Construction Focus Four: Struck-By Hazards
Student Handouts

- Hazard Alert – Nail Gun Safety
- Focus 4 “Cranes and Rigging”
- PPE for Workers Checklist

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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

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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.

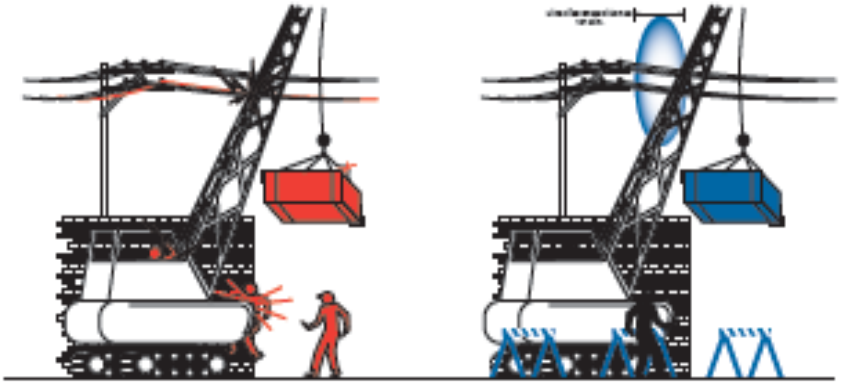
FOCUS

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.

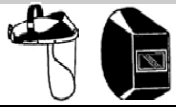
Follow these safe work practices

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

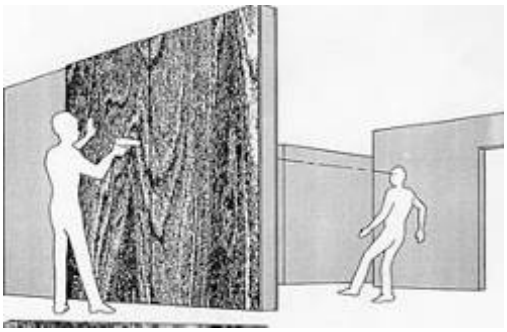
Protection	TYPICAL OPERATIONS OF CONCERN	YES	NO
EYE 	Sawing, cutting, drilling, sanding, grinding, hammering, chopping, abrasive blasting, punch press operations, etc.		
	Pouring, mixing, painting, cleaning, siphoning, dip tank operations, dental and health care services, etc.		
	Battery charging, installing 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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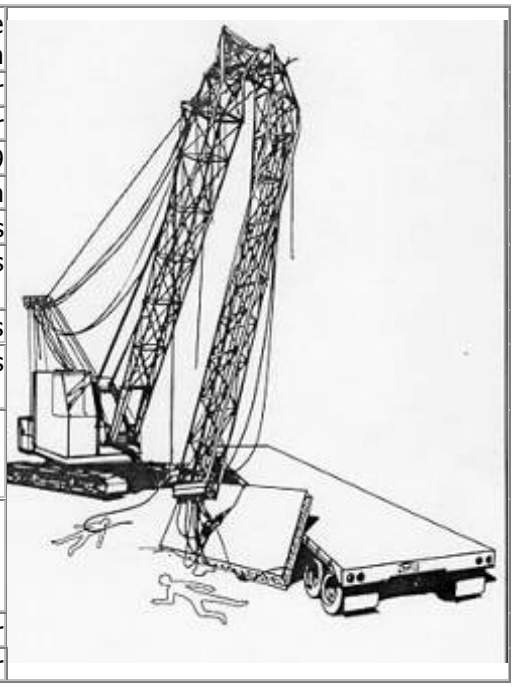
NOTE: *The case here described was selected as being representative of fatalities caused by improper work practices. No special emphasis or priority is implied nor is the case necessarily a recent occurrence. The legal aspects of the incident have been resolved, and the case is now closed.*

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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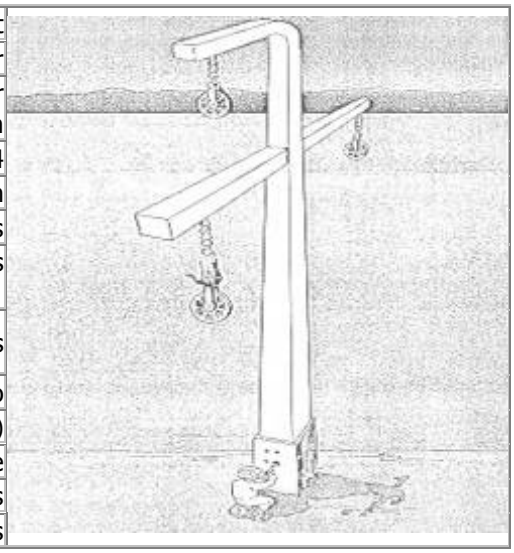
ACCIDENT REPORT
FATAL FACTS

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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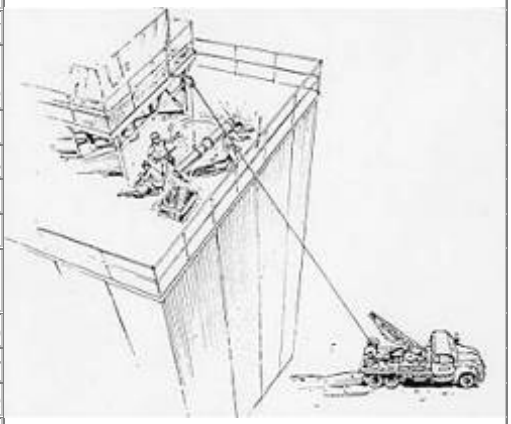
ACCIDENT REPORT
FATAL FACTS

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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Construction Focus Four: Electrocution Hazards
Student Handouts

