prevent these results?

- Inspect all electrical equipment before use.
- Use GFCI with all power tools.
- Use intact and properly rated cords (i.e. correct AWG).
- Do not use damaged equipment - take it out of service.
- Institute an assured equipment grounding conductor program.
- Do not work in wet conditions with electricity.

[Ask the following questions about this site and ensure every item is covered.]

Let's talk about this site now.

- What factors increase your chance of being electrocuted?
- Can someone demonstrate how to inspect this tool for electrical safety? (If possible, provide a tool)
- What are some areas on the site that could use attention pertaining to electrical hazards?

What are the hazards show in these photos?

[Record questions below that you want to ask about this site.]

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Focus Four [Electrocution] Toolbox Talks 2:

What protective devices and procedures can you use to prevent electrocution?

[Ask the following questions and give time for answers.]

What are the hazards? Bodily contact with electricity due to faulty equipment, ungrounded or damaged equipment, wet conditions, etc.

What are the results? Shock, fire, burns, falls or death

What should we look for? Proper training in using engineering controls (e.g. GFCIs, proper cords), assured equipment grounding conductor written program, electrical testing meters

[Relate this incident or, better, one you know.]

Actual Incident: A 29-year- old male welder was electrocuted and died when he contacted an energized receptacle end of an extension cord. It was found that the welding unit and cord were incompatible; however, both the welding cord and extension cord were damaged allowing them to be used together. The result was an ungrounded system that killed a worker.

American Wire Gauge (AWG)	
Cord Size	Handles Up To
#10 AWG	30 amps
#12 AWG	25 amps
#14 AWG	18 amps
#16 AWG	13 amps

[Ask the following question and ensure every item is covered.]

How do we prevent these results?

- Inspect all electrical equipment before use.
- Use GFCI with all power tools.
- Use intact and properly-rated cords (i.e. correct AWG).
- Do not use damaged equipment - take it out of service.
- Institute an assured equipment grounding conductor program.
- Use testing meters, where appropriate, if you are trained to do so.

[Ask the following questions about this site and ensure every item is covered.]

Let's talk about this site now.

- Can someone explain how a GFCI works? (If possible, provide a GFCI to use).
- Who has read this site's assured equipment grounding conductor program?
- What are some of the requirements?

[Record questions below that you want to ask about this site.]

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Focus Four [Electrocution] Toolbox Talks 3:

How can we prevent electrocutions while using power tools?

[Ask the following questions and give time for answers.]

What are the hazards? Bodily contact with electricity

What are the results? Shock, fire, burns, falls or death

What should we look for? Tools that aren't double-insulated, damaged tools and cords, incorrect cords, wet conditions, tools used improperly

[Relate this incident or, better, one you know.]

Actual Incident: A 45-year-old male electrician was electrocuted when he contacted an energized 1/2" electric drill casing. The victim was working in wet conditions and using a single insulated drill attached to damaged extensions cords run through water.

[Ask the following question and ensure every item is covered.]

How do we prevent these results?

- Get proper training on manufacturers' tool use and specs.
- Inspect tool before each use according to manufacturers' instructions.
- Do not use damaged tools, remove them from service.
- Use only battery-powered tools in wet conditions.
- Use with GFCI.
- Use with properly sized and intact cords.

[Ask the following questions about this site and ensure every item is covered.]

Let's talk about this site now.

- What can lead to an electrocution while using power tools? *Non double-insulated tools, damaged cord, wet conditions*
- Have you seen or used any defective power tool?
- What should you do if you find a defective power tool?

[Record questions below that you want to ask about this site.]

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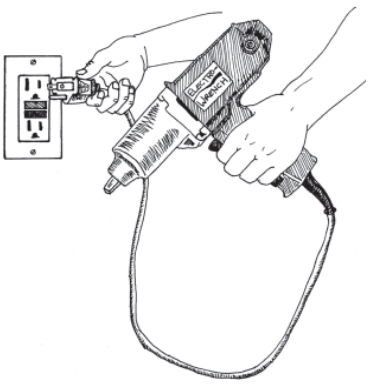
ACTIVITY OPTION A **Student Copy**
Wet Conditions / Ground Fault Circuit Interrupters

Source: Central New York (COSH) Susan Harwood Training Grant #SH-16586-07-06-F-36

In your small group, read fact sheets A1 and A2, and the following scenario. Then answer the questions that follow.

- You're an experienced worker in building maintenance, helping a new worker to learn the job. The task involves cleaning up a flooded basement. The new worker has started setting up electrical cords and tools for the job. You tell her, "Hold on a minute, let's check out the wiring first." Then you say, "No, we can't do this without GFCI protection. I'll tell you why."



