



Course Instructions

The following pages contain all course materials in addition to a preview of the final exam. The final exam given here is identical to the final exam available online after purchase of the course.

Upon purchase of the course online, you will be directed to a receipt page online which contains the link to take the test online. You will then click that link to be taken to the final exam.

4 Easy Steps to Complete this Course:

- 1. Read the course PDF below.**
- 2. Purchase the course online.**
- 3. Take the final exam (see notes above)**
- 4. Print out your certificate**

Oregon Construction Site Safety Practices Final Exam

- 1.) According to OSHA estimates, how many injuries occur per year on ladders and stairways?
 - a. 25
 - b. 250
 - c. 2,500
 - d. 25,000
- 2.) Which one of the statements below is NOT true about rules that apply to ladders
 - a. It is best to extend the ladder while in use
 - b. Keep areas clear around the top and bottom of ladders
 - c. Face the ladder when moving up or down
 - d. Use at least one hand to grasp the ladder when climbing
- 3.) When portable ladders are used for access to an upper landing surface, the side rails must extend:
 - a. 1 foot about the upper landing surface
 - b. 2 feet above the upper landing surface
 - c. 3 feet above the upper landing surface
 - d. 4 feet above the upper landing surface
- 4.) Nail guns are responsible for an estimated _____ emergency room visits each year:
 - a. 15,000
 - b. 21,000
 - c. 37,000
 - d. 42,000
- 5.) Studies of residential carpenters found that the overall risk of nail gun injury is _____ as high when using contact trigger nail guns compared to using sequential trigger nail guns:
 - a. almost
 - b. twice
 - c. three times
 - d. not
- 6.) An example of a health hazard includes:
 - a. High intensity lighting
 - b. Overexposure to harmful dusts, chemicals or radiation
 - c. Rolling objects
 - d. Sharp edges
- 7.) For heavy gas welding, what is the minimum protective shade number required for filter lenses?
 - a. 3
 - b. 4
 - c. 5
 - d. 6
- 8.) Hard hats must have straps that suspend the shell from _____ away from the head:
 - a. 1 to 1¼ inches
 - b. 1¼ to 1½ inches
 - c. 1½ to 1¾ inches
 - d. 1¾ to 3 inches
- 9.) Each year, on average, between _____ workers are killed and more than 100,000 are injured as a result of falls at construction sites:
 - a. 20 and 30
 - b. 150 and 200
 - c. 50 and 75
 - d. 5 and 10
- 10.) Lanyards and vertical lifelines must have a minimum breaking strength of ____ pounds:
 - a. 1500
 - b. 2500
 - c. 3000
 - d. 5,000

CONTINUING EDUCATION

For Professional
OREGON
Contractors

Stairways and Ladders

Nail Gun Safety

Personal Protective Equipment

Fall Protection in Construction

Stairways and Ladders

INTRODUCTION

Working on and around stairways and ladders is hazardous. Stairways and ladders are major sources of injuries and fatalities among construction workers for example, and many of the injuries are serious enough to require time off the job. OSHA estimates that there are almost 25,000 injuries and as many as 36 fatalities per year due to falls on stairways and ladders used in construction.

OSHA rules apply to all stairways and ladders used in construction, alteration, repair, painting, decorating and demolition of worksites covered by OSHA's construction safety and health standards.

This course is based on OSHA's 29 CFR 1926.1050-1060 (Subpart X)

GENERAL REQUIREMENTS

These rules specify when employers must provide stairways and ladders. In general, the standards require the following:

- When there is a break in elevation of 19 inches (48 cm) or more and no ramp, runway, embankment or personnel hoist is available, employers must provide a stairway or ladder at all worker points of access.
- When there is only one point of access between levels, employers must keep it clear of obstacles to permit free passage by workers. If free passage becomes restricted, employers must provide a second point of access and ensure that workers use it.
- When there are more than two points of access between levels, employers must ensure that at least one point of access remains clear.

In addition, employers must install all stairway and ladder fall protection systems required by these rules and ensure that their worksite meets all requirements of the stairway and ladder rules before employees use stairways or ladders.

Note: The standard does not apply to ladders specifically manufactured for scaffold access and egress, but does apply to job-made and manufactured portable ladders intended for general purpose use. Rules for ladders used on or with scaffolds are addressed in 29 CFR 1926.451 Subpart L.

RULES FOR LADDERS

All Ladders

The following rules apply to all ladders:

- Maintain ladders free of oil, grease and other slipping hazards.
- Do not load ladders beyond their maximum intended load nor beyond their manufacturer's rated capacity.
- Use ladders only for their designed purpose.
- Use ladders only on stable and level surfaces unless secured to prevent accidental movement.
- Do not use ladders on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental movement.
- Do not use slip resistant feet as a substitute for exercising care when placing, lashing or holding a ladder upon slippery surfaces.
- Secure ladders placed in areas such as passageways, doorways or driveways, or where they can be displaced by workplace activities or traffic to prevent accidental movement. Or use a barricade to keep traffic or activity away from the ladder.
- Keep areas clear around the top and bottom of ladders.
- Do not move, shift or extend ladders while in use.
- Use ladders equipped with nonconductive side rails if the worker or the ladder could contact exposed energized electrical equipment.
- Face the ladder when moving up or down.
- Use at least one hand to grasp the ladder when climbing.
- Do not carry objects or loads that could cause loss of balance and falling.

In addition, the following general requirements apply to all ladders, including ladders built at the jobsite:

- Double-cleated ladders or two or more ladders must be provided when ladders are the only way to enter or exit a work area where 25 or more employees work or when a ladder serves simultaneous two-way traffic.
- Ladder rungs, cleats and steps must be parallel, level and uniformly spaced when the ladder is in position for use.
- Rungs, cleats and steps of portable and fixed ladders (except as provided below) must not be spaced less than 10 inches (25 cm) apart, nor more than 14 inches (36 cm) apart, along the ladder's side rails.
- Rungs, cleats and steps of step stools must not be less

than 8 inches (20 cm) apart, nor more than 12 inches (31 cm) apart, between center lines of the rungs, cleats and steps.

- Rungs, cleats and steps at the base section of extension trestle ladders must not be less than 8 inches (20 cm) nor more than 18 inches (46 cm) apart, between center lines of the rungs, cleats and steps. The rung spacing on the extension section must not be less than 6 inches (15 cm) nor more than 12 inches (31 cm).
- Ladders must not be tied or fastened together to create longer sections unless they are specifically designed for such use.
- When splicing side rails, the resulting side rail must be equivalent in strength to a one-piece side rail made of the same material.
- Two or more separate ladders used to reach an elevated work area must be offset with a platform or landing between the ladders, except when portable ladders are used to gain access to fixed ladders.
- Ladder components must be surfaced to prevent snagging of clothing and injury from punctures or lacerations.
- Wood ladders must not be coated with any opaque covering except for identification or warning labels, which may be placed only on one face of a side rail.

Note: A competent person must inspect ladders for visible defects periodically and after any incident that could affect their safe use.

Specific Types of Ladders

- Do not use single-rail ladders.
- Use non-self-supporting ladders at an angle where the horizontal distance from the top support to the foot of the ladder is approximately one-quarter of the working length of the ladder.
- Use wooden ladders built at the jobsite with spliced side rails at an angle where the horizontal distance is one-eighth of the working length of the ladder.

In addition, the top of a non-self-supporting ladder must be placed with two rails supported equally unless it is equipped with a single support attachment.

Step Ladders

- Do not use the top or top step of a step ladder as a step.
- Do not use cross bracing on the rear section of step ladders for climbing unless the ladders are designed and provided with steps for climbing on both front and rear sections.
- Metal spreader or locking devices must be provided

on step ladders to hold the front and back sections in an open position when ladders are being used.

Portable Ladders

The minimum clear distance between side rails for all portable ladders must be 11.5 inches (29 cm).

In addition, the rungs and steps of portable metal ladders must be corrugated, knurled, dimpled, coated with skid-resistant material or treated to minimize slipping.

Non-self-supporting and self-supporting portable ladders must support at least four times the maximum intended load; extra heavy-duty type 1A metal or plastic ladders must sustain 3.3 times the maximum intended load. To determine whether a self-supporting ladder can sustain a certain load, apply the load to the ladder in a downward vertical direction with the ladder placed at a horizontal angle of 75.5 degrees.

When portable ladders are used for access to an upper landing surface, the side rails must extend at least 3 feet (.9 m) above the upper landing surface. When such an extension is not possible, the ladder must be secured and a grasping device such as a grab rail must be provided to assist workers in mounting and dismounting the ladder. A ladder extension must not deflect under a load that would cause the ladder to slip off its supports.

Fixed Ladders

- If the total length of the climb on a fixed ladder equals or exceeds 24 feet (7.3 m), the ladder must be equipped with ladder safety devices; or self-retracting lifelines and rest platforms at intervals not to exceed 150 feet (45.7 m); or a cage or well and multiple ladder sections with each ladder section not to exceed 50 feet (15.2 m) in length. These ladder sections must be offset from adjacent sections and landing platforms must be provided at maximum intervals of 50 feet (15.2 m). In addition, fixed ladders must meet the following requirements:
- Fixed ladders must be able to support at least two loads of 250 pounds (114 kg) each, concentrated between any two consecutive attachments. Fixed ladders also must support added anticipated loads caused by ice buildup, winds, rigging and impact loads resulting from using ladder safety devices.
- Individual rung/step ladders must extend at least 42 inches (1.1 m) above an access level or landing platform either by the continuation of the rung spacings as horizontal grab bars or by providing vertical grab bars that must have the same lateral spacing as the vertical legs of the ladder rails.
- Each step or rung of a fixed ladder must be able to support a load of at least 250 pounds (114 kg) applied in the middle of the step or rung.

- Minimum clear distance between the sides of individual rung/step ladders and between the side rails of other fixed ladders must be 16 inches (41 cm).
- Rungs of individual rung/step ladders must be shaped to prevent slipping off the end of the rungs.
- Rungs and steps of fixed metal ladders manufactured after March 15, 1991, must be corrugated, knurled, dimpled, coated with skid-resistant material or treated to minimize slipping.
- Minimum perpendicular clearance between fixed ladder rungs, cleats, and steps and any obstruction behind the ladder must be 7 inches (18 cm), except that the clearance for an elevator pit ladder must be 4.5 inches (11 cm).
- Minimum perpendicular clearance between the centerline of fixed ladder rungs, cleats and steps, and any obstruction on the climbing side of the ladder must be 30 inches (76 cm). If obstructions are unavoidable, clearance may be reduced to 24 inches (61 cm), provided a deflection device is installed to guide workers around the obstruction.
- Step-across distance between the center of the steps or rungs of fixed ladders and the nearest edge of a landing area must be no less than 7 inches (18 cm) and no more than 12 inches (30 cm). A landing platform must be provided if the step-across distance exceeds 12 inches (30 cm).
- Fixed ladders without cages or wells must have at least a 15-inch (38 cm) clearance width to the nearest permanent object on each side of the centerline of the ladder.
- Fixed ladders must be provided with cages, wells, ladder safety devices or self-retracting lifelines where the length of climb is less than 24 feet (7.3 m) but the top of the ladder is at a distance greater than 24 feet (7.3 m) above lower levels.
- Side rails of through or side-step fixed ladders must extend 42 inches (1.1 m) above the top level or landing platform served by the ladder. Parapet ladders must have an access level at the roof if the parapet is cut to permit passage through it. If the parapet is continuous, the access level is the top of the parapet.
- Steps or rungs for through-fixed-ladder extensions must be omitted from the extension; and the extension of side rails must be flared to provide between 24 inches (61 cm) and 30 inches (76 cm) clearance between side rails.
- When safety devices are provided, the maximum clearance distance between side rail extensions must not exceed 36 inches (91 cm).
- Fixed ladders must be used at a pitch no greater than 90 degrees from the horizontal, measured from the back side of the ladder.

Cages for Fixed Ladders

The requirements for cages for fixed ladders are as follows:

- Horizontal bands must be fastened to the side rails of rail ladders or directly to the structure, building or equipment for individual-rung ladders.
- Vertical bars must be on the inside of the horizontal bands and must be fastened to them.
- Cages must not extend less than 27 inches (68 cm), or more than 30 inches (76 cm) from the centerline of the step or rung and must not be less than 27 inches (68 cm) wide.
- Insides of cages must be clear of projections.
- Horizontal bands must be spaced at intervals not more than 4 feet (1.2 m) apart measured from centerline to centerline.
- Vertical bars must be spaced at intervals not more than 9.5 inches (24 cm), measured centerline to centerline.
- Bottoms of cages must be between 7 feet (2.1 m) and 8 feet (2.4 m) above the point of access to the bottom of the ladder. The bottom of the cage must be flared not less than 4 inches (10 cm) between the bottom horizontal band and the next higher band.
- Tops of cages must be a minimum of 42 inches (1.1 m) above the top of the platform or the point of access at the top of the ladder. There must be a way to access the platform or other point of access.