- "Construction Focus Four: Electrocution, Safety Tips for Workers" tri-fold brochure format
- Focus Four Toolbox Talks 1, 2, and 3 produced by IUOE National Training Fund under OSHA grant number SH-16591-07-06-F-11
- OSHA Quick CardTM "Electrical Safety"

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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

OSHA®

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Construction Focus Four: Electrocution

Safety Tips for Workers

Contents:

- Electrical Safety Overview
- General Rules for Electrical Work
- Condensed Electrical Glossary
- General Rules for Construction Electrical Safety
- Effects of Electric Current in the Human Body

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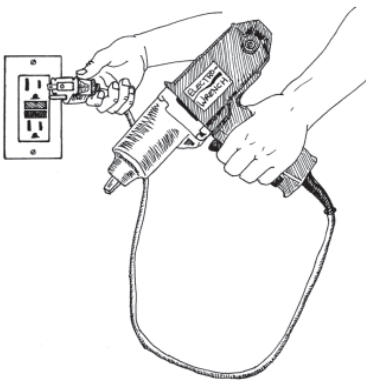
ACTIVITY OPTION A **Student Copy**
Wet Conditions / Ground Fault Circuit Interrupters

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.

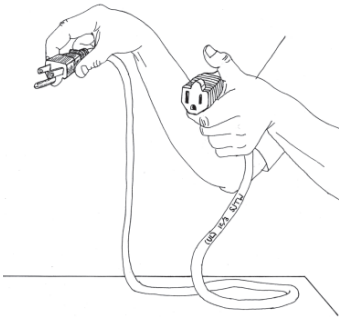
The ground fault circuit interrupter (GFCI) works by using the above principles. It measures total current on the hot side and total current on the neutral side of the circuit. They are supposed to be equal. If these two currents differ from each other by *more than 5 milliamps* (plus or minus 1 mA), 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

OSHA® FactSheet

Personal Protective Equipment

Personal protective equipment, or PPE, is designed to protect workers from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Besides face shields, safety glasses, hard hats, and safety shoes, protective equipment includes a variety of devices and garments such as goggles,coveralls, gloves, vests, earplugs, and respirators.

Employer Responsibilities

OSHA's primary personal protective equipment standards are in Title 29 of the Code of Federal Regulations (CFR), Part 1910 Subpart I, and equivalent regulations in states with OSHA-approved state plans, but you can find protective equipment requirements elsewhere in the General Industry Standards. For example, 29 CFR 1910.156, OSHA's Fire Brigades Standard, has requirements for firefighting gear. In addition, 29 CFR 1926.95-106 covers the construction industry. OSHA's general personal protective equipment requirements mandate that employers conduct a hazard assessment of their workplaces to determine what hazards are present that require the use of protective equipment, provide workers with appropriate protective equipment, and require them to use and maintain it in sanitary and reliable condition.

Using personal protective equipment is often essential, but it is generally the last line of defense after engineering controls, work practices, and administrative controls. Engineering controls involve physically changing a machine or work environment. Administrative controls involve changing how or when workers do their jobs, such as scheduling work and rotating workers to reduce exposures. Work practices involve training workers how to perform tasks in ways that reduce their exposure to workplace hazards.

As an employer, you must assess your workplace to determine if hazards are present that require the use of personal protective equipment. If such hazards are present, you must select protective equipment and require workers to use it, communicate your protective equipment selection decisions to your workers, and select personal protective equipment that properly fits your workers.

You must also train workers who are required to wear personal protective equipment on how to do the following:

- Use protective equipment properly,
- Be aware of when personal protective equipment is necessary,
- Know what kind of protective equipment is necessary,
- Understand the limitations of personal protective equipment in protecting workers from injury,
- Put on, adjust, wear, and take off personal protective equipment, and
- Maintain protective equipment properly.

Protection from Head Injuries

Hard hats can protect your workers from head impact, penetration injuries, and electrical injuries such as those caused by falling or flying objects, fixed objects, or contact with electrical conductors. Also, OSHA regulations require employers to ensure that workers cover and protect long hair to prevent it from getting caught in machine parts such as belts and chains.

Protection from Foot and Leg Injuries

In addition to foot guards and safety shoes, leggings (e.g., leather, aluminized rayon, or otherappropriate material) can help prevent injuries by protecting workers from hazards such as falling or rolling objects, sharp objects, wet and slippery surfaces, molten metals, hot surfaces, and electrical hazards.

Protection from Eye and Face Injuries

Besides spectacles and goggles, personal protective equipment such as special helmets or shields, spectacles with side shields, and faceshields can protect workers from the hazards of flying fragments, large chips, hot sparks,

optical radiation, splashes from molten metals, as well as objects, particles, sand, dirt, mists, dusts, and glare.

Protection from Hearing Loss

Wearing earplugs or earmuffs can help prevent damage to hearing. Exposure to high noise levels can cause irreversible hearing loss or impairment as well as physical and psychological stress. Earplugs made from foam, waxed cotton, or fiberglass wool are self-forming and usually fit well. A professional should fit your workers individually for molded or preformed earplugs. Clean earplugs regularly, and replace those you cannot clean.

Protection from Hand Injuries

Workers exposed to harmful substances through skin absorption, severe cuts or lacerations, severe abrasions, chemical burns, thermal burns, and harmful temperatureextremes will benefit from hand protection.

Protection from Body Injury

In some cases workers must shield most or all of their bodies against hazards in the workplace, such as exposure to heat and radiation as well as hot metals, scalding liquids, body fluids, hazardous materials or waste, and other hazards. In addition to fire-retardant wool and fireretardant cotton, materials used in whole-body personal protective equipment include rubber, leather, synthetics, and plastic.