1. What would you tell your new co-worker?

2. What can you do to correct this problem for now?

3. What is the best way to deal with this in the future?

4. What work practices help protect you against electrical hazards?

_____
_____
_____
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Examples of accidents related to wet conditions/ground fault circuit interrupters

A journeyman HVAC worker was installing metal duct work using a double-insulated drill connected to a drop light cord. Power was supplied through two extension cords from a nearby residence. The individual's perspiration-soaked clothing/body contacted bare exposed conductors on one of the cords, causing an electrocution. No GFCI's were used. Additionally, the ground prongs were missing from the two cords.

Factsheet A1 – Using Electrical Equipment in Wet Locations

Using electrical tools or equipment in wet areas can be a hazard. If your skin is dry, it has quite a lot of *resistance* (measured in *ohms* or Ω). However, if your skin is wet for any reason (rain, sweat, standing in a puddle of water), the skin's electrical resistance drops dramatically. The amount of electrical **current**, in *amps,* that flows through your body **goes up when resistance** in *ohms* **goes down. Amps** = **Volts/Ohms.**

The Current in **Amps** = Voltage in **Volts** DIVIDED BY Resistance in **Ohms**.
HIGHER VOLTAGE = more current (if resistance remains the same).
LOWER RESISTANCE = more current (if voltage remains the same).
HOW MUCH CURRENT DOES IT TAKE TO KILL ME?

It doesn't take much, especially if it passes through your heart. Currents above about *75 milliamps(mA)* can cause a condition called *ventricular fibrillation***.** (A milliamp is 1/1,000 of 1 amp.) If your heart goes into fibrillation, it beats very rapidly – but it doesn't pump any blood – because it's not beating in its normal rhythm. If your blood can't carry oxygen to your brain, you'll experience brain death in 3 to 4 minutes. The way to get you back involves another electric shock, from a *defibrillator.*

If your skin is wet and you get your body across 120 volts of electricity, it's very likely that you'll have a current of 100 mA or more flowing through your heart. ***Currents ABOVE* 10 *mA*** can cause *muscle paralysis.* You may not be able to let go of energized tools or equipment. ***Shocks that are longer in duration are more severe.***

Electrical systems must be wired with either *fuse*s or *circuit breakers.* These devices are known as *overcurrent protection* and they are rated in amps. Most common household circuits are wired for 15 amps or 20 amps. **Overcurrent protection devices protect wiring and equipment from overheating and fires.** They may – or may not – protect you from electrical shock. If the current isn't high enough, the fuse won't blow or the circuit breaker won't trip. You could be shocked or killed without ever blowing a fuse or tripping a circuit breaker.

Factsheet A2 – GFCIs to the Rescue

A great breakthrough in electrical safety came with the invention of the *ground fault circuit interrupter (GFCI).* A *ground fault* occurs when electrical current flows on a path where it's not supposed to be. Under normal conditions, current flows in a circuit, traveling from the source, through the device it operates, called the *load,* and then back to the source. [See Activity 2 for more about wiring of electrical circuits.]

Current (amps) flows out to the load from the "hot" side (which is generally at 120 volts AC) and returns on the "neutral" side (which is at zero volts). Under normal conditions, these two currents (hot and neutral) are equal. If they are not equal, because of *current leakage* (current returning on a different path than the neutral conductor), we get a ground fault. This can occur if current flows through your body and returns to the source through a path to ground. **Electricity will take ANY available path to return to its source.** We want it to return only on the neutral.

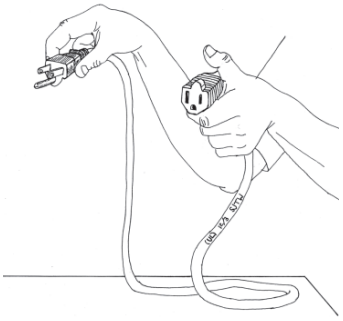
The ground fault circuit interrupter (GFCI) works by using the above principles. It measures total current on the hot side and total current on the neutral side of the circuit. They are supposed to be equal. If these two currents differ from each other by *more than 5 milliamps* (plus or minus 1 mA), the GFCI acts as a fast-acting circuit breaker and shuts off the electricity within 1/40 of 1 second. You can still feel this small amount of current, but it will quickly shut off.

GFCIs are manufactured in many forms. The most common one is the GFCI outlet. However, there are also GFCI circuit breakers, plug-in GFCI outlets and GFCI extension cords, as well as GFCIs hard-wired into devices such as hair dryers. All types have **"Test"** and **"Reset"** functions. **The GFCI must trip when you press the "Test" button. It must also energize the circuit when you press "Reset." If either test fails, you must replace the GFCI in order to be protected!**

Activity Option B **Student Copy**
Extension Cords, Copper and Current

In your small group, read fact sheets B1 and B2, and the following scenario. Then answer the questions that follow.

SCENARIO:
You're at work one day and a co-worker starts screaming: It looks like his saw is smoking, it smells like it's burning and his extension cord is getting hot enough to burn his hand. You walk over, take one look at the scene and start shaking your head. "Well, I know what your problem is, and I'll explain if you stop shouting," you tell him.