Wells for Fixed Ladders

The requirements for wells for fixed ladders are as follows:

- Wells must completely encircle the ladder.
- Wells must be free of projections.
- Inside faces of wells on the climbing side of the ladder must extend between 27 inches (68 cm) and 30 inches (76 cm) from the centerline of the step or rung.
- Inside widths of wells must be at least 30 inches (76 cm).
- Bottoms of wells above the point of access to the bottom of the ladder must be between 7 feet (2.1 m) and 8 feet (2.4 m).

Ladder Safety Devices and Related Support Systems for Fixed Ladders

The connection between the carrier or lifeline and the point of attachment to the body belt or harness must not exceed 9 inches (23 cm) in length. In addition,

ladder safety devices and related support systems on fixed ladders must conform to the following:

- All safety devices must be able to withstand, without failure, a drop test consisting of a 500-pound weight (226 kg) dropping 18 inches (41 cm).
- All safety devices must permit the worker to ascend or descend without continually having to hold, push or pull any part of the device, leaving both hands free for climbing.
- All safety devices must be activated within 2 feet (.61 m) after a fall occurs and limit the descending velocity of an employee to 7 feet/second (2.1 m/sec) or less.

Requirements for Mounting Ladder Safety Devices for Fixed Ladders

The requirements for mounting ladder safety devices for fixed ladders are as follows:

- Mountings for rigid carriers must be attached at each end of the carrier, with intermediate mountings spaced along the entire length of the carrier, to provide the necessary strength to stop workers' falls.
- Mountings for flexible carriers must be attached at each end of the carrier. Cable guides for flexible carriers must be installed with a spacing between 25 feet (7.6 m) and 40 feet (12.2 m) along the entire length of the carrier, to prevent wind damage to the system.
- Design and installation of mountings and cable guides must not reduce the strength of the ladder.
- Side rails and steps or rungs for side-step fixed ladders must be continuous in extension.

Defective Ladders

Ladders needing repairs are subject to the following rules:

- Portable ladders with structural defects—such as broken or missing rungs, cleats or steps, broken or split rails, corroded components or other faulty or defective components—must immediately be marked defective or tagged with "Do Not Use" or similar language and withdrawn from service until repaired.
- Fixed ladders with structural defects—such as broken or missing rungs, cleats or steps, broken or split rails or corroded components—must be withdrawn from service until repaired.
- Defective fixed ladders are considered withdrawn from use when they are immediately tagged with "Do Not Use" or similar language, or marked in a manner that identifies them as defective, or blocked—such as with a plywood attachment that spans several rungs.

- Ladder repairs must restore the ladder to a condition meeting its original design criteria before the ladder is returned to use.

RULES FOR STAIRWAYS

The rules covering stairways and their components generally depend on how and when stairs are used. Specifically, there are rules for stairs used during construction and stairs used temporarily during construction, as well as rules governing stair rails and handrails.

Stairways Used During Construction

The following requirements apply to all stairways used during construction:

- Stairways that will not be a permanent part of the building under construction must have landings at least 30 inches deep and 22 inches wide (76 x 56 cm) at every 12 feet (3.7 m) or less of vertical rise.
- Stairways must be installed at least 30 degrees—and no more than 50 degrees—from the horizontal.
- Variations in riser height or stair tread depth must not exceed 1/4 inch in any stairway system, including any foundation structure used as one or more treads of the stairs.
- Doors and gates opening directly onto a stairway must have a platform that extends at least 20 inches (51 cm) beyond the swing of the door or gate.
- Metal pan landings and metal pan treads must be secured in place before filling.
- Stairway parts must be free of dangerous projections such as protruding nails.
- Slippery conditions on stairways must be corrected.
- Workers must not use spiral stairways that will not be a permanent part of the structure.

Temporary Stairs

The following requirements apply to stairways used temporarily during construction.

Except during construction of the stairway,

- Do not use stairways with metal pan landings and treads if the treads and/or landings have not been filled in with concrete or other materials unless the pans of the stairs and/or landings are temporarily filled in with wood or other materials. All treads and landings must be replaced when worn below the top edge of the pan.
- Do not use skeleton metal frame structures and steps (where treads and/or landings will be installed later) unless the stairs are fitted with secured temporary

treads and landings.

Note: Temporary treads must be made of wood or other solid material and installed the full width and depth of the stair.

Stair Rails

The following general requirements apply to all stair rails:

- Stairways with four or more risers or rising more than 30 inches (76 cm) in height—whichever is less—must be installed along each unprotected side or edge. When the top edge of a stair rail system also serves as a handrail, the height of the top edge must be no more than 37 inches (94 cm) nor less than 36 inches (91.5 cm) from the upper surface of the stair rail to the surface of the tread.
- Stair rails installed after March 15, 1991, must be not less than 36 inches (91.5 cm) in height.
- Top edges of stair rail systems used as handrails must not be more than 37 inches (94 cm) high nor less than 36 inches (91.5 cm) from the upper surface of the stair rail system to the surface of the tread. (If installed before March 15, 1991, not less than 30 inches).
- Stair rail systems and handrails must be surfaced to prevent injuries such as punctures or lacerations and to keep clothing from snagging.
- Ends of stair rail systems and handrails must be built to prevent dangerous projections, such as rails protruding beyond the end posts of the system.

In addition,

- Unprotected sides and edges of stairway landings must have standard 42-inch (1.1 m) guardrail systems.
- Intermediate vertical members, such as balusters used as guardrails, must not be more than 19 inches (48 cm) apart.
- Other intermediate structural members, when used, must be installed so that no openings are more than 19 inches (48 cm) wide.
- Screens or mesh, when used, must extend from the top rail to the stairway step and along the opening between top rail supports.

Handrails

Requirements for handrails are as follows:

- Handrails and top rails of the stair rail systems must be able to withstand, without failure, at least 200 pounds (890 n) of weight applied within 2 inches (5 cm) of the top edge in any downward or outward direction, at any point along the top edge.

- Handrails must not be more than 37 inches (94 cm) high nor less than 30 inches (76 cm) from the upper surface of the handrail to the surface of the tread.
- Handrails must provide an adequate handhold for employees to grasp to prevent falls.
- Temporary handrails must have a minimum clearance of 3 inches (8 cm) between the handrail and walls, stair rail systems and other objects.
- Stairways with four or more risers, or that rise more than 30 inches (76 cm) in height— whichever is less—must have at least one handrail.
- Winding or spiral stairways must have a handrail to prevent use of areas where the tread width is less than 6 inches (15 cm).

Midrails

Midrails, screens, mesh, intermediate vertical members or equivalent intermediate structural members must be provided between the top rail and stairway steps to the stair rail system. When midrails are used, they must be located midway between the top of the stair rail system and the stairway steps.

TRAINING REQUIREMENTS

Employers must train all employees to recognize hazards related to ladders and stairways, and instruct them to minimize these hazards. For example, employers must ensure that each employee is trained by a competent person in the following areas, as applicable:

- Nature of fall hazards in the work area;
- Correct procedures for erecting, maintaining and disassembling the fall protection systems to be used;
- Proper construction, use, placement and care in handling of all stairways and ladders; and
- Maximum intended load-carrying capacities of ladders used.

Note: Employers must retrain each employee as necessary to maintain their understanding and knowledge on the safe use and construction of ladders and stairs.

GLOSSARY

cleat — A ladder crosspiece of rectangular cross section placed on edge upon which a person may step while ascending or descending a ladder.

double-cleat ladder —A ladder with a center rail to allow simultaneous two-way traffic for employees ascending or descending.

failure — Load refusal, breakage or separation of components.

fixed ladder — A ladder that cannot be readily moved or carried because it is an integral part of a building or structure.

handrail — A rail used to provide employees with a handhold for support.

job-made ladder — A ladder that is fabricated by employees, typically at the construction site; non-commercially manufactured. **load refusal** — The point where the structural members lose their ability to carry the load.

point of access — All areas used by employees for work-related passage from one area or level to another.

portable ladder — A ladder that can be readily moved or carried.

riser height — The vertical distance from the top of a tread or platform/landing to the top of the next higher tread or platform/landing.

side-step fixed ladder — A fixed ladder that requires a person to get off at the top to step to the side of the ladder side rails to reach the landing.

single-cleat ladder — A ladder consisting of a pair of side rails connected together by cleats, rungs or steps.

stair rail system — A vertical barrier erected along the unprotected sides and edges of a stairway to prevent employees from falling to lower levels.

temporary service stairway — A stairway where permanent treads and/or landings are to be filled in at a later date.

through fixed ladder — A fixed ladder that requires a person getting off at the top to step between the side rails of the ladder to reach the landing.

tread depth — The horizontal distance from front to back of a tread, excluding nosing, if any.

Nail Gun Safety

A Guide for Construction Contractors

INTRODUCTION

Nail guns are used every day on many construction jobs—especially in residential construction. They boost productivity but also cause tens of thousands of painful injuries each year. Nail gun injuries are common—one study found that 2 out of 5 residential carpenter apprentices experienced a nail gun injury over a four-year period. When they do occur, these injuries are often not reported or given any medical treatment. Research has identified the risk factors that make nail gun injuries more likely to occur. The type of trigger system and the extent of training are important factors. The risk of a nail gun injury is twice as high when using a multi-shot contact trigger as when using a single-shot sequential trigger nailer.

This course is for residential home builders and construction contractors, subcontractors, and supervisors. The course was developed to give construction employers the information they need to prevent nail gun injuries. Throughout the course types of triggers and key terms are described. The course also highlights what is known about nail gun injuries, including the parts of the body most often injured and the types of severe injuries that have been reported. Common causes of nail gun injuries are discussed, and six practical steps that contractors can take to prevent these injuries are described. These steps are:

- 1) Use full sequential trigger nail guns;
- 2) Provide training;
- 3) Establish nail gun work procedures;
- 4) Provide personal protective equipment (PPE);
- 5) Encourage reporting and discussion of injuries and close calls; and
- 6) Provide first aid and medical treatment.

This Nail Gun Safety course includes actual workplace cases along with a short section on other types of nail gun hazards and sources of additional information.

Nail guns are powerful, easy to operate, and boost productivity for nailing tasks. They are also responsible for an estimated 37,000 emergency room visits each year. Severe

nail gun injuries have led to construction worker deaths.

Nail gun injuries are common in residential construction. About two-thirds of these injuries occur in framing and sheathing work. Injuries also often occur in roofing and exterior siding and finishing.

How likely are nail gun injuries? A study of apprentice carpenters found that:

- 2 out of 5 were injured using a nail gun during their 4 years of training.
- 1 out of 5 were injured twice.
- 1 out of 10 were injured three or more times.

More than half of reported nail gun injuries are to the hand and fingers. One-quarter of these hand injuries involve structural damage to tendons, joints, nerves, and bones. After hands, the next most often injured are the leg, knee, thigh, foot, and toes. Less common are injuries to the forearm or wrist, head and neck, and trunk. Serious nail gun injuries to the spinal cord, head, neck, eye, internal organs, and bones have been reported. Injuries have resulted in paralysis, blindness, brain damage, bone fractures, and death.

Nail guns present a number of hazards and risks. We have prepared this publication to provide builders and contractors with the latest information on nail gun hazards and practical advice on the steps you should take to prevent nail gun injuries on construction jobs.

This course covers nail guns (also called nailers) used for fastening wood, shingles, and siding materials. The course refers specifically to pneumatic tools but also applies to nail guns that use gas, electric, or hybrid power sources. It does NOT cover powder actuated tools used for fastening material to metal or concrete. This course assumes that contractors are generally familiar with how nail guns work and the various types of specialized nail guns (for example, framing, roofing, flooring).

This course is applicable to all nail guns. The emphasis is on framing (“stick” and “coil”) nail guns because they fire the largest nails, are the most powerful, and are considered to be the most dangerous to use.

- Worksite story -

A 26-year-old Idaho construction worker died following a nail gun accident in April 2007. He was framing a house when he slipped and fell. During the fall, his finger was on the contact trigger of the nail gun he had been using. The nosepiece hit his head as he fell, driving a 3-inch nail into his skull. The nail injured his brain stem, causing his death. When inspected afterward, the safety controls on the nail gun were found to be intact. Death and serious injury can occur while using nail guns—even when they are working properly.



TRIGGERS

Nail gun safety starts with understanding the various trigger mechanisms. Here is what you need to know:

How triggers differ

All nailers rely on two basic controls: a finger trigger and a contact safety tip located on the nose of the gun. Trigger mechanisms can vary based on: 1) the order in which the controls are activated, and 2) whether the trigger can be held in the squeezed position to discharge multiple nails OR if it must be released and then squeezed again for each individual nail. Combining these variations gives four kinds of triggers. Some nail guns have a selective trigger switch which allows the user to choose among two or more trigger systems. Each trigger type is described below along with a summary of how the controls are activated.

Full Sequential trigger

This is the safest type of nail gun trigger. This trigger will only fire a nail when the controls are activated in a certain order. First, the safety contact tip must be pushed into the work piece, then the user squeezes the trigger to discharge a nail. Both the safety contact tip and the trigger must be released and activated again to fire a second nail. Nails cannot be bump fired. Also known as singleshot trigger, restrictive trigger, or trigger fire mode.