When to Wear Respiratory Protection

When engineering controls are not feasible, workers must use appropriate respirators to protect against adverse health effects caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors. Respirators generally cover the nose and mouth or the entire face or head and help prevent illness and injury. A proper fit is essential, however, for respirators to be effective. Required respirators must be NIOSH-approved and medical evaluation and training must be provided before use.

Additional Information

For additional information concerning protective equipment view the publication, Assessing the Need for Personal Protective Equipment: A Guide for Small Business Employers (OSHA 3151) available on OSHA's web site at www.osha. gov. For more information about personal protective equipment in the construction industry, visit www.osha-slc.gov/SLTC/constructionppe/ index.html.

Contacting OSHA

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

For more complete information:

OSHA® Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov

(800) 321-OSHA

DOC 4/2006

Hoja de Datos OSHA®

Equipo de Protección Personal

El equipo de protección personal (PPE – Personal Protection Equipment) está diseñado para proteger a los empleados en el lugar de trabajo de lesiones o enfermedades serias que puedan resultar del contacto con peligros químicos, radiológicos, físicos, eléctricos, mecánicos u otros. Además de caretas, gafas de seguridad, cascos y zapatos de seguridad, el equipo de protección personal incluye una variedad de dispositivos y ropa tales como gafas protectoras, overoles, guantes, chalecos, tapones para oídos y equipo respiratorio.

Responsabilidades del Empleador

Las normas principales del equipo de protección personal de OSHA se encuentran en Title 29 of the Code of Federal Regulations (CFR) (Título 29 del Código de Reglamentos Federales), Parte 1910, subpárrafo 1, y en reglamentos equivalentes en los estados que cuentan con planes estatales aprobados por OSHA. No obstante, puede encontrar los requisitos dl equipo de protección personal en otros textos como en las Normas de la Industria General. Por ejemplo, 29 CFR 1910.156, la Norma de Brigadas de bomberos, establece requisitos para el equipo de bomberos. Además, 29 CFR 1926.95 cubre la industria de la construcción. Los requisitos generales dl equipo de protección personal de OSHA exigen que los empleadores lleven a cabo una evaluación de los riesgos en sus lugares de trabajo para identificar los riesgos que existen y que requieren el uso del equipo de protección personal, para que brinden el equipo de protección personal adecuado a los trabajadores y que exijan que estos mismos hagan uso del equipo además de mantenerlo en condiciones sanitarias y fiables.

El uso del equipo de protección personal suele ser esencial, pero es generalmente la última alternativa luego de los controles de ingeniería, de las prácticas laborales y de los controles administrativos. Los controles de ingeniería implican la modificación física de una máquina o del ambiente de trabajo. Los controles administrativos implican modificar cómo y cuando los trabajadores realizan sus tareas, tales cómo los horarios de trabajo y la rotación de trabajadores con el fin de reducir la exposición. Las prácticas laborales implican la capacitación de los trabajadores en la forma de realizar tareas quereducen los peligros de exposición en el lugar de trabajo.

Como empleador, usted debe evaluar su lugar de trabajo con el fin de determinar si existen riesgos que requieran el uso del equipo de protección personal. Si existen estos riesgos, usted debe seleccionar el equipo de protección personal y exigir que lo utilicen sus trabajadores, comunicar sus selecciones del equipo de protección personal a sus trabajadores y seleccionar el equipo de protección personal que se ajuste a la talla de sus trabajadores.

Debe también capacitar a los empleados que tienen que hacer uso del equipo de protección personal para que sepan como hacer lo siguiente:

- Usar adecuadamente el equipo de protección personal.
- Saber cuándo es necesario el equipo de protección personal.
- Conocer qué tipo del equipo de protección personal es necesario.
- Conocer las limitaciones del equipo de protección personal para proteger de lesiones a los empleados.
- Ponerse, ajustarse, usar y quitarse el equipo de protección personal.
- Mantener el equipo de protección personal en buen estado.

Protección de Lesiones Cerebrales

Los cascos pueden proteger a sus empleados de impactos al cráneo, de heridas profundas y de choques eléctricos como los que causan los objetos que se caen o flotan en el aire, los objetos fijos o el contacto con conductores de electricidad. Asimismo, el reglamento de OSHA requiere que los empleadores se cercioren de que los trabajadores cubren y protegen el cabello largo con el fin de evitar que se agarre en piezas de maquinaria como las correas y las cadenas.

Protección de Lesiones en los Pies y los Piernas

Además del equipo de protección de pies y del zapato de seguridad, las polainas (de cuero, de rayón aluminizado u otro material adecuado, por ejemplo) pueden ayudar a evitar lesiones y proteger a los trabajadores de objetos que se caen o que ruedan, de objetos afilados, de superficies mojadas o resbalosas, de metales fundidos, de superficies calientes y de peligros eléctricos.

Protección de Lesiones a los Ojos y a la Cara

Además de las gafas de seguridad y las gafas protectoras de goma, el equipo de protección personal tales como los cascos o protectores especiales, las gafas con Departamento de Trabajo de los EE.UU. Administración de Seguridad y Salud Ocupacional 2002 protectores laterales y las caretas pueden

ayudar a proteger a los trabajadores de ser impactados por fragmentos, las astillas de gran tamaño, las chispas calientes, la radiación óptica, las salpicaduras de metales fundidos, así como los objetos, las partículas, la arena, la suciedad, los vapores, el polvo y los resplandores.