1. What is your explanation to the worker?

2. What are some steps to deal with this issue?

3. What is the best way to correct the problem?

Factsheet B1 – Wire Size and Ampacity

In terms of conducting electrical current, size matters: the size of the electrical conductor. Take a look at the following table regarding *ampacity,* the current carrying capacity of a conductor in amps. You'll notice two things: the **amount of current** a wire can safely carry **increases** as the **diameter** (and area) of the wire increases and as the number of the **wire size decreases**. Welcome to the American Wire Gauge (AWG).

AWG Copper Wire Table

Copper Wire Size (AWG)	Diameter (mils)	Area (Circular mils)	Ampacity in free air	Ampacity as part of 3-conductor cable
14 AWG	64.1	4109	20 Amps	15 Amps
12 AWG	80.8	6529	25 Amps	20 Amps
10 AWG	101.9	10,384	40 Amps	30 Amps
8 AWG	128.5	16,512	70 Amps	50 Amps

BUT I DON'T WANT TO BE AN ENGINEER...

Hey, neither do I, but this stuff is important. Notice that a #8 wire is ***twice the diameter,*** but ***four times the area*** of a #14 wire. There are a couple of practical applications here. For one thing, the gauge of the wire determines the rating of a fuse or circuit breaker in amps. A circuit wired with #14 copper will get a 15 amp circuit breaker. A circuit with #12 copper can get a 20 amp breaker; #10 copper can be 30 amps, and so on.

The second thing to consider is that it's possible to create a fire hazard by *overloading an extension cord.* This occurs when too much current is fl owing in a conductor that's not heavy enough for the electrical load in amps. The circuit can be properly wired and its circuit breaker correctly rated, but if too much current flows through an extension cord whose wires are too small, the cord will heat up. Sometimes there is also a *voltage drop* over a longer extension cord, which could damage your tools.

Factsheet B2 – Extension Cord Facts

With the wide use of power tools on construction sites, flexible extension cords often are necessary. Because they are exposed, flexible, and unsecured, they are more susceptible to damage than is fixed wiring. Hazards are created when cords, cord connectors, receptacles, and cord- and plug connected equipment are improperly used and maintained. **Here are some factors on extension cord safety noted by OSHA.**

Strain Relief

- To reduce hazards, flexible cords must connect to devices and to fittings in ways that prevent tension at joints and terminal screws. Flexible cords are finely stranded for flexibility, so straining a cord can cause the strands of one conductor to loosen from under terminal screws and touch another conductor.

Cord Damage

- A flexible cord may be damaged by door or window edges, by staples and fastenings, by abrasion from adjacent materials, or simply by aging. If the electrical conductors become exposed, there is a danger of shocks, burns, or fire. Replace frayed or damaged cords. Avoid running cords over sharp corners and edges.

Durability

- The OSHA construction standard requires flexible cords to be rated for hard or extra-hard usage. These ratings are derived from the National Electrical Code, and are required to be indelibly marked approximately every foot along the length of the cord. Examples of these codes are: S, ST, SO, and STO for hard service, and SJ, SJO, SJT, and SJTO for junior hard service.

Grounding

- Extension cords must be 3-wire type so they may be grounded, and to permit grounding of any tools or equipment connected to them.

Wet Conditions

When a cord connector is wet, electric current can leak to the equipment grounding conductor, and to anyone who picks up that connectors if they provide a path to ground. Such leakage can occur not just on the face of the conductor, but at any wetter portion. Limit exposure of connectors and tools to excessive moisture by using watertight or sealable connectors.

OSHA QUICK CARD™

Electrical Safety

Electrical hazards can cause burns, shocks and electrocution (death).

Safety Tips

- Assume that all overhead wires are energized at lethal voltages. Never assume that a wire is safe to touch even if it is down or appears to be insulated.
- Never touch a fallen overhead power line. Call the electric utility company to report fallen electrical lines.
- Stay at least 10 feet (3 meters) away from overhead wires during cleanup and other activities. If working at heights or handling long objects, survey the area before starting work for the presence of overhead wires.
- If an overhead wire falls across your vehicle while you are driving, stay inside the vehicle and continue to drive away from the line. If the engine stalls, do not leave your vehicle. Warn people not to touch the vehicle or the wire. Call or ask someone to call the local electric utility company and emergency services.
- Never operate electrical equipment while you are standing in water.
- Never repair electrical cords or equipment unless qualified and authorized.
- Have a qualified electrician inspect electrical equipment that has gotten wet before energizing it.
- If working in damp locations, inspect electric cords and equipment to ensure that they are in good condition and free of defects, and use a ground-fault circuit interrupter (GFCI).
- Always use caution when working near electricity.

For more complete information:

OSHA Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA

OSHA 3259-09N-05