Single nail:

Push safety contact, then squeeze trigger

Multiple nails:

Release both safety contact and trigger and repeat process

Contact trigger

Fires a nail when the safety contact and trigger are activated in any order. You can push the safety contact tip first and then squeeze the trigger, or you can squeeze the trigger first and then push the safety contact tip. If the trigger is kept squeezed, a nail will be driven each time the safety contact is pushed in. This is called bump firing or bounce nailing, and all nails can be bump fired. This might also be known

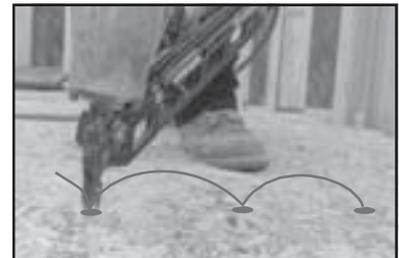
Illustrated terms



Trigger



Contact safety tip



Bump firing or bounce nailing is using a nail gun with a contact trigger held squeezed and bumping or bouncing the tool along the work piece to fire nails.

Red dots show path of motion.



as bump trigger, multi-shot trigger, successive trigger, dual-action, touch trip, contact trip, and bottom fire.

Single nail:

Push safety contact, then squeeze trigger, or squeeze trigger, then push safety contact

Multiple nails:

Squeeze and hold trigger, then push safety contact to fire one nail, move and push safety contact again to fire additional nails

Single Sequential trigger

Like the full sequential trigger, this trigger will only fire a nail when the controls are activated in a certain order. First, the safety contact tip must be pushed into the work piece. Then, the user squeezes the trigger to discharge a nail. To fire a second nail, only the trigger must be released. The safety contact tip can stay pressed into the work piece. Nails cannot be bump fired.

Single nail:

Push safety contact, then squeeze trigger

Multiple nails:

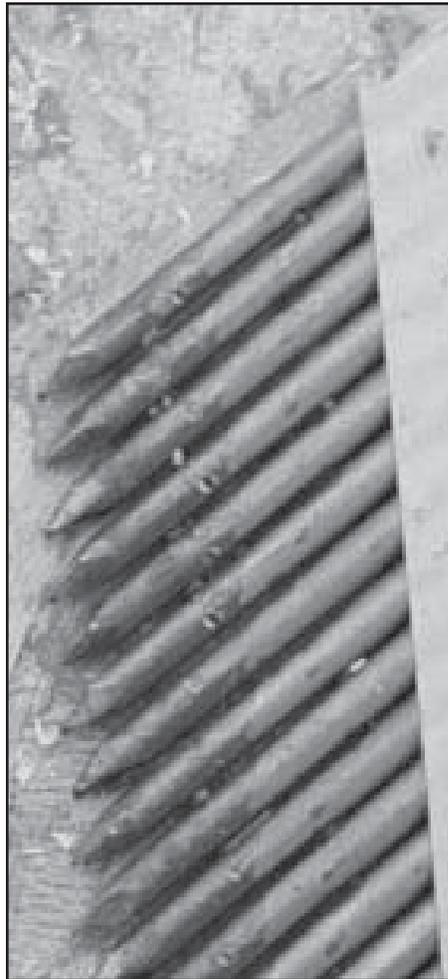
Release trigger, move tool, and squeeze trigger to fire additional nail

Single Actuation trigger

Like the contact trigger, this trigger will fire a single nail when the safety contact and trigger are activated in any order. A second nail can be fired by releasing the trigger, moving the tool and squeezing the trigger again without releasing the safety contact tip. Note that some manufacturers refer to these triggers as “single sequential triggers”, but they are different. The first nail can be bump fired with a single actuation trigger but not with a true single sequential trigger.

Single nail:

Push safety contact, squeeze trigger, or squeeze trigger, then push safety contact to fire



Multiple nails:

Release trigger, move tool, and squeeze trigger to fire additional nail

Other trigger terms

The International Staple, Nail and Tool Association (ISANTA) voluntary standard includes technical definitions for trigger “actuation systems”. Tool manufacturers have names for trigger modes such as “intermittent operation method” or “precision placement driving”. Contractors and workers use their own names for triggers and operating modes such as “single shot” and “multi-shot”.

The bottom line: contractors should check the tool label and manual for manufacturer-specific trigger names and operating information.

Worksite story

Two framers were working together to lay down and nail a subfloor. One framer was waiting and holding the nail gun with his finger on the contact trigger. The other framer was walking backwards toward him and dragging a sheet of plywood. The framer handling the plywood backed into the tip of the nail gun and was shot in the back. The nail nicked his kidney, but fortunately he recovered. As a result of this incident, the contractor switched to using only sequential triggers on framing nail guns. Co-workers can get injured if they bump into your contact trigger nail gun. You can prevent this by using a full sequential trigger.

Useful terms

Recoil is the rapid rebound or kickback after the nailer is fired.

A double fire occurs when a second nail unintentionally fires because the nailer recontacted the work piece after recoil. It can also occur if the safety contact slips while the user is positioning the nail gun. Several tool manufacturers offer “anti-double fire” features for their nail guns.

You should know

Unintended nail discharge is a common source of injuries. A study of workers’ compensation records found that two-thirds of nail gun injury claims involved some type of unintended nail gun discharge or misfire.

HOW NAIL GUN INJURIES HAPPEN

There are seven major risk factors that can lead to a nail gun injury. Understanding them will help you to prevent injuries on your jobsites.

Unintended nail discharge from double fire.

Occurs with CONTACT triggers.

The Consumer Product Safety Commission (CPSC) found that contact trigger nailers are susceptible to double firing, especially when trying to accurately place the nailer against the work piece. The CPSC found that a second unintended firing can happen faster than the user is able to react and release the trigger.

Unintended nails can cause injuries.

Double fire can be a particular problem for new workers who may push hard on the tool to compensate for recoil. It can also occur when the user is working in an awkward position, such as in tight spaces where the gun doesn't have enough space to recoil. The recoil of the gun itself can even cause a non-nail injury in tight spaces if the nail gun hits the user's head or face.

Unintended nail discharge from knocking the safety contact with the trigger squeezed.

Occurs with CONTACT and SINGLE ACTUATION triggers.

Nail guns with contact and single actuation triggers will fire if the trigger is being held squeezed and the safety contact tip gets knocked or pushed into an object or person by mistake. For example, a framer might knock his leg going down a ladder or bump into a co-worker passing through a doorway. Contact trigger nailers can release multiple nails, and single actuation trigger nailers can release a single nail to cause injury.

Holding or carrying contact trigger or single actuation trigger nail guns with the trigger squeezed increases the risk of unintended nail discharge.

Construction workers tend to keep a finger on the trigger because it is more natural to hold and carry an 8-pound nail gun using a full, four-finger grip. Tool manufacturers, however, do warn against it.

Nail penetration through lumber work piece.

Occurs with ALL trigger types.

Nails can pass through a work piece and either hit the worker's hand or fly off as a projectile (airborne) nail. A blow-out nail is one example. Blow-outs can occur when a nail is placed near a knot in the wood. Knots involve a change in wood grain, which creates both weak spots and hard spots that can make the nail change direction and exit the work piece. Nail penetration is especially a concern for placement work where a piece of lumber needs to be held in place by hand. If the nail misses or breaks through the lumber it can injure the non-dominant hand holding it.

Nail ricochet after striking a hard surface or metal feature.

Occurs with ALL trigger types.

When a nail hits a hard surface, it has to change direction and it can bounce off the surface, becoming a projectile. Wood knots and metal framing hardware are common causes of ricochets. Problems have also been noted with ricochets when nailing into dense laminated beams. Ricochet nails can strike the worker or a co-worker to cause an injury.

Missing the work piece.

Occurs with ALL trigger types.

Injuries may occur when the tip of the nail gun does not make full contact with the work piece and the discharged nail becomes airborne. This can occur when nailing near the edge of a work piece, such as a plate. Positioning the safety contact is more difficult in these situations and sometimes the fired nail completely misses the lumber. Injuries have also occurred when a nail shot through

Illustrated terms



Common nail gun grip with finger on trigger



Nail penetration through the lumber is a special concern where the piece is held in place by hand



Toe-nailing

Worksite story

A carpenter apprentice on his first day ever using a nail gun injured his right leg. He was working on a step ladder and was in the process of lowering the nail gun to his side when the gun struck his leg and fired a nail into it. He had no training prior to using the nail gun. New worker training is important and should include hands-on skills.

You should know

Studies of residential carpenters found that the overall risk of nail gun injury is twice as high when using contact trigger nail guns compared to using sequential trigger nail guns.⁸

Note that the studies could not quantify injury risks associated with specific tasks; it is likely that some nailing tasks are more dangerous than others.

About 1 in 10 nail gun injuries happen to co-workers.⁹ This is from either airborne (projectile) nails or bumping into a co-worker while carrying a contact trigger nail gun with the trigger squeezed.

A voluntary ANSI standard¹⁰ calls for all large pneumatic framing nailers manufactured after 2003 to be shipped with a sequential trigger. However, these may not always be FULL SEQUENTIAL triggers. Contractors may need to contact manufacturers or suppliers to purchase a FULL SEQUENTIAL trigger kit.

plywood or oriented strand board sheathing missed a stud and became airborne.

Awkward position nailing.

Occurs with ALL trigger types.

Unintended discharges are a concern in awkward position work with CONTACT and SINGLE ACTUATION triggers.

Nailing in awkward positions where the tool and its recoil are more difficult to control may increase the risk of injury. These include toe-nailing, nailing above shoulder height, nailing in tight quarters, holding the nail gun with the non-dominant hand, nailing while on a ladder, or nailing when the user's body is in the line of fire (nailing towards yourself). Toe-nailing is awkward because the gun cannot be held flush against the work piece. Nailing from a ladder makes it difficult to position the nail gun accurately. Nailing beyond a comfortable reach distance from a ladder, elevated work platform, or leading edge also places the user at risk for a fall.

Bypassing safety mechanisms.

Occurs with ALL trigger types.

Bypassing or disabling certain features of either the trigger or safety contact tip is an important risk of injury. For example, removing the spring from the safety contact tip makes an unintended discharge even more likely. Modifying tools can lead to safety problems for anyone who uses the nail gun. Nail gun manufacturers strongly recommend against bypassing safety features, and voluntary standards prohibit modifications or tampering.⁷ OSHA's Construction standard at 29 CFR 1926.300(a) requires that all hand and power tools and similar equipment, whether furnished by the employer or the employee shall be maintained in a safe condition.

Worksite story

After his crews experienced many double fires and a related serious nail gun injury, a New Jersey contractor switched to using only sequential triggers. He believes he has eliminated the risk of double fire injuries and he estimates that the change has had only a slight impact on productivity—a few extra hours per house.



SIX STEPS TO NAIL GUN SAFETY

1 Use the full sequential trigger

The full sequential trigger is always the safest trigger mechanism for the job. It reduces the risk of unintentional nail discharge and double fires—including injuries from bumping into co-workers.

- At a minimum, provide full sequential trigger nailers for placement work where the lumber needs to be held in place by hand. Examples include building walls and nailing blocking, fastening studs to plates and blocks to studs, and installing trusses.

Unintended nail discharge is more likely to lead to a hand or arm injury for placement work compared to flat work, where the lumber does not need to be held in place by hand. Examples of flat work include roofing, sheathing, and subflooring.

- Consider restricting inexperienced employees to full sequential trigger nail guns starting out. Some contractors using more than one type of trigger on their jobs color-code the nail guns so that the type of trigger can be readily identified by workers and supervisors.
- Some contractors have been reluctant to use full sequential triggers fearing a loss of productivity. How do the different types of triggers compare?

The one available study had 10 experienced framers stick-build two identical small (8 ft x 10 ft) wood structures—one using a sequential trigger nail gun and one using a contact trigger nail gun. Small structures were built in this study so that there would be time for each carpenter to complete two sheds.

Average nailing time using the contact trigger was 10% faster, which accounted for less than 1% of the total building time when cutting and layout was included.¹¹ However, in this study the trigger type was less important to overall productivity than who was using the tool; this suggests productivity concerns should focus on the skill of the carpenter rather than on the trigger.

Although the study did not evaluate framing a residence or light commercial building, it shows that productivity is not just about the trigger. The wood structures built for the study did include common types of nailing tasks (flat nailing, through nailing, toe-nailing) and allowed comparisons for both total average nailing time and overall project time. The study did not compare productivity differences for each type of nailing task used to build the sheds.

2 Provide training

Both new and experienced workers can benefit from safety training to learn about the causes of nail gun injuries and specific steps to reduce them. Be sure that training is provided in a manner that employees can understand. Here is a list of topics for training:

- How nail guns work and how triggers differ.
- Main causes of injuries – especially differences among types of triggers.
- Instructions provided in manufacturer tool manuals and where the manual is kept.
- Hands-on training with the actual nailers to be used on the job. This gives each employee an opportunity to handle the nailer and to get feedback on topics such as:
 - How to load the nail gun
 - How to operate the air compressor
 - How to fire the nail gun
 - How to hold lumber during placement work
 - How to recognize and approach ricochet-prone work surfaces
 - How to handle awkward position work (e.g., toe-nailing and work on ladders)
 - How best to handle special risks associated with contact and single actuation triggers such as nail gun recoil and double fires. For example, coach new employees on how to minimize double fires by allowing the nail gun to recoil rather than continuing to push against the gun after it fires.
- What to do when a nail gun malfunctions.
- Training should also cover items covered in the following sections of the guidance, such as company nail gun work procedures, personal protective equipment, injury reporting, and first aid and medical treatment.