Protección de Pérdida Auditiva

Utilizar tapones para oídos u orejeras puede ayudar a proteger los oídos. La exposición a altos niveles de ruido puede causar pérdidas o discapacidades auditivas irreversibles así como estrés físico o psicológico. Los tapones para oídos de material alveolar, de algodón encerado o de lana de fibra de vidrio son fáciles de ajustar correctamente. Tapones de oídos moldeados o preformados deben ser adecuados a los trabajadores que van a utilizarlos por un profesional. Limpie los tapones con regularidad y reemplace los que no pueda limpiar.

Protección de Lesiones de los Manos

Los trabajadores expuestos a sustancias nocivas mediante absorción por la piel, a laceraciones o cortes profundos, abrasiones serias, quemaduras químicas, quemaduras térmicas y extremos de temperatura nocivos deben proteger sus manos.

Protección De Lesiones a Todo el Cuerpo

En ciertos casos los trabajadores deben proteger la mayor parte de, o todo, su cuerpo contra los peligros en el lugar de trabajo, como en el caso de exposición al calor y a la radiación así como contra metales calientes, líquidos hirvientes, líquidos orgánicos, materiales o desechos peligrosos, entre otros peligros. Además de los materiales de algodón y de lana que retardan el fuego, materiales utilizados en el equipo de protección personal de cuerpo entero incluyen el hule, el cuero, los sintéticos y el plástico.

Cuándo Usar la Protección Respiratoria

Cuando los controles de ingeniería no son factibles, los trabajadores deben utilizar equipo respiratorio para protegerse contra los efectos nocivos a la salud causados al respirar aire contaminado por polvos, brumas, vapores, gases, humos, salpicaduras o emanaciones perjudiciales. Generalmente, el equipo respiratorio tapa la nariz y la boca, o la cara o cabeza entera y ayuda a evitar lesiones o enfermedades. No obstante, un ajuste adecuado es esencial para que sea eficaz el equipo respiratorio. Todo empleado al que se le requiera hacer uso de equipos respiratorios debe primero someterse a un examen médico.

Información Adicional

Puede encontrar más información sobre el equipo de protección personal, incluyendo el texto completo de las normas de OSHA, en el Website de OSHA www.osha.gov. Además, Publicaciones que explican en mayor detalle el tema de PPE pueden obtenerse a través de OSHA. Personal Protective Equipment—OSHA 3077 (Equipo de Protección Personal) Se hallan disponibles en el Website de OSHA. Para más información sobre el equipo de protección personal en la industria de la construcción, visíte www.osha-slc.gov/SLTC/constructionppe/index.html.

Para Ponerse en Contacto de OSHA

Para presentar una queja por teléfono, comunicar una emergencia u obtener consejos, ayuda o productos de OSHA, contacte a su oficina de OSHA más cercana listada bajo “U.S. Department of Labor” en su guía telefónica o llame libre de cargos marcando el (800) 321-OSHA (6742). El número de teleprinter (TTY) es (877) 889-5627. Para presentar una queja en línea u obtener más información sobre los programas federales y estatales de OSHA, visite el Website de OSHA www.osha.gov.

Para información más completa:

OSHA®

Departamento del Trabajo de Estados Unidos

www.osha.gov

(800) 321-OSHA

DOC 7/2010

Name: _____ Date: _____

Knowledge Check: PPE

1. Who is responsible for providing PPE?
    a. The employer
    b. The employee
    c. OSHA
    d. Workers' Compensation

2. Common causes of foot injuries include: crushing, penetration, molten metal, chemicals, slippery surfaces, and sharp objects.
    a. True
    b. False

3. Safety controls must meet the following order of priority:
    a. Substitution, PPE, workaround, and administrative
    b. Workaround, stop work, PPE, and engineering
    c. Stop work, PPE, engineering, and substitution
    d. Substitution, engineering, administrative, and PPE

4. Which type of hard hat would provide the most protection from electrical hazards?
    a. Class A
    b. Class C
    c. Class E
    d. Class G

5. The need for hearing protection is triggered at which decibel level?
    a. When it exceeds 80 decibels
    b. When it exceeds 90 decibels
    c. When it exceeds 100 decibels
    d. When it exceeds 110 decibels

6. Who is responsible for providing specialized work footwear?
    a. The employer
    b. The employee
    c. OSHA
    d. Insurance companies

7. Which of the following is considered approved eye protection?
    a. Sun glasses
    b. Prescription glasses
    c. Reading glasses
    d. Glasses meeting ANSI standard Z87

8. Which of the following is not considered PPE?
    a. Rubber gloves
    b. Glasses meeting ANSI Z87
    c. Sports shoes
    d. Hearing muffs

OSHA FactSheet

Protecting Workers from Asbestos Hazards

Cleaning up after a flood requires hundreds of workers to renovate and repair, or tear down and dispose of, damaged or destroyed structures and materials. However, repair, renovation, and demolition operations often generate airborne asbestos, a mineral fiber that can cause chronic lung disease or cancer. The Occupational Safety and Health Administration (OSHA) has developed regulations designed to protect cleanup workers from asbestos hazards.

How You Can Become Exposed to Asbestos

Before it was known that inhalation of asbestos fibers causes several deadly diseases—including asbestosis, a progressive and often fatal lung disease, and lung and other cancers—asbestos was used in a large number of building materials and other products because of its strength, flame resistance, and insulating properties. Asbestos was used in asbestos-cement pipe and sheeting, floor and roofing felts, dry wall, floor tiles, spray on ceiling coatings, and packing materials. When buildings containing these materials are renovated or torn down, or when the asbestos- containing materials themselves are disturbed, minute asbestos fibers may be released into the air. The fibers are so small that they often cannot be seen with the naked eye; the fact that you can inhale these fibers without knowing it makes asbestos an even more dangerous hazard.