3 Establish nail gun work procedures

Contractors should develop their own nail gun work rules and procedures to address risk factors and make the work as safe as possible. Examples of topics for contractor work procedures include but are not limited to the following:

Do's...

- Make sure that tool manuals for the nailers used on the job are always available on the jobsite.
- Make sure that manufacturers' tool labels and instructions are understood and followed.

You should know

Training is important: untrained workers are more likely to experience a nail gun injury than a trained worker.¹²

Training does not trump triggers: trained workers using contact triggers still have twice the overall risk of injury as trained workers using sequential triggers.



- Check tools and power sources before operating to make sure that they are in proper working order. Take broken or malfunctioning nail guns out of service immediately.
- Set up operations so that workers are not in the line of fire from nail guns being operated by co-workers.
- Check lumber surfaces before nailing. Look for knots, nails, straps, hangers, etc. that could cause recoil or ricochet.
- Use a hammer or positive placement nailer when nailing metal joinery or irregular lumber.
- For placement work, keep hands at least 12 inches away from the nailing point at all times. Consider using clamps to brace instead of your hands.
- Always shoot nail guns away from your body and away from co-workers.
- Always disconnect the compressed air when:
 - Leaving a nailer unattended;
 - Travelling up and down a ladder or stairs;
 - Passing the nail gun to a co-worker;
 - Clearing jammed nails;
 - Performing any other maintenance on the nail gun.
- Recognize the dangers of awkward position work and provide extra time and precautions:
 - Use a hammer if you cannot reach the work while holding the nailer with your dominant hand.
 - Use a hammer or reposition for work at face or head height. Recoil is more difficult to control and could be dangerous.
 - Use a hammer or full sequential trigger nailer when working in a tight space. Recoil is more difficult to control and double fires could occur with contact triggers.
 - Take extra care with toe-nailing. Nail guns can slip before or during firing because the gun cannot be held flush against the work piece. Use a nail gun with teeth on the safety contact to bite into the work piece to keep the gun from slipping during the shot. Use the trigger to fire only after the safety contact piece is positioned.
- Recognize the dangers of nail gun work at height and provide extra time and precautions:
 - Set up jobs to minimize the need for nailing at height.
 - Consider using scaffolds instead of ladders.
 - If work must be done on ladders, use full sequential trigger nailers to prevent nail gun injuries which could occur from bumping a leg while climbing up or down a ladder.
 - Position ladders so you don't have to reach too far. Your belt buckle should stay between the side rails when reaching to the side.
 - Maintain three points of contact with the ladder at all times to prevent a fall—this means that clamps may need to be used for placement work. Holding a nailer in one hand and the work piece with the other provides only two points of contact (your feet). Reaching and recoil can make you lose your balance and fall. Falls, especially with contact trigger nailers, can result in nail gun injuries.

Don'ts...

- Never bypass or disable nail gun safety features. This is strictly prohibited. Tampering includes removing the spring from the safety-contact tip and/or tying down, taping or otherwise securing the trigger so it does not need to be pressed. Tampering increases the chance that the nail gun will fire unintentionally both for the current user and anyone else who may use the nail gun. Nail gun manufacturers strongly recommend against tampering and OSHA

requires that tools be maintained in a safe condition. There is NO legitimate reason to modify or disable a nail gun safety device.

- Encourage your workers to keep their fingers off the trigger when holding or carrying a nail gun. If this is not natural, workers should use a full sequential nail gun or set down the nailer until they begin to nail again.
- Never lower the nail gun from above or drag the tool by the hose. If the nail-gun hose gets caught on something, don't pull on the hose. Go find the problem and release the hose.
- Never use the nailer with the non-dominant hand.

4 Provide Personal Protective Equipment (PPE)

Safety shoes, which help protect workers' toes from nail gun injuries, are typically required by OSHA on residential construction sites. In addition, employers should provide, at no cost to employees, the following protective equipment for workers using nail guns:

- Hard hats
- High Impact eye protection – safety glasses or goggles marked ANSI Z87.1
- Hearing protection – either earplugs or earmuffs

5 Encourage reporting and discussion of injuries and close calls

Studies show that many nail gun injuries go unreported. Employers should ensure that their policies and practices encourage reporting of nail gun injuries. Reporting helps ensure that employees get medical attention (see #6 below). It also helps contractors to identify unrecognized job site risks that could lead to additional injuries if not addressed.

Injuries and close calls provide teachable moments that can help improve crew safety.

If you have a safety incentive program, be sure that it does not discourage workers from reporting injuries. Employers that intentionally underreport work-related injuries will be in violation of OSHA's injury and illness recordkeeping regulation.

6 Provide first aid and medical treatment

Employers and workers should seek medical attention immediately after nail gun injuries, even for hand injuries that appear to be minimal. Studies suggest that 1 out of 4 nail gun hand injuries can involve some type of structural damage such as bone fracture.¹³ Materials such as nail strip glue or plastic or even clothing can get embedded in the injury and lead to infection. Barbs on the nail can cause secondary injury if the nail is removed incorrectly. These complications can be avoided by having workers seek immediate medical care.

OTHER NAIL GUN RELATED HAZARDS

Air pressure. Pneumatic tools and compressor use are regulated under OSHA's Construction standard at 29 CFR 1926.302(b). The provisions in this standard that are relevant for nail guns are provided below.

- (1) Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming accidentally disconnected.

Note: An OSHA letter of interpretation¹⁴ allows the use of a quick disconnect with a pull-down sleeve to meet this requirement. It is composed of a male fitting (connector) and female fitting (coupling) that has a sleeve which must be pulled away from the end of the hose to separate the two fittings to prevent the tool from becoming accidentally disconnected.

Worksite story

A construction worker accidentally drove a 16 penny framing nail into his thigh. It didn't bleed much and he didn't seek medical care. He removed the nail himself. Three days later he felt a snap in his leg and severe pain. In the emergency room, doctors removed a sheared off nail and found that his thigh bone had fractured. Not all injuries are immediately visible. Failure to seek medical care can result in complications and more serious injuries.



Worker using recommended PPE when working with nail guns: hard hat, safety glasses, and hearing protection

- (3) All pneumatically driven nailers, staplers, and other similar equipment provided with automatic fastener feed, which operate at more than 100 p.s.i. pressure at the tool shall have a safety device on the muzzle to prevent the tool from ejecting fasteners, unless the muzzle is in contact with the work surface.
- (5) The manufacturer's safe operating pressure for hoses, pipes, valves, filters, and other fittings shall not be exceeded.
- (6) The use of hoses for hoisting or lowering tools shall not be permitted.

Noise. Pneumatic nail guns produce short (less than a tenth of a second in duration) but loud “impulse” noise peaks: one from driving the nail and one from exhausting the air. Most nail gun manufacturers recommend that users wear hearing protection when operating a nailer.

Available information indicates that nail gun noise can vary depending on the gun, the work piece, air pressure, and the work setting. The type of trigger system does not appear to affect the noise level. Peak noise emission levels for several nailers ranged from 109 to 136 dBA.^{15,16} These loud short bursts can contribute to hearing loss. Employers should provide hearing protection in the form of earplugs or muffs and ensure that they are worn correctly. Employers should also ask about noise levels when buying nail guns—studies have identified ways to reduce nail gun noise and some manufacturers may incorporate noise reduction features.

Note: OSHA's standard for exposure to continuous noise levels (29 CFR 1926.52) addresses both the noise level and the duration of exposure. In this standard, workers exposed for 15 minutes at 115 A-weighted decibels (dBA) have the same exposure as workers exposed for 8 hours at 90 dBA.

The NIOSH and OSHA limit for impulse noise is 140 decibels: above this level a single exposure can cause instant damage to the ear.

NIOSH recommends that an 8-hour exposure should not exceed 85 dBA and a one-second exposure should not exceed 130 dBA without using hearing protection.

Musculoskeletal disorders. Framing nail guns can weigh up to 8 pounds and many framing jobs require workers to hold and use these guns for long periods of time in awkward hand/arm postures. Holding an 8-pound weight for long periods of time can lead to musculoskeletal symptoms such as soreness or tenderness in the fingers, wrist, or forearm tendons or muscles. These symptoms can progress to pain, or in the most severe cases, inability to work. No studies have shown that one trigger type is any more or less likely to cause musculoskeletal problems from long periods of nail gun use. If use of a nail gun is causing musculoskeletal pain or symptoms of musculoskeletal disorders, medical care should be sought.

CONCLUSION

Nail gun injuries are painful. Some cause severe injuries or death. Nail gun injuries have been on the rise along with the increased popularity of these powerful tools. These injuries can be prevented, and more and more contractors are making changes to improve nail gun safety. Take a look at your practices and use this course to improve safety on your job sites. Working together with tool gun manufacturers, safety and health professionals, and other organizations, we can reduce nail gun injuries.

FOR ADDITIONAL INFORMATION

OSHA

Woodworking eTool—Handheld Nail/Stapling Guns www.osha.gov/SLTC/etools/woodworking/production_handheldstaplegun.html

Center for Construction Research and Training (CPWR)

Nail Gun Hazard Alert www.cpwr.com/hazpdfs/Nail%20Gun%20Safety%202pg%20final%20FINAL.pdf Nail Gun Injuries, Productivity, and Recommendations

www.elcosh.org/en/document/1160/d001056/nail-guns%253A-injuries%252C-productivity-and-recommendations.html

International Staple, Nail and Tool Association (ISANTA)

American National Standard SNT-101-2002—Safety Requirements for Portable, Compressed-Air-Actuated Fastener Driving Tools.

Home Page www.isanta.org/

Oregon OSHA

Pneumatic Nail and Staple Gun Safety Hazard Alert www.oroSHA.org/pdf/hazards/2993-21.pdf

California OSHA

Pneumatically Driven Nailers and Staplers CCR Title 8, Section 1704 www.dir.ca.gov/Title8/1704.html

Nail gun video materials

WorkSafe British Columbia—Nail Gun Safety, and Safe Handling of Nail Guns www2.worksafebc.com/Publications/Multimedia/Videos.asp?ReportID=35773

Unsafe Handling of Nail Guns. Case study and video www.speakingofsafety.ca/2011/04/28/unsafe-handling-of-nail-guns/

Sacramento Bee—Nail Gun Safety www.youtube.com/watch?v=MsCu9luSRRY&feature=related

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- 6 Dement J, Lipscomb H, Leiming L, Epling C, Desai, T [2003]. Nail Gun Injuries among Construction Workers. *Appl Occup Environ Hyg* 18(5):374-383.
- 7 American National Standard Institute (ANSI) [2002]. Safety Requirements for Portable, Compressed-Air-Actuated Fastener Driving Tools. ANSI SNT-101-2002 Sections 4.4: Tools shall not be modified or altered; 8.4.2.3: Improperly functioning tools must not be used; 8.4.2.5.1: Do not remove, tamper with, or otherwise cause the tool operating controls to become inoperable.
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Contacting NIOSH

To receive documents or more information about occupational safety and health topics, please contact NIOSH: 1-800-CDC-INFO (1-800-232-4636); TTY: 1-888-232-6348; e-mail: cdcinfo@cdc.gov or visit the NIOSH web site at www.cdc.gov/niosh.

Contacting OSHA

To order additional copies of this publication, to get a list of other OSHA publications, to ask questions or to get more information, or to file a confidential complaint, contact OSHA at 1-800-321-OSHA (6742) or TTY: 1-877-889-5627 or go to www.osha.gov.

Personal Protective Equipment

INTRODUCTION

Hazards exist in every workplace in many different forms: sharp edges, falling objects, flying sparks, chemicals, noise and a myriad of other potentially dangerous situations. The Occupational Safety and Health Administration (OSHA) requires that employers protect their employees from workplace hazards that can cause injury.

Controlling a hazard at its source is the best way to protect employees. Depending on the hazard or workplace conditions, OSHA recommends the use of engineering or work practice controls to manage or eliminate hazards to the greatest extent possible. For example, building a barrier between the hazard and the employees is an engineering control; changing the way in which employees perform their work is a work practice control.

When engineering, work practice and administrative controls are not feasible or do not provide sufficient protection, employers must provide personal protective equipment (PPE) to their employees and ensure its use. Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to a variety of hazards. Examples of PPE include such items as gloves, foot and eye protection, protective hearing devices (earplugs, muffs) hard hats, respirators and full body suits.

This course will help both employers and employees do the following:

- Understand the types of PPE.
- Know the basics of conducting a "hazard assessment" of the workplace.
- Select appropriate PPE for a variety of circumstances.
- Understand what kind of training is needed in the proper use and care of PPE.