OSHA's Standards for Asbestos

The work of flood cleanup personnel involves the repair, renovation, removal, demolition, or salvage of flood-damaged structures and materials. Such materials may contain or be covered with asbestos, and cleanup personnel are protected by OSHA's construction industry asbestos standard
(Title 29 Code of Federal Regulations (CFR), Part 1926.1101). This standard requires employers to follow various procedures to protect their employees from inhaling asbestos fibers. The standard contains many requirements that vary depending on the kind of work being undertaken, the amount of asbestos in the air, and other factors. You and your employer can obtain a copy of this standard and the booklet, Asbestos Standards for Construction (OSHA 3096) describing how to comply with it, from OSHA Publications, P.O. Box 37535, Washington, DC 20013-7535, (202) 693- 1888(phone), or (202) 693-2498(fax); or visit OSHA's website at www.osha.gov.

Major Elements of OSHA's Asbestos Standard

The following include some of the major requirements of the asbestos standard. For complete information on all requirements, see 29 CFR 1926.1101.

- A permissible exposure limit (PEL) of 0.1 fiber of asbestos per cubic centimeter of air as averaged over an 8-hour period, with an excursion limit of 1.0 asbestos fibers per cubic centimeter over a 30-minute period.
- Requirements for an initial exposure assessment to ascertain expected exposures during that work operation, and periodic expo-sure monitoring in certain instances.
- Use of engineering controls, to the extent feasible, to meet the PEL. Where this is not possible, engineering controls must be used to reduce exposures to the lowest levels possible and then supplemented by the use of appropriate respiratory protection.

- Use of regulated areas to limit access to locations where asbestos concentrations may be dangerously high.
- No smoking, eating, or drinking in asbestos-regulated areas.
- Requirements for warning signs and caution labels to identify and communicate the presence of hazards and hazardous materials; recordkeeping; and medical surveillance.

Additional Information

For more information on this, and other health-related issues impacting workers, visit OSHA's Web site at www.osha.gov.

This is one in a series of informational fact sheets highlighting OSHA programs, policies or standards. It does not impose any new compliance requirements. For a comprehensive list of compliance requirements of OSHA standards or regulations, refer to Title 29 of the Code of Federal Regulations. This information will be made available to sensory impaired individuals upon request. The voice phone is (202) 693-1999; teletypewriter (TTY) number: (877) 889-5627.

For more complete information:

OSHA Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov

(800) 321-OSHA

DSTM 9/2005

OSHA FACT Sheet

Crystalline Silica Exposure
Health Hazard Information

What is crystalline silica?

Crystalline silica is a basic component of soil, sand, granite, and many other minerals. Quartz is the most common form of crystalline silica. Cristobalite and tridymite are two other forms of crystalline silica. All three forms may become respirable size particles when workers chip, cut, drill, or grind objects that contain crystalline silica.

What are the hazards of crystalline silica?

Silica exposure remains a serious threat to nearly 2 million U.S. workers, including more than 100,000 workers in high risk jobs such as abrasive blasting, foundry work, stonecutting, rock drilling, quarry work and tunneling. The seriousness of the health hazards associated with silica exposure is demonstrated by the fatalities and disabling illnesses that continue to occur in sandblasters and rockdrillers. Crystalline silica has been classified as a human lung carcinogen. Additionally, breathing crystalline silica dust can cause **silicosis**, which in severe cases can be disabling, or even fatal. The respirable silica dust enters the lungs and causes the formation of scar tissue, thus reducing the lungs' ability to take in oxygen. There is no cure for silicosis. Since silicosis affects lung function, it makes one more susceptible to lung infections like **tuberculosis.** In addition, smoking causes lung damage and adds to the damage caused by breathing silica dust.

What are the symptoms of silicosis?

Silicosis is classified into three types: chronic/classic, accelerated, and acute.

Chronic/classic silicosis, the most common, occurs after 15–20 years of moderate to low exposures to respirable crystalline silica. Symptoms associated with chronic silicosis may or may not be obvious; therefore, workers need to have a chest x-ray to determine if there is lung damage. As the disease progresses, the worker may experience shortness of breath upon exercising and have clinical signs of poor oxygen/carbon dioxide exchange. In the later stages, the worker may experience fatigue, extreme shortness of breath, chest pain, or respiratory failure.

Accelerated silicosis can occur after 5–10 years of high exposures to respirable crystalline silica. Symptoms include severe shortness of breath, weakness, and weight loss. The onset of symptoms takes longer than in acute silicosis.

Acute silicosis occurs after a few months or as long as 2 years following exposures to extremely high concentrations of respirable crystalline silica. Symptoms of acute silicosis include severe disabling shortness of breath, weakness, and weight loss, which often leads to death.

Where are construction workers exposed to crystalline silica?

Exposure occurs during many different construction activities. The most severe exposures generally occur during abrasive blasting with sand to remove paint and rust from bridges, tanks, concrete structures, and other surfaces. Other construction activities that may result in severe exposure include: jack hammering, rock/well drilling, concrete mixing, concrete drilling, brick and concrete block cutting and sawing, tuck pointing, tunneling operations.

Where are general industry employees exposed to crystalline silica dust?

The most severe exposures to crystalline silica result from abrasive blasting, which is done to clean and smooth irregularities from molds, jewelry, and foundry castings, finish tombstones, etch or frost glass, or remove paint, oils, rust, or dirt form objects needing to be repainted or treated. Other exposures to silica dust occur in cement and brick manufacturing, asphalt pavement manufacturing, china and ceramic manufacturing and the tool and die, steel and foundry industries. Crystalline silica is used in manufacturing, household abrasives, adhesives, paints, soaps, and glass. Additionally, crystalline silica exposures occur in the maintenance, repair and replacement of refractory brick furnace linings.

In the maritime industry, shipyard employees are exposed to silica primarily in abrasive blasting operations to remove paint and clean and prepare steel hulls, bulkheads, decks, and tanks for paints and coatings.

How is OSHA addressing exposure to crystalline silica?

OSHA has an established Permissible Exposure Limit, or PEL, which is the maximum amount of crystalline silica to which workers may be exposed during an 8-hour work shift (29 *CFR* 1926.55, 1910.1000). OSHA also requires hazard

Crystalline Silica Exposure
Health Hazard Information

communication training for workers exposed to crystalline silica, and requires a respirator protection program until engineering controls are implemented. Additionally, OSHA has a National Emphasis Program (NEP) for Crystalline Silica exposure to identify, reduce, and eliminate health hazards associated with occupational exposures.

What can employers/employees do to protect against exposures to crystalline silica?

- Replace crystalline silica materials with safer substitutes, whenever possible.
- Provide engineering or administrative controls, where feasible, such as local exhaust ventilation, and blasting cabinets. Where necessary to reduce exposures below the PEL, use protective equipment or other protective measures.
- Use all available work practices to control dust exposures, such as water sprays.
- Wear only a N95 NIOSH certified respirator, if respirator protection is required. Do not alter the respirator. Do not wear a tight-fitting respirator with a beard or mustache that prevents a good seal between the respirator and the face.
- Wear only a Type CE abrasive-blast supplied-air respirator for abrasive blasting.
- Wear disposable or washable work clothes and shower if facilities are available. Vacuum the dust from your clothes or change into clean clothing before leaving the work site.
- Participate in training, exposure monitoring, and health screening and surveillance programs to monitor any adverse health effects caused by crystalline silica exposures.
- Be aware of the operations and job tasks creating crystalline silica exposures in your workplace environment and know how to protect yourself.
- Be aware of the health hazards related to exposures to crystalline silica. Smoking adds to the lung damage caused by silica exposures.
- Do not eat, drink, smoke, or apply cosmetics in areas where crystalline silica dust is present. Wash your hands and face outside of dusty areas before performing any of these activities.
- Remember: If it's silica, it's not just dust.

How can I get more information on safety and health?

OSHA has various publications, standards, technical assistance, and compliance tools to help you, and offers extensive assistance through workplace consultation, voluntary protection programs, strategic partnerships, alliances, state plans, grants, training, and education. OSHA's *Safety and Health Program Management Guidelines* (*Federal Register* 54:3904-3916, January 26, 1989) detail elements critical to the development of a successful safety and health management system. This and other information are available on OSHA's website.

- For one free copy of OSHA publications, send a self-addressed mailing label to OSHA Publications Office, 200 Constitution Avenue N.W., N-3101, Washington, DC 20210; or send a request to our fax at (202) 693–2498, or call us toll-free at (800) 321–OSHA.
- To order OSHA publications online at **www.osha.gov**, go to **Publications** and follow the instructions for ordering.
- 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 toll-free at **(800) 321– OSHA (6742)**. The 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.

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OSHA
Occupational Safety and Health Administration
U.S. Department of Labor
2002

OSHA HOJA Informativa

Exposición a la sílice cristalina
Información sobre riesgos de la salud

¿Qué es la sílice cristalina?

La sílice cristalina es un componente básico de tierra, arena, granito y muchos otros minerales. El cuarzo es la forma más común de la sílice cristalina. La cristobalita y la tridimita son dos otras formas de la sílice cristalina. Las tres formas pueden convertirse en partículas que se pueden inhalar cuando los trabajadores, tallan, cortan, perforan o trituran objetos que contienen sílice cristalina.

¿Qué son los peligros de la sílice cristalina?

La exposición a la sílice sigue siendo un grave peligro para casi 2 millones de trabajadores en los Estados Unidos, incluyendo a más de 100,000 trabajadores en trabajos de gran riesgo como las limpiezas abrasivas, el trabajo de fundición, tallar piedra, perforar rocas, el trabajo de canteras y los túneles. Las muertes y enfermedades incapacitadoras que ocurren entre los trabajadores que limpian con chorros de arena o que perforan rocas son indicadoras de la gravedad de los riesgos de salud asociados con la exposición a la sílice. La sílice cristalina ha sido clasificada como carcinógena para el pulmón humano. Además, el hecho de respirar el polvo de sílice cristalina puede causar **silicosis**, que en sus aspectos más severos puede resultar en la discapacidad o la muerte. El polvo de sílice respirable entra en los pulmones y crea la formación de tejido de cicatriz reduciendo la capacidad de absorción de oxígeno por los pulmones. La silicosis no tiene cura. Dado que la silicosis afecta el funcionamiento de los pulmones, uno es más susceptible de contraer infecciones pulmonares como la **tuberculosis.** Además el hecho de fumar puede dañar los pulmones y empeorar el daño que causa la inhalación de polvo de sílice.

¿Qué son los síntomas de la silicosis?

Existen tres tipos de silicosis: silicosis crónica/clásica, acelerada y aguda.

La **silicosis crónica/clásica**, la más común, ocurre con 15 a 20 años de exposiciones moderadas o bajas a la sílice cristalina respirable. Los síntomas asociados con la silicosis cróni pueden ser o no ser evidentes; por lo tanto, los trabajadores necesitan hacerse una radiografía del pecho para determinar si se han dañado los pulmones. A medida que avanza la enfermedad, el trabajador puede perder el aliento cuando hace un esfuerzo o tener indicaciones clínicas de un intercambio insuficiente de oxígeno y dióxido de carbono. En las fases posteriores, el trabajador puede sentirse cansado, tener poco aliento, dolor de pecho o insuficiencia respiratoria.