THE REQUIREMENT FOR PPE

To ensure the greatest possible protection for employees in the workplace, the cooperative efforts of both employers and employees will help in establishing and maintaining a safe and healthful work environment.

In general, employers are responsible for:

- Performing a "hazard assessment" of the workplace to identify and control physical and health hazards.
- Identifying and providing appropriate PPE for employees.
- Training employees in the use and care of the PPE.
- Maintaining PPE, including replacing worn or damaged PPE.
- Periodically reviewing, updating and evaluating the effectiveness of the PPE program.

In general, employees should:

- Properly wear PPE,
- Attend training sessions on PPE,
- Care for, clean and maintain PPE, and
- Inform a supervisor of the need to repair or replace PPE.

Specific requirements for PPE are presented in many different OSHA standards, published in 29 CFR. Some standards require that employers provide PPE at no cost to the employee while others simply state that the employer must provide PPE.

The Hazard Assessment

A first critical step in developing a comprehensive safety and health program is to identify physical and health hazards in the workplace. This process is known as a "hazard assessment."

Potential hazards may be

physical or health-related and a comprehensive hazard assessment should identify hazards in both categories. Examples of physical hazards include moving objects, fluctuating temperatures, high intensity lighting, rolling or pinching objects, electrical connections and sharp edges. Examples of health hazards include overexposure to harmful dusts, chemicals or radiation.

The hazard assessment should begin with a walk-through survey of the facility to develop a list of potential hazards in the following basic hazard categories:

- Impact,
- Penetration,
- Compression (roll-over),
- Chemical,
- Heat/cold,
- Harmful dust,
- Light (optical) radiation, and
- Biologic.

In addition to noting the basic layout of the facility and reviewing any history of occupational illnesses or injuries, things to look for during the walk-through survey include:

- Sources of electricity.
- Sources of motion such as machines or processes where movement may exist that could result in an impact between personnel and equipment.
- Sources of high temperatures that could result in burns, eye injuries or fire.
- Types of chemicals used in the workplace.
- Sources of harmful dusts.
- Sources of light radiation, such as welding, brazing, cutting, furnaces, heat treating, high intensity lights, etc.
- The potential for falling or dropping objects.

- Sharp objects that could poke, cut, stab or puncture.
- Biologic hazards such as blood or other potentially infected material.

When the walk-through is complete, the employer should organize and analyze the data so that it may be efficiently used in determining the proper types of PPE required at the worksite. The employer should become aware of the different types of PPE available and the levels of protection offered. It is definitely a good idea to select PPE that will provide a level of protection greater than the minimum required to protect employees from hazards.

The workplace should be periodically reassessed for any changes in conditions, equipment or operating procedures that could affect occupational hazards. This periodic reassessment should also include a review of injury and illness records to spot any trends or areas of concern and taking appropriate corrective action. The suitability of existing PPE, including an evaluation of its condition and age, should be included in the reassessment.

Documentation of the hazard assessment is required through a written certification that includes the following information:

- Identification of the workplace evaluated;
- Name of the person conducting the assessment;
- Date of the assessment; and
- Identification of the document certifying completion of the hazard assessment.

SELECTING PPE

All PPE clothing and equipment should be of safe design and construction, and should be maintained in a clean and reliable fashion. Employers should take the fit and comfort of PPE into consideration when selecting appropriate items for their workplace. PPE that fits well and is comfortable to wear will encourage employee use of PPE. Most protective devices are available in multiple sizes and care should be taken to select the proper size for each employee. If several different types of PPE are worn together, make sure they are compatible. If PPE does not fit properly, it can make the difference between being safely covered or dangerously exposed. It may not provide the level of protection desired and may discourage employee use.

OSHA requires that many categories of PPE meet or be equivalent to standards developed by the American National Standards Institute (ANSI). ANSI has been preparing safety standards since the 1920s, when the first safety standard was approved to protect the heads and eyes of industrial workers. Employers who need to provide PPE in the categories listed below must make certain that any new equipment procured meets the cited ANSI standard. Existing PPE stocks

must meet the ANSI standard in effect at the time of its manufacture or provide protection equivalent to PPE manufactured to the ANSI criteria. Employers should inform employees who provide their own PPE of the employer's selection decisions and ensure that any employee-owned PPE used in the workplace conforms to the employer's criteria, based on the hazard assessment, OSHA requirements and ANSI standards. OSHA requires PPE to meet the following ANSI standards:

- Eye and Face Protection: ANSI Z87.1-1989 (USA Standard for Occupational and Educational Eye and Face Protection).
- Head Protection: ANSI Z89.1-1986.
- Foot Protection: ANSI Z41.1-1991.

For hand protection, there is no ANSI standard for gloves but OSHA recommends that selection be based upon the tasks to be performed and the performance and construction characteristics of the glove material. For protection against chemicals, glove selection must be based on the chemicals encountered, the chemical resistance and the physical properties of the glove material.

TRAINING EMPLOYEES IN THE PROPER USE OF PPE

Employers are required to train each employee who must use PPE. Employees must be trained to know at least the following:

- When PPE is necessary.
- What PPE is necessary.
- How to properly put on, take off, adjust and wear the PPE.
- The limitations of the PPE.
- Proper care, maintenance, useful life and disposal of PPE.

Employers should make sure that each employee demonstrates an understanding of the PPE training as well as the ability to properly wear and use PPE before they are allowed to perform work requiring the use of the PPE. If an employer believes that a previously trained employee is not demonstrating the proper understanding and skill level in the use of PPE, that employee should receive retraining. Other situations that require additional or retraining of employees include the following circumstances: changes in the workplace or in the type of required PPE that make prior training obsolete.

The employer must document the training of each employee required to wear or use PPE by preparing a certification containing the name of each employee trained, the date of training and a clear identification of the subject of the certification.

EYE AND FACE PROTECTION

Employees can be exposed to a large number of hazards that pose danger to their eyes and face. OSHA requires employers to ensure that employees have appropriate eye or face protection if they are exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, potentially infected material or potentially harmful light radiation.

Many occupational eye injuries occur because workers are not wearing any eye protection while others result from wearing improper or poorly fitting eye protection. Employers must be sure that their employees wear appropriate eye and face protection and that the selected form of protection is appropriate to the work being performed and properly fits each worker exposed to the hazard.

Prescription Lenses

Everyday use of prescription corrective lenses will not provide adequate protection against most occupational eye and face hazards, so employers must make sure that employees with corrective lenses either wear eye protection that incorporates the prescription into the design or wear additional eye protection over their prescription lenses. It is important to ensure that the protective eyewear does not disturb the proper positioning of the prescription lenses so that the employee's vision will not be inhibited or limited. Also, employees who wear contact lenses must wear eye or face PPE when working in hazardous conditions.

Eye Protection for Exposed Workers

OSHA suggests that eye protection be routinely considered for use by carpenters, electricians, machinists, mechanics, millwrights, plumbers and pipefitters, sheet metal workers and tinsmiths, assemblers, sanders, grinding machine operators, sawyers, welders, laborers, chemical process operators and handlers, and timber cutting and logging workers. Employers of workers in other job categories should decide whether there is a need for eye and face PPE through a hazard assessment.

Examples of potential eye or face injuries include:

- Dust, dirt, metal or wood chips entering the eye from activities such as chipping, grinding, sawing, hammering, the use of power tools or even strong wind forces.
- Chemical splashes from corrosive substances, hot liquids, solvents or other hazardous solutions.
- Objects swinging into the eye or face, such as tree limbs, chains, tools or ropes.
- Radiant energy from welding, harmful rays from the use of lasers or other radiant light (as well as heat, glare, sparks, splash and flying particles).

Types of Eye Protection

Selecting the most suitable eye and face protection for employees should take into consideration the following elements:

1. Ability to protect against specific workplace hazards.
2. Should fit properly and be reasonably comfortable to wear.
3. Should provide unrestricted vision and movement.
4. Should be durable and cleanable.
5. Should allow unrestricted functioning of any other required PPE.

The eye and face protection selected for employee use must clearly identify the manufacturer. Any new eye and face protective devices must comply with ANSI Z87.1-1989 or be at least as effective as this standard requires. Any equipment purchased before this requirement took effect on July 5, 1994, must comply with the earlier ANSI Standard (ANSI Z87.1-1968) or be shown to be equally effective.

An employer may choose to provide one pair of protective eyewear for each position rather than individual eyewear for each employee. If this is done, the employer must make sure that employees disinfect shared protective eyewear after each use. Protective eyewear with corrective lenses may only be used by the employee for whom the corrective prescription was issued and may not be shared among employees.

Some of the most common types of eye and face protection include the following:

- **Safety spectacles.** These protective eyeglasses have safety frames constructed of metal or plastic and impact-resistant lenses. Side shields are available on some models.
- **Goggles.** These are tight-fitting eye protection that completely cover the eyes, eye sockets and the facial area immediately surrounding the eyes and provide protection from impact, dust and splashes. Some goggles will fit over corrective lenses.
- **Welding shields.** Constructed of vulcanized fiber or fiberglass and fitted with a filtered lens, welding shields protect eyes from burns caused by infrared or intense radiant light; they also protect both the eyes and face from flying sparks, metal spatter and slag chips produced during welding, brazing, soldering and cutting operations. OSHA requires filter lenses to have a shade number appropriate to protect against the specific hazards of the work being performed in order to protect against harmful light radiation.
- **Laser safety goggles.** These specialty goggles protect against intense concentrations of light produced by lasers. The type of laser safety goggles an employer chooses will depend upon the equipment and operating conditions in the workplace.

- **Face shields.** These transparent sheets of plastic extend from the eyebrows to below the chin and across the entire width of the employee's head. Some are polarized for glare protection. Face shields protect against nuisance dusts and potential splashes or sprays of hazardous liquids but will not provide adequate protection against impact hazards. Face shields used in combination with goggles or safety spectacles will provide additional protection against impact hazards.

Each type of protective eyewear is designed to protect against specific hazards. Employers can identify the specific workplace hazards that threaten employees' eyes and faces by completing a hazard assessment as outlined in the earlier section.

Welding Operations

The intense light associated with welding operations can cause serious and sometimes permanent eye damage if operators do not wear proper eye protection. The intensity of light or radiant energy produced by welding, cutting or brazing operations varies according to a number of factors including the task producing the light, the electrode size and the arc current. The following table shows the minimum protective shades for a variety of welding, cutting and brazing operations in general industry and in the shipbuilding industry.

Operations	Electrode size in 1/32" (0.8mm)	Arc current	Minimum* protective Shade
Shielded metal arc welding	< 3	< 60	7
	3 - 5	60 - 160	8
	5 - 8	160 - 250	10
	> 8	250 - 550	11
Gas metal arc welding and flux cored arc welding		< 60	7
		60 - 160	10
		160 - 250	10
		250 - 500	10
Gas tungsten arc welding		< 50	8
		50 - 150	8
		150 - 500	10
Air carbon (light)		< 500	10
Arc cutting (heavy)		500 - 1,000	11
Plasma arc welding		< 20	6
		20 - 100	8
		100 - 400	10
		400 - 800	11
Plasma arc cutting (light)** (medium)** (heavy)**		< 300	8
		300 - 400	9
		400 - 800	0
Torch brazing			3
Torch soldering			2
Carbon arc welding			14

Table 1 (Continued)
Filter Lenses for Protection Against Radiant Energy

Operations	Electrode size in 1/32" (0.8mm)	Arc current	Minimum* protective Shade
Gas welding: Light	< 1/8	< 3.2	4
Gas welding: Medium	1/8 - 1/2	3.2 - 12.7	5
Gas welding: Heavy	> 1/2	> 12.7	6
Oxygen cutting: Light	< 1	< 25	3
Oxygen cutting: Medium	1 - 6	25 - 150	4
Oxygen cutting: Heavy	> 6	> 150	5

Source: 29 CFR 1910.133(a)(5).

- * As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxy-fuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.
- ** These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the work piece. The construction industry has separate requirements for filter lens protective levels for specific types of welding operations, as indicated in the table below:

Table 2
Construction Industry Requirements for Filter Lens Shade Numbers for Protection Against Radiant Energy

Welding Operation	Shade Number
Shielded metal-arc welding 1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes	10
Gas-shielded arc welding (nonferrous) 1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes	11
Gas-shielded arc welding (ferrous) 1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes	12
Shielded metal-arc welding 3/16-, 7/32-, 1/4-inch diameter electrodes	12
5/16-, 3/8-inch diameter electrodes	14
Atomic hydrogen welding	10 – 14
Carbon-arc welding	14
Soldering	2
Torch brazing	3 or 4
Light cutting, up to 1 inch	3 or 4
Medium cutting, 1 to 6 inches	4 or 5
Heavy cutting, more than 6 inches	5 or 6
Gas welding (light), up to 1/8-inch	4 or 5
Gas welding (medium), 1/8- to 1/2-inch	5 or 6
Gas welding (heavy), more than 1/2-inch	6 or 8

Source: 29 CFR 1926.102(b)(1).

Laser Operations

Laser light radiation can be extremely dangerous to the unprotected eye and direct or reflected beams can cause permanent eye damage. Laser retinal burns can be painless, so it is essential that all personnel in or around laser operations wear appropriate eye protection.