La **silicosis acelerada** puede ocurrir con 5 a 10 años de exposición elevada a la sílice cristalina respirable. Los síntomas incluyen tener muy poco aliento, debilidad y pérdida de peso. El inicio de los síntomas tarda más tiempo que en el caso de la silicosis aguda.

La **silicosis aguda** ocurre en unos cuantos meses o hasta 2 años después de la exposición a muy altas concentraciones de sílice cristalina respirable. Los síntomas de la silicosis aguda incluyen una pérdida de aliento severa e incapacitadora, debilidad y pérdida de peso y suele resultar en la muerte.

¿Dónde se exponen los trabajadores de la construcción a la sílice cristalina?

La exposición ocurre durante varias activida des diferentes de la construcción. Las exposiciones más severas suelen ocurrir durante la limpieza abrasiva con chorros de arena para quitar pintura y derrumbre de puentes, tanques, estructuras de hormigón y de otras superficies. Otras actividades de construcción que pueden resultar en exposiciones graves se asocian con las perforadoras de martillo, la perforación de rocas o pozos, la mezcla de hormigón, la perforación de hormigón, con cortar y serrar ladrillos y bloques de hormigón, con los rejuntados salientes y las operaciones de excavación de túneles.

¿Dónde se exponen los empleados de la industria general al polvo de sílice cristalina?

Las más serias exposiciones a la sílice cristalina son el resultado de la limpieza abrasiva, que se realiza para limpiar y pulir las irregularidades de los moldes, las joyas y los moldes de fundición, del acabado de lápidas sepulcrales, el grabado o esmerilado de vidrio, y de la remoción de pintura, aceites, derrumbres o suciedad de objetos que se deben pintar o tratar. Otras exposiciones a la sílice ocurren en la fabricación de cemento o de ladrillos, la fabricación de pavimentos de asfalto, la fabricación de porcelana o cerámica, y en las industrias de matrices de herramientas, de acero y de fundición. Se utiliza la sílice cristalina en la fabricación, en los productos de limpieza abrasivos caseros, en los adhesivos, las pinturas, los jabones y el vidrio. Además las exposiciones a la sílice cristalina ocurren en tareas de mantenimiento, reparación y reemplazo de revestimientos de hornos de ladrillo refractario.

En la industria marítima, los empleados de astilleros se exponen a la sílice principalmente en las tareas de limpieza abrasiva para quitar pintura y limpiar y preparar tanques, cubiertas, mamparos y cascos metálicos para que se pinten o revistan.

Exposición a la sílice cristalina
Información sobre riesgos de la salud

¿Qué medidas ha iniciado OSHA frente a la exposición de sílice cristalina?

OSHA ha establecido un límite permisible de exposición (Permissible Exposition Limit—PEL) que es la cantidad máxima de sílice cristalino a los que se puedan exponer los trabajadores en un turno de trabajo de 8 horas (29 *CFR* 1926.55, 1910.1000). OSHA también requiere formación de comunicación de peligros para los trabajadores expuestos a la sílice cristalina, y requiere un programa de protección respiratoria hasta que se implementen controles de ingeniería. Además, OSHA ha creado un programa de énfasis nacional (National Emphasis Program—NEP) para la exposición a la sílice cristalina con el fin de identificar, reducir y eliminar los riesgos de salud asociados con las exposiciones ocupacionales.

¿Qué pueden hacer los empleadores y empleados para protegerse contra las exposiciones a la sílice cristalina?

- Reemplazar materiales de sílice cristalina con sustancias seguras, cuando sea posible.
- Brindar controles de ingeniería y administración, en la medida de lo posible, tales como ventilación en la zona y contenedores para la limpieza abrasiva. Donde se requiera reducir las exposiciones a niveles inferiores al límite permisible de exposición, utilizar equipo de protección u otras medidas de protección.
- Utilizar todas las prácticas de trabajo disponibles para controlar las exposiciones al polvo, tales como rociadores de agua.
- Utilizar solamente un respirador certificado "N95 NIOSH," si se requiere protección respiratoria. No se debe modificar el respirador. No se debe utilizar un respirador apretado con una barba o con un bigote que impida un buen encaje entre el respirador y la cara.
- Utilizar solamente un respirador con alimentación de aire para limpieza abrasiva de tipo "Type CE" para la limpieza abrasiva.
- Utilizar ropa de trabajo que se pueda tirar o lavar y ducharse si se hallan duchas disponibles. Utilizar una aspiradora para limpiarse el polvo de la ropa o ponerse ropa limpia antes de salir del lugar de trabajo.
- Participar en la formación, la supervisión de exposición y los programas de análisis y vigilancia con el fin de monitorear cualquier efecto negativo en la salud debido a exposiciones de sílice cristalina.
- Tomar conciencia de las operaciones y tareas que crean exposiciones a la sílice cristalina en el lugar de trabajo y aprender cómo protegerse a uno mismo.
- Tomar conciencia de los peligros de salud asociados con las exposiciones a la sílice cristalina. El hecho de fumar empeora el daño a los pulmones que causan las exposiciones a la sílice.
- No comer, beber, fumar o utilizar productos cosméticos en zonas donde existe polvo de sílice cristalina. Limpiarse las manos y la cara fuera de las zonas que contienen polvo antes de realizar cualquiera de estas tareas.
- ¡No se olvide! Si es sílice no es tan sólo polvo.

¿Cómo obtener más información sobre la seguridad y la salud?

OSHA ofrece varias publicaciones, normas, ayuda técnica y herramientas de conformidad para ayudarle. Asimismo, ofrece una ayuda extensa mediante consultas en el lugar de trabajo, programas voluntarios de protección, subvenciones, asociaciones estratégicas, planes estatales, formación y educación. *Las Directivas de Gestión del Programa de Seguridad y Salud de OSHA* (*Registro Federal* 54:3904-3916, 26 de enero de 1989) presentan información detallada esencial para el desarrollo de un buen sistema de gestión de seguridad y salud. Esta y demás datos se hallan disponibles en el Website de OSHA.

- Para obtener una copia gratis de las publicaciones de OSHA, envíe una etiqueta de correo rotulada con su propia dirección a OSHA Publicaciones Office, P.O. Box 37535, Washington, DC 20013-7535, o envíe una solicitud por fax marcando el (202) 693–2498, o bien llámenos al (202) 693–1888.
- Para pedir publicaciones de OSHA en línea en **www.osha.gov**, diríjase a **Publicaciones** y siga las instrucciones para realizar su pedido.
- Para presentar una demanda por teléfono, comunicar una emergencia u obtener consejos, ayuda o productos de OSHA, contacte a su oficina de OSHA más cercana listada bajo "U.S. Department of Labor" en su anuario telefónico o llame gratis marcando el **(800) 321–OSHA (6742)**. El número de teleprinter (TTY) es (877) 889–5627.
- Para presentar una demanda en línea u obtener mayor información sobre los programas federales y estatales de OSHA, visite el Website de OSHA.

Este texto forma parte de una serie de hojas de datos que enfocan programas, políticas o normas de OSHA y no impone ningún requisito de conformidad nuevo. Para obtener una lista completa de los requisitos de conformidad de las normas y de los reglamentos de OSHA, consulte el *Título 29 del Código de Reglamentos Federales. Esta* información se halla disponible a personas con discapacidad sensorial cuando se solicite. El teléfono de voz es (202) 693–1999. Véase también el Website de OSHA en **www.osha.gov**.

OSHA
Occupational Safety and Health Administration
U.S. Department of Labor
2003

OSHA FactSheet

Protecting Workers from Lead Hazards

Cleaning up after a flood requires hundreds of workers to renovate and repair, or tear down and dispose of, damaged or destroyed structures and materials. Repair, renovation and demolition operations often generate dangerous airborne concentrations of lead, a metal that can cause damage to the nervous system, kidneys, blood forming organs, and reproductive system if inhaled or ingested in danger-ous quantities. The Occupational Safety and Health Administration (OSHA) has developed regulations designed to protect workers involved in construction activities from the hazards of lead exposure.

How You Can Become Exposed to Lead

Lead is an ingredient in thousands of products widely used throughout industry, including lead-based paints, lead solder, electrical fittings and conduits, tank linings, plumbing fixtures, and many metal alloys. Although many uses of lead have been banned, lead-based paints continue to be used on bridges, railways, ships, and other steel structures because of its rust- and corrosion-inhibiting properties. Also, many homes were painted with lead-containing paints. Significant lead exposures can also occur when paint is removed from surfaces previously covered with lead-based paint.

Operations that can generate lead dust and fumes include:

- Demolition of structures;
- Flame-torch cutting;
- Welding;
- Use of heat guns, sanders, scrapers, or grinders to remove lead paint; and
- Abrasive blasting of steel structures

OSHA has regulations governing construc-tion worker exposure to lead. Employers of construction workers engaged in the repair, renovation, removal, demolition, and salvage of flood-damaged structures and materials are responsible for the development and implementation of a worker protection program in accordance with Title 29 Code of Federal Regulations (CFR), Part 1926.62. This program is essential to minimize worker risk of lead exposure. Construction projects vary in their scope and potential for exposing workers to lead and other hazards. Many projects involve only limited exposure, such as the removal of paint from a few interior residential surfaces, while others may involve substantial exposures. Employers must be in compliance with OSHA's lead standard at all times. A copy of the standard and a brochure— Lead in Construction (OSHA 3142) —describing how to comply with it, are avail-able from OSHA Publications, P.O. Box 37535, Washington, D.C. 20013-7535, (202) 693-1888(phone), or (202) 693-2498(fax); or visit OSHA's website at www.osha.gov.

Major Elements of OSHA's Lead Standard

- A permissible exposure limit (PEL) of 50 micrograms of lead per cubic meter of air, as averaged over an 8-hour period.
- Requirements that employers use engineering controls and work practices, where feasible, to reduce worker exposure.
- Requirements that employees observe good personal hygiene practices, such as washing hands before eating and taking a shower before leaving the worksite.
- Requirements that employees be provided with protective clothing and, where necessary, with respiratory protection accordance with 29 CFR 1910.134.

- A requirement that employees exposed to high levels of lead be enrolled in a medical surveillance program.

Additional Information

For more information on this, and other health-related issues impacting workers, visit OSHA's Web site at www.osha.gov.

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For more complete information:

OSHA Occupational Safety and Health Administration

U.S. Department of Labor
www.osha.gov
(800) 321-OSHA

DSTM 11/2005

Name: _____ Date: _____

Knowledge Check: Health Hazards in Construction

1. Which of the following is a common type of health hazard?
    a. Chemical hazards
    b. Economic hazards
    c. Electrical hazards
    d. Fall hazards

2. Which of the following is an example of a physical health hazard?
    a. Asbestos
    b. Noise
    c. Silica
    d. Lead

3. Which is an appropriate engineering control for protection against noise exposures?
    a. Audiograms
    b. Earplugs
    c. Increasing distance between source
    d. Constructing sound barriers

4. Which is a requirement of the employer?
    a. Determine if workers exposures exceed OSHA PELs
    b. Perform medical evaluations on all employees
    c. Develop silica training programs for all employees
    d. Provide workers with steel-toed boots