Laser safety goggles should protect for the specific wavelength of the laser and must be of sufficient optical density for the energy involved. Safety goggles intended for use with laser beams must be labeled with the laser wavelengths for which they are intended to be used, the optical density of those wavelengths and the visible light transmission.

The table below lists maximum power or energy densities and appropriate protection levels for optical densities 5 through 8.

Intensity, CW maximum power density (watts/cm ²) (O.D.)	Attenuation	
	Optical density	Attenuation factor
10-2	5	105
10-1	6	106
1.0	7	107
10.0	8	108

Source: 29 CFR 1926.102(b)(2).

HEAD PROTECTION

Protecting employees from potential head injuries is a key element of any safety program. A head injury can impair an employee for life or it can be fatal. Wearing a safety helmet or hard hat is one of the easiest ways to protect an employee's head from injury. Hard hats can protect employees from impact and penetration hazards as well as from electrical shock and burn hazards.

Employers must ensure that their employees wear head protection if any of the following apply:

- Objects might fall from above and strike them on the head;
- They might bump their heads against fixed objects, such as exposed pipes or beams; or
- There is a possibility of accidental head contact with electrical hazards.

Some examples of occupations in which employees should be required to wear head protection include construction workers, carpenters, electricians, linemen, plumbers and pipefitters, timber and log cutters, welders, among many others. Whenever there is a danger of objects falling from above, such as working

below others who are using tools or working under a conveyor belt, head protection must be worn. Hard hats must be worn with the bill forward to protect employees properly.

In general, protective helmets or hard hats should do the following:

- Resist penetration by objects.
- Absorb the shock of a blow.
- Be water-resistant and slow burning.
- Have clear instructions explaining proper adjustment and replacement of the suspension and headband.

Hard hats must have a hard outer shell and a shock-absorbing lining that incorporates a headband and straps that suspend the shell from 1 to 1 1/4 inches (2.54 cm to 3.18 cm) away from the head. This type of design provides shock absorption during an impact and ventilation during normal wear.

Protective headgear must meet ANSI Standard Z89.1-1986 (Protective Headgear for Industrial Workers) or provide an equivalent level of protection. Helmets purchased before July 5, 1994 must comply with the earlier ANSI Standard (Z89.1-1969) or provide equivalent protection.

Types of Hard Hats

There are many types of hard hats available in the marketplace today. In addition to selecting protective headgear that meets ANSI standard requirements, employers should ensure that employees wear hard hats that provide appropriate protection against potential workplace hazards. It is important for employers to understand all potential hazards when making this selection, including electrical hazards. This can be done through a comprehensive hazard analysis and an awareness of the different types of protective headgear available.

Hard hats are divided into three industrial classes:

- **Class A hard hats** provide impact and penetration resistance along with limited voltage protection (up to 2,200 volts).
- **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). They also provide protection from impact and penetration hazards by flying/falling objects.
- **Class C hard hats** provide lightweight comfort and impact protection but offer no protection from electrical hazards.

Another class of protective headgear on the market is called a "bump hat," designed for use in areas with low

head clearance. They are recommended for areas where protection is needed from head bumps and lacerations. These are not designed to protect against falling or flying objects and are not ANSI approved. It is essential to check the type of hard hat employees are using to ensure that the equipment provides appropriate protection. Each hat should bear a label inside the shell that lists the manufacturer, the ANSI designation and the class of the hat.

Size and Care Considerations

Head protection that is either too large or too small is inappropriate for use, even if it meets all other requirements. Protective headgear must fit appropriately on the body and for the head size of each individual. Most protective headgear comes in a variety of sizes with adjustable headbands to ensure a proper fit (many adjust in 1/8-inch increments). A proper fit should allow sufficient clearance between the shell and the suspension system for ventilation and distribution of an impact. The hat should not bind, slip, fall off or irritate the skin.

Some protective headgear allows for the use of various accessories to help employees deal with changing environmental conditions, such as slots for earmuffs, safety glasses, face shields and mounted lights. Optional brims may provide additional protection from the sun and some hats have channels that guide rainwater away from the face. Protective headgear accessories must not compromise the safety elements of the equipment.

Periodic cleaning and inspection will extend the useful life of protective headgear. A daily inspection of the hard hat shell, suspension system and other accessories for holes, cracks, tears or other damage that might compromise the protective value of the hat is essential. Paints, paint thinners and some cleaning agents can weaken the shells of hard hats and may eliminate electrical resistance. Consult the helmet manufacturer for information on the effects of paint and cleaning materials on their hard hats. Never drill holes, paint or apply labels to protective headgear as this may reduce the integrity of the protection. Do not store protective headgear in direct sunlight, such as on the rear window shelf of a car, since sunlight and extreme heat can damage them.

Hard hats with any of the following defects should be removed from service and replaced:

- Perforation, cracking, or deformity of the brim or shell;
- Indication of exposure of the brim or shell to heat, chemicals or ultraviolet light and other radiation (in addition to a loss of surface gloss, such signs include chalking or flaking).

Always replace a hard hat if it sustains an impact, even

if damage is not noticeable. Suspension systems are offered as replacement parts and should be replaced when damaged or when excessive wear is noticed. It is not necessary to replace the entire hard hat when deterioration or tears of the suspension systems are noticed.

FOOT AND LEG PROTECTION

Employees, who face possible foot or leg injuries from falling or rolling objects, or from crushing or penetrating materials, should wear protective footwear. Also, employees whose work involves exposure to hot substances or corrosive or poisonous materials must have protective gear to cover exposed body parts, including legs and feet. If an employee's feet may be exposed to electrical hazards, non-conductive footwear should be worn. On the other hand, workplace exposure to static electricity may necessitate the use of conductive footwear.

Examples of situations in which an employee should wear foot and/or leg protection include:

- When heavy objects such as barrels or tools might roll onto or fall on the employee's feet;
- Working with sharp objects such as nails or spikes that could pierce the soles or uppers of ordinary shoes;
- Exposure to molten metal that might splash on feet or legs;
- Working on or around hot, wet or slippery surfaces; and
- Working when electrical hazards are present.

Safety footwear must meet ANSI minimum compression and impact performance standards in ANSI Z41-1991 (American National Standard for Personal Protection-Protective Footwear) or provide equivalent protection. Footwear purchased before July 5, 1994, must meet or provide equivalent protection to the earlier ANSI Standard (ANSI Z41.1-1967). All ANSI approved footwear has a protective toe and offers impact and compression protection. But the type and amount of protection is not always the same.

Different footwear protects in different ways. Check the product's labeling or consult the manufacturer to make sure the footwear will protect the user from the hazards they face.

Foot and leg protection choices include the following:

- **Leggings** protect the lower legs and feet from heat hazards such as molten metal or welding sparks. Safety snaps allow leggings to be removed quickly.
- **Metatarsal guards** protect the instep area from impact and compression. Made of aluminum, steel, fiber or plastic, these guards may be strapped to the outside of shoes.

- **Toe guards** fit over the toes of regular shoes to protect the toes from impact and compression hazards. They may be made of steel, aluminum or plastic.
- **Combination foot and shin guards** protect the lower legs and feet, and may be used in combination with toe guards when greater protection is needed.
- **Safety shoes** have impact-resistant toes and heat-resistant soles that protect the feet against hot work surfaces common in roofing, paving and hot metal industries. The metal insoles of some safety shoes protect against puncture wounds. Safety shoes may also be designed to be electrically conductive to prevent the buildup of static electricity in areas with the potential for explosive atmospheres or nonconductive to protect workers from workplace electrical hazards.

Special Purpose Shoes

Electrically conductive shoes provide protection against the buildup of static electricity. Employees working in explosive and hazardous locations such as explosives manufacturing facilities or grain elevators must wear conductive shoes to reduce the risk of static electricity buildup on the body that could produce a spark and cause an explosion or fire. Foot powder should not be used in conjunction with protective conductive footwear because it provides insulation, reducing the conductive ability of the shoes. Silk, wool and nylon socks can produce static electricity and should not be worn with conductive footwear. Conductive shoes must be removed when the task requiring their use is completed.

Note: Employees exposed to electrical hazards must never wear conductive shoes.

Electrical hazard, safety-toe shoes are nonconductive and will prevent the wearers' feet from completing an electrical circuit to the ground. These shoes can protect against open circuits of up to 600 volts in dry conditions and should be used in conjunction with other insulating equipment and additional precautions to reduce the risk of a worker becoming a path for hazardous electrical energy. The insulating protection of electrical hazard, safety-toe shoes may be compromised if the shoes become wet, the soles are worn through, metal particles become embedded in the sole or heel, or workers touch conductive, grounded items.

Note: Nonconductive footwear must not be used in explosive or hazardous locations.

Foundry Shoes

In addition to insulating the feet from the extreme heat of molten metal, foundry shoes keep hot metal from lodging in shoe eyelets, tongues or other shoe

parts. These snug-fitting leather or leather-substitute shoes have leather or rubber soles and rubber heels. All foundry shoes must have built-in safety toes.

Care of Protective Footwear

As with all protective equipment, safety footwear should be inspected prior to each use. Shoes and leggings should be checked for wear and tear at reasonable intervals. This includes looking for cracks or holes, separation of materials, broken buckles or laces.

The soles of shoes should be checked for pieces of metal or other embedded items that could present electrical or tripping hazards. Employees should follow the manufacturers' recommendations for cleaning and maintenance of protective footwear.

HAND AND ARM PROTECTION

If a workplace hazard assessment reveals that employees face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls, employers must ensure that employees wear appropriate protection. Potential hazards include skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures and amputations. Protective equipment includes gloves, finger guard and arm coverings or elbow-length gloves.

Employers should explore all possible engineering and work practice controls to eliminate hazards and use PPE to provide additional protection against hazards that cannot be completely eliminated through other means. For example, machine guards may eliminate a hazard. Installing a barrier to prevent workers from placing their hands at the point of contact between a table saw blade and the item being cut is another method.

Types of Protective Gloves

There are many types of gloves available today to protect against a wide variety of hazards. The nature of the hazard and the operation involved will affect the selection of gloves. The variety of potential occupational hand injuries makes selecting the right pair of gloves challenging. It is essential that employees use gloves specifically designed for the hazards and tasks found in their workplace because gloves designed for one function may not protect against a different function even though they may appear to be an appropriate protective device.

The following are examples of some factors that may influence the selection of protective gloves for a workplace.

- Type of chemicals handled.

- Nature of contact (total immersion, splash, etc.).
- Duration of contact.
- Area requiring protection (hand only, forearm, arm).
- Grip requirements (dry, wet, oily).
- Thermal protection.
- Size and comfort.
- Abrasion/resistance requirements.

Gloves made from a wide variety of materials are designed for many types of workplace hazards. In general, gloves fall into four groups:

1. Gloves made of leather, canvas or metal mesh;
2. Fabric and coated fabric gloves;
3. Chemical- and liquid-resistant gloves;
4. Insulating rubber gloves

Leather, Canvas or Metal Mesh Gloves

Sturdy gloves made from metal mesh, leather or canvas provides protection against cuts and burns. Leather or canvas gloves also protect against sustained heat.

- **Leather gloves** protect against sparks, moderate heat, blows, chips and rough objects.
- **Aluminized gloves** provide reflective and insulating protection against heat and require an insert made of synthetic materials to protect against heat and cold.
- **Aramid fiber gloves** protect against heat and cold, are cut-resistant and abrasive-resistant. They also wear well.
- **Synthetic gloves** of various materials offer protection against heat and cold are cut-resistant and abrasive-resistant and may withstand some diluted acids. These materials do not stand up against alkalis and solvents.

Fabric and Coated Fabric Gloves

Fabric and coated fabric gloves are made of cotton or other fabric to provide varying degrees of protection.

- **Fabric gloves** protect against dirt, slivers, chafing and abrasions. They do not provide sufficient protection for use with rough, sharp or heavy materials. Adding a plastic coating will strengthen some fabric gloves.
- **Coated fabric gloves** are normally made from cotton flannel with napping on one side. By coating the unnapped side with plastic, fabric gloves are transformed into general-purpose hand protection offering slip-resistant qualities. These gloves are used for tasks ranging from handling bricks and wire to chemical laboratory containers. When selecting gloves to protect against chemical exposure hazards,

always check with the manufacturer or review the manufacturer's product literature to determine the gloves' effectiveness against specific workplace chemicals and conditions.

Chemical- and Liquid-Resistant Gloves

Chemical-resistant gloves are made with different kinds of rubber: natural, butyl, neoprene, nitrile and fluorocarbon (viton); or various kinds of plastic: polyvinyl chloride (PVC), polyvinyl alcohol and polyethylene. These materials can be blended or laminated for better performance. As a general rule, the thicker the glove material, the greater the chemical resistance but thick gloves may impair grip and dexterity, having a negative impact on safety.

Some examples of chemical-resistant gloves include:

- **Butyl gloves** are made of a synthetic rubber and protect against a wide variety of chemicals, such as peroxide, rocket fuels, highly corrosive acids (nitric acid, sulfuric acid, hydrofluoric acid and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters and nitro compounds. Butyl gloves also resist oxidation, ozone corrosion and abrasion, and remain flexible at low temperatures. Butyl rubber does not perform well with aliphatic and aromatic hydrocarbons and halogenated solvents.
- **Natural (latex) rubber gloves** are comfortable to wear, which makes them a popular general-purpose glove. They feature outstanding tensile strength, elasticity and temperature resistance. In addition to resisting abrasions caused by grinding and polishing, these gloves protect workers' hands from most water solutions of acids, alkalis, salts and ketones. Latex gloves have caused allergic reactions in some individuals and may not be appropriate for all employees. Hypoallergenic gloves, glove liners and powderless gloves are possible alternatives for workers who are allergic to latex gloves.
- **Neoprene gloves** are made of synthetic rubber and offer good pliability, finger dexterity, and high density and tear resistance. They protect against hydraulic fluids, gasoline, alcohols, organic acids and alkalis. They generally have chemical and wear resistance properties superior to those made of natural rubber.
- **Nitrile gloves** are made of a copolymer and provide protection from chlorinated solvents such as trichloroethylene and perchloroethylene. Although intended for jobs requiring dexterity and sensitivity, nitrile gloves stand up to heavy use even after prolonged exposure to substances that cause other gloves to deteriorate. They offer protection when working with oils, greases, acids, caustics and alcohols but are generally not recommended for use with strong oxidizing agents, aromatic solvents, ketones and acetates.

Note: When selecting chemical-resistant gloves be sure to consult the manufacturer's recommendations, especially if the gloved hand(s) will be immersed in the chemical.

Care of Protective Gloves

Protective gloves should be inspected before each use to ensure that they are not torn, punctured or made ineffective in any way. A visual inspection will help detect cuts or tears but a more thorough inspection by filling the gloves with water and tightly rolling the cuff towards the fingers will help reveal any pinhole leaks. Gloves that are discolored or stiff may also indicate deficiencies caused by excessive use or degradation from chemical exposure.

Any gloves with impaired protective ability should be discarded and replaced. Reuse of chemical-resistant gloves should be evaluated carefully, taking into consideration the absorptive qualities of the gloves. A decision to reuse chemically-exposed gloves should take into consideration the toxicity of the chemicals involved and factors such as duration of exposure, storage and temperature.

BODY PROTECTION

Employees who face possible bodily injury of any kind that cannot be eliminated through engineering, work practice or administrative controls, must wear appropriate body protection while performing their jobs. In addition to cuts and radiation, the following are examples of workplace hazards that could cause bodily injury:

- Temperature extremes;
- Hot splashes from molten metal's and other hot liquids;
- Potential impacts from tools, machinery and materials;
- Hazardous chemicals.

There are many varieties of protective clothing available for specific hazards. Employers are required to ensure that their employees wear personal protective equipment only for the parts of the body exposed to possible injury. Examples of body protection include laboratory coats, coveralls, vests, jackets, aprons, surgical gowns and full body suits.

If a hazard assessment indicates a need for full body protection against toxic substances or harmful physical agents, the clothing should be carefully inspected before each use, it must fit each worker properly and it must function properly and for the purpose for which it is intended.

Protective clothing comes in a variety of materials, each effective against particular hazards, such as:

- **Paper-like fiber** used for disposable suits provides protection against dust and splashes.
- **Treated wool and cotton** adapts well to changing temperatures, is comfortable and fire-resistant and protects against dust, abrasions and rough and irritating surfaces.
- **Duck** is a closely woven cotton fabric that protects against cuts and bruises when handling heavy, sharp or rough materials.
- **Leather** is often used to protect against dry heat and flames.
- **Rubber, rubberized fabrics, neoprene and plastics** protect against certain chemicals and physical hazards. When chemical or physical hazards are present, check with the clothing manufacturer to ensure that the material selected will provide protection against the specific hazard.

HEARING PROTECTION

Determining the need to provide hearing protection for employees can be challenging. Employee exposure to excessive noise depends upon a number of factors, including:

- The loudness of the noise as measured in decibels (dB).
- The duration of each employee's exposure to the noise.
- Whether employees move between work areas with different noise levels.
- Whether noise is generated from one or multiple sources.

Generally, the louder the noise, the shorter the exposure time before hearing protection is required. For instance, employees may be exposed to a noise level of 90 dB for 8 hours per day (unless they experience a Standard Threshold Shift) before hearing protection is required. On the other hand, if the noise level reaches 115 dB hearing protection is required if the anticipated exposure exceeds 15 minutes.

Table 4, below, shows the permissible noise exposures that require hearing protection for employees exposed to occupational noise at specific decibel levels for specific time periods. Noises are considered continuous if the interval between occurrences of the maximum noise level is one second or less. Noises not meeting this definition are considered impact or impulse noises (loud momentary explosions of sound) and exposures to this type of noise must not exceed 140 dB. Examples of situations or tools that may result in impact or impulse noises are powder-actuated nail guns, a punch press or drop hammers.

There isn't a Table 5 in this.

Table 4
Permissible Noise Exposures

Duration per day, in hours	Sound level in dB*
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

*When measured on the A scale of a standard sound level meter at slow response.

Source: 29 CFR 1910.95, Table G-16.

If engineering and work practice controls do not lower employee exposure to workplace noise to acceptable levels, employees must wear appropriate hearing protection. It is important to understand that hearing protectors reduce only the amount of noise that gets through to the ears. The amount of this reduction is referred to as attenuation, which differs according to the type of hearing protection used and how well it fits. Hearing protectors worn by employees must reduce an employee's noise exposure to within the acceptable limits noted in [Table 5](#).

Manufacturers of hearing protection devices must display the device's NRR on the product packaging. If employees are exposed to occupational noise at or above 85 dB averaged over an eight hour period, the employer is required to institute a hearing conservation program that includes regular testing of employees' hearing by qualified professionals.

Some types of hearing protection include:

- **Single-use earplugs** are made of waxed cotton, foam, silicone rubber or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs.
- **Pre-formed or molded earplugs** must be individually fitted by a professional and can be disposable or reusable. Reusable plugs should be cleaned after each use.
- **Earmuffs** require a perfect seal around the ear. Glasses, facial hair, long hair or facial movements such as chewing may reduce the protective value of earmuffs.

OSHA ASSISTANCE

OSHA can provide extensive help through a variety of programs, including technical assistance about effective safety and health programs, state plans, workplace consultations, voluntary protection programs, strategic partnerships, training and education, and more. An overall commitment to workplace safety and health can add value to your business, to your workplace and to your life.

SAFETY AND HEALTH PROGRAM MANAGEMENT GUIDELINES

Effective management of worker safety and health protection is a decisive factor in reducing the extent and severity of work-related injuries and illnesses and their related costs. In fact, an effective safety and health program forms the basis of good worker protection and can save time and money (about \$4 for every dollar spent) and increase productivity and reduce worker injuries, illnesses and related workers' compensation costs.

To assist employers and employees in developing effective safety and health programs, OSHA published recommended Safety and Health Program Management Guidelines. These voluntary guidelines apply to all places of employment covered by OSHA.

The guidelines identify four general elements critical to the development of a successful safety and health management program:

- Management leadership and employee involvement.
- Work analysis.
- Hazard prevention and control.
- Safety and health training.

The guidelines recommend specific actions, under each of these general elements, to achieve an effective safety and health program.

Fall Protection in Construction

WHY DOES OSHA HAVE A STANDARD FOR FALL PROTECTION?

In the construction industry in the U.S., falls are the leading cause of worker fatalities. Each year, on average, between 150 and 200 workers are killed and more than 100,000 are injured as a result of falls at construction sites. OSHA recognizes that accidents involving falls are generally complex events frequently involving a variety of factors. Consequently, the standard for fall protection deals with both the human and equipment-related issues in protecting workers from fall hazards.

For example, employers and employees need to do the following:

- Select fall protection systems appropriate for given situations.
- Use proper construction and installation of safety systems.
- Supervise employees properly.
- Use safe work procedures.
- Train workers in the proper selection, use, and maintenance of fall protection systems.

A number of factors are often involved in falls, including unstable work surfaces, misuse or failure to use fall protection equipment and human error. Studies have shown that using guardrails, fall arrest systems, safety nets, covers and restraint systems can prevent many deaths and injuries from falls.

The purpose of this course is to get you familiar with OSHA's construction safety standard for fall protection 29 CFR, Subpart M.

FALL PROTECTION IN CONSTRUCTION

OSHA has construction industry safety standards, set forth in *Title 29 Code of Federal Regulations*, Subpart M, Fall Protection, 1926.500(a), 1926.501, 1926.502, and 1926.503, and developed systems and procedures designed to prevent employees from falling off, onto, or through working levels and to protect employees from being struck by falling objects. The performance-oriented requirements make it easier for employers to provide the necessary protection.

The rule covers most construction workers except those inspecting, investigating, or assessing workplace conditions prior to the actual start of work or after all work has been completed.

The rule identifies areas or activities where fall protection is needed. These include, but are not limited

to, ramps, runways, and other walkways, excavations, hoist areas, holes, formwork and reinforcing steel, leading edge work, unprotected sides and edges, overhand bricklaying and related work, roofing work, precast concrete erection, wall openings, residential construction, and other walking/working surfaces. The rule sets a uniform threshold height of 6 feet (1.8 meters), thereby providing consistent protection. This means that construction employers must protect their employees from fall hazards and falling objects whenever an affected employee is 6 feet (1.8 meters) or more above a lower level. Protection also must be provided for construction workers who are exposed to the hazard of falling into dangerous equipment.

Under the standard, employers are able to select fall protection measures compatible with the type of work being performed. Fall protection generally can be provided through the use of guardrail systems, safety net systems, personal fall arrest systems, positioning device systems, and warning line systems, among others.

The OSHA rule clarifies what an employer must do to provide fall protection for employees, such as identifying and evaluating fall hazards and providing specific training. Requirements to provide fall protection for workers on scaffolds and ladders and for workers engaged in steel erection of buildings are covered in other subparts of OSHA regulations.

The standard prescribes the duty to provide fall protection, sets the criteria and practices for fall protection systems, and requires training. It covers hazard assessment and fall protection and safety monitoring systems. Also addressed are controlled access zones, safety nets, and guardrail, personal fall arrest, warning line, and positioning device systems.

Under *29 CFR Subpart M, Fall Protection, 1926.501*, employers must assess the workplace to determine if the walking or working surfaces on which employees are to work have the strength and structural integrity to safely support workers. Employees are not permitted to work on those surfaces until it has been determined that the surfaces have the requisite strength and structural integrity to support the workers. Once employers have determined that the surface is safe for employees to work on, the employer must select one of the options listed for the work operation if a fall hazard is present.

For example, if an employee is exposed to falling 6 feet (1.8 meters) or more from an unprotected side or edge, the employer must select a guardrail system, safety net system, or personal fall arrest system to protect the worker.

Similar requirements are prescribed for other fall hazards as follows:

❖ **Controlled Access Zones - 1926.502(g)**

A controlled access zone is a work area designated and clearly marked in which certain types of work (such as overhand bricklaying) may take place without the use of conventional fall protection systems—guardrail, personal arrest or safety net—to protect the employees working in the zone.

Controlled access zones are used to keep out workers other than those authorized to enter work areas from which guardrails have been removed. Where there are no guardrails, masons are the only workers allowed in controlled access zones.

Controlled access zones, when created to limit entrance to areas where leading edge work and other operations are taking place, must be defined by a control line or by any other means that restrict access. Control lines shall consist of ropes, wires, tapes or equivalent materials, and supporting stanchions, and each must be:

- Flagged or otherwise clearly marked at not more than 6-foot (1.8 meters) intervals with high-visibility material.
- Rigged and supported in such a way that the lowest point (including sag) is not less than 39 inches (1 meter) from the walking/working surface and the highest point is not more than 45 inches (1.3 meters)—nor more than 50 inches (1.3 meters) when overhand bricklaying operations are being performed—from the walking/working surface.
- Strong enough to sustain stress of not less than 200 pounds. Control lines shall extend along the entire length of the unprotected or leading edge and shall be approximately parallel to the unprotected or leading edge.
- Control lines also must be connected on each side to a guardrail system or wall.

When control lines are used, they shall be erected not less than 6 feet (1.8 meters) nor more than 25 feet (7.6 meters) from the unprotected or leading edge, except when precast concrete members are being erected. In the latter case, the control line is to be erected not less than 6 feet (1.8 meters) or more than 60 feet (18 meters) or half the length of the member being erected, whichever is less, from the leading edge.

Controlled access zones when used to determine access to areas where overhand bricklaying and related work are taking place are to be defined by a control line erected not less than 10 feet (3 meters) nor more than 15 feet (4.6 meters) from the working edge. Additional control lines must be erected at each end to enclose the controlled access zone. Only employees engaged in overhand bricklaying or related work is permitted in the controlled access zones.

On floors and roofs where guardrail systems are not in

place prior to the beginning of overhand bricklaying operations, controlled access zones must be enlarged as necessary to enclose all points of access, material handling areas, and storage areas.

On floors and roofs where guardrail systems are in place, but need to be removed to allow overhand bricklaying work or leading edge work to take place, only that portion of the guardrail necessary to accomplish that day's work shall be removed.

❖ **Excavations - 1926.501(b)(7)**

Each employee at the edge of an excavation 6 feet (1.8 meters) or more deep shall be protected from falling by guardrail systems, fences, barricades, or covers. Where walkways are provided to permit employees to cross over excavations, guardrails are required on the walkway if the fall would be 6 feet (1.8 meters) or more to the lower level.

❖ **Fall Protection Systems Criteria and Practices**

Covers - 1926.502(i)

Covers located in roadways and vehicular aisles must be able to support at least twice the maximum axle load of the largest vehicle to which the cover might be subjected. All other covers must be able to support at least twice the weight of employees, equipment, and materials that may be imposed on the cover at any one time. To prevent accidental displacement resulting from wind, equipment, or workers' activities, all covers must be secured. All covers shall be color coded or bear the markings "HOLE" or "COVER."

Guardrail Systems - 1926.501(502)(b)

If the employer chooses to use guardrail systems to protect workers from falls, the systems must meet the following criteria. Toprails and midrails of guardrail systems must be at least one-quarter inch (0.6 centimeters) nominal diameter or thickness to prevent cuts and lacerations. If wire rope is used for toprails, it must be flagged at not more than 6 feet intervals (1.8 meters) with high-visibility material. Steel and plastic banding cannot be used as toprails or midrails. Manila, plastic, or synthetic rope used for toprails or midrails must be inspected as frequently as necessary to ensure strength and stability.

The top edge height of toprails or (equivalent) guardrails must be 42 inches (1.1 meters) plus or minus 3 inches (8 centimeters), above the walking/working level. When workers are using stilts, the top edge height of the top rail, or equivalent member, must be increased an amount equal to the height of the stilts.

Screens, midrails, mesh, intermediate vertical members, or equivalent intermediate structural members must be installed between the top edge of the guardrail

system and the walking/working surface when there are no walls or parapet walls at least 21 inches (53 centimeters) high. When midrails are used, they must be installed at a height midway between the top edge of the guardrail system and the walking/working level. When screens and mesh are used, they must extend from the top rail to the walking/working level and along the entire opening between top rail supports. Intermediate members, such as balusters, when used between posts, shall not be more than 19 inches (48 centimeters) apart.

Other structural members, such as additional midrails and architectural panels, shall be installed so that there are no openings in the guardrail system more than 19 inches (48 centimeters).

The guardrail system must be capable of withstanding a force of at least 200 pounds applied within 2 inches of the top edge in any outward or downward direction. When the 200 pound test is applied in a downward direction, the top edge of the guardrail must not deflect to a height less than 39 inches (1 meter) above the walking/working level.

Midrails, screens, mesh, intermediate vertical members, solid panels, and equivalent structural members shall be capable of withstanding a force of at least 150 pounds applied in any downward or outward direction at any point along the midrail or other member.

Guardrail systems shall be surfaced to protect workers from punctures or lacerations and to prevent clothing from snagging.

The ends of top rails and midrails must not overhang terminal posts, except where such an overhang does not constitute a projection hazard.

When guardrail systems are used at hoisting areas, a chain, gate or removable guardrail section must be placed across the access opening between guardrail sections when hoisting operations are not taking place.

At holes, guardrail systems must be set up on all unprotected sides or edges. When holes are used for the passage of materials, the hole shall have not more than two sides with removable guardrail sections. When the hole is not in use, it must be covered or provided with guardrails along all unprotected sides or edges.

If guardrail systems are used around holes that are used as access points (such as ladderways), gates must be used or the point of access must be offset to prevent accidental walking into the hole.

If guardrails are used at unprotected sides or edges of ramps and runways, they must be erected on each unprotected side or edge.

Personal Fall Arrest Systems - 1926.502(d)

These consist of an anchorage, connectors, and a body harness and may include a deceleration device,

lifeline, or suitable combinations. If a personal fall arrest system is used for fall protection, it must do the following:

- Limit maximum arresting force on an employee to 1,800 pounds when used with a body harness;
- Be rigged so that an employee can neither free fall more than 6 feet (1.8 meters) nor contact any lower level;
- Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.07 meters); and
- Have sufficient strength to withstand twice the potential impact energy of an employee free-falling a distance of 6 feet (1.8 meters) or the free fall distance permitted by the system, whichever is less.

The use of a body belt for fall arrest is prohibited; however, the use of a body belt in a positioning device system is acceptable.

Personal fall arrest systems must be inspected prior to each use for wear damage, and other deterioration. Defective components must be removed from service. Dee-rings and snaphooks must have a minimum tensile strength of 5,000 pounds. Dee-rings and snaphooks shall be proof-tested to a minimum tensile load of 3,600 pounds without cracking, breaking, or suffering permanent deformation.

Snaphooks shall be sized to be compatible with the member to which they will be connected, or shall be of a locking configuration.

Unless the snaphook is a locking type and designed for the following connections, they shall not be engaged (a) directly to webbing, rope, or wire rope; (b) to each other; (c) to a dee-ring to which another snaphook or other connector is attached; (d) to a horizontal lifeline; or (e) to any object incompatible in shape or dimension relative to the snaphook, thereby causing the connected object to depress the snaphook keeper and release unintentionally.

OSHA considers a hook to be compatible when the diameter of the dee-ring to which the snaphook is attached is greater than the inside length of the snaphook when measured from the bottom (hinged end) of the snaphook keeper to the inside curve of the top of the snaphook. Thus, no matter how the dee-ring is positioned or moved (rolls) with the snaphook attached, the dee-ring cannot touch the outside of the keeper, thus depressing it open. The use of non-locking snaphooks is prohibited.

On suspended scaffolds or similar work platforms with horizontal lifelines that may become vertical lifelines, the devices used to connect to a horizontal lifeline shall be capable of locking in both directions on the lifeline.

Horizontal lifelines shall be designed, installed, and

used under the supervision of a qualified person, as part of a complete personal fall arrest system that maintains a safety factor of at least two. Lifelines shall be protected against being cut or abraded.

Self-retracting lifelines and lanyards that automatically limit free fall distance to 2 feet (0.61 meters) or less shall be capable of sustaining a minimum tensile load of 3,000 pounds applied to the device with the lifeline or lanyard in the fully extended position.

Self-retracting lifelines and lanyards that do not limit free fall distance to 2 feet (0.61 meters) or less, ripstitch lanyards, and tearing and deforming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds applied to the device with the lifeline or lanyard in the fully extended position.

Ropes and straps (webbing) used in lanyards, lifelines, and strength components of body belts and body harnesses shall be made of synthetic fibers.

Anchorage shall be designed, installed, and used under the supervision of a qualified person, as part of a complete personal fall arrest system that maintains a safety factor of at least two, i.e., capable of supporting at least twice the weight expected to be imposed upon it. Anchorages used to attach personal fall arrest systems shall be independent of any anchorage being used to support or suspend platforms and must be capable of supporting at least 5,000 pounds per person attached.

Lanyards and vertical lifelines must have a minimum breaking strength of 5,000 pounds.

Positioning Device Systems - 1926.502(e)

These body belt or body harness systems are to be set up so that a worker can free fall no farther than 2 feet (0.6 meters). They shall be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 pounds, whichever is greater. Requirements for snaphooks, dee-rings, and other connectors used with positioning device systems must meet the same criteria as those for personal fall arrest systems.

Safety Monitoring Systems - 1926.502(h)

When no other alternative fall protection has been implemented, the employer shall implement a safety monitoring system. Employers must appoint a competent person to monitor the safety of workers and the employer shall ensure that the safety monitor:

- Is competent in the recognition of fall hazards,
- Is capable of warning workers of fall hazard dangers and in detecting unsafe work practices,
- Is operating on the same walking/working surfaces of the workers and can see them, and
- Is close enough to work operations to communicate

orally with workers and has no other duties to distract from the monitoring function.

Mechanical equipment shall not be used or stored in areas where safety monitoring systems are being used to monitor employees engaged in roofing operations on low-sloped roofs.

No worker, other than one engaged in roofing work (on low sloped roofs) or one covered by a fall protection plan, shall be allowed in an area where an employee is being protected by a safety monitoring system.

All workers in a controlled access zone shall be instructed to promptly comply with fall hazard warnings issued by safety monitors.

Safety Net Systems - 1926.502(c)

Safety nets must be installed as close as practicable under the walking/working surface on which employees are working and never more than 30 feet (9.1 meters) below such levels. Defective nets shall not be used. Safety nets shall be inspected at least once a week for wear, damage, and other deterioration. The maximum size of each safety net mesh opening shall not exceed 36 square inches (230 square centimeters) nor be longer than 6 inches (15 centimeters) on any side, and the openings, measured center-to-center, of mesh ropes or webbing, shall not exceed 6 inches (15 centimeters). All mesh crossings shall be secured to prevent enlargement of the mesh opening.

Each safety net or section shall have a border rope for webbing with a minimum breaking strength of 5,000 pounds. Connections between safety net panels shall be as strong as integral net components and be spaced no more than 6 inches (15 centimeters) apart.

Safety nets shall be installed with sufficient clearance underneath to prevent contact with the surface or structure below.

When nets are used on bridges, the potential fall area from the walking/working surface to the net shall be unobstructed.

Safety nets must extend outward from the outermost projection of the work surface as follows:

Vertical distance from working level to horizontal plane of net surface.	Minimum required horizontal distance of outer edge of net from edge of working surface.
Up to 5 feet (1.5 meters)	8 feet (2.4 meters)
More than 5 feet (1.5 meters) up to 10 feet (3 meters)	10 feet (3 meters)
More than 10 feet (3 meters)	13 feet (3.9 meters)

Safety nets shall be capable of absorbing an impact force of a drop test consisting of a 400-pound bag of sand 30 inches (76 centimeters) in diameter dropped from the highest walking/working surface at which workers are exposed, but not from less than 42 inches (1.1 meters) above that level.

Items that have fallen into safety nets including—but not restricted to, materials, scrap, equipment, and tools—must be removed as soon as possible and at least before the next work shift.

Warning Line Systems - 1926.502(f)

Warning line systems consist of ropes, wires, or chains, and supporting stanchions and are set up as follows:

- Flagged at not more than 6-foot (1.8 meters) intervals with high-visibility material.
- Rigged and supported so that the lowest point including sag is no less than 34 inches (0.9 meters) from the walking/ working surface and its highest point is no more than 39 inches (1 meter) from the walking/working surface.
- Stanchions, after being rigged with warning lines, shall be capable of resisting, without tipping over; a force of at least 16 pounds applied horizontally against the stanchion, 30 inches (0.8 meters) above the walking/working surface, perpendicular to the warning line and in the direction of the floor, roof, or platform edge.
- The rope, wire, or chain shall have a minimum tensile strength of 500 pounds, and after being attached to the stanchions, must support without breaking the load applied to the stanchions as prescribed above.
- Shall be attached to each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in the adjacent section before the stanchion tips over.

Warning lines shall be erected around all sides of roof work areas. When mechanical equipment is being used, the warning line shall be erected not less than 6 feet (1.8 meters) from the roof edge parallel to the direction of mechanical equipment operation, and not less than 10 feet (3 meters) from the roof edge perpendicular to the direction of mechanical equipment operation.

When mechanical equipment is not being used, the warning line must be erected not less than 6 feet (1.8 meters) from the roof edge.

❖ Formwork and Reinforcing Steel - 1926.501(b)(5)

For employees, while moving vertically and/or horizontally on the vertical face of rebar assemblies

built in place, fall protection is not required when employees are moving. OSHA considers the multiple hand holds and foot holds on rebar assemblies as providing similar protection as that provided by a fixed ladder. Consequently, no fall protection is necessary while moving point to point for heights below 24 feet (7.3 meters). An employee must be provided with fall protection when climbing or otherwise moving at a height more than 24 feet (7.3 meters), the same as for fixed ladders.

❖ Hoist Areas - 1926.501(b)(3)

Each employee in a hoist area shall be protected from falling 6 feet (1.8 meters) or more by guardrail systems or personal fall arrest systems. If guardrail systems (or chain gate or guardrail) or portions thereof must be removed to facilitate hoisting operations, as during the landing of materials, and a worker must lean through the access opening or out over the edge of the access opening to receive or guide equipment and materials, that employee must be protected by a personal fall arrest system.

❖ Holes - 1926.501(b)(4)

Personal fall arrest systems, covers, or guardrail systems shall be erected around holes (including skylights) that are more than 6 feet (1.8 meters) above lower levels.

❖ Leading Edges - 1926.501(b)(2)

Each employee who is constructing a leading edge 6 feet (1.8 meters) or more above lower levels shall be protected by guardrail systems, safety net systems, or personal fall arrest systems. If the employer can demonstrate that it is infeasible or creates a greater hazard to implement these systems, he or she must develop and implement a fall protection plan that meets the requirements of 29 CFR 1926.502(k).

❖ Overhand Bricklaying and Related Work - 1926.501(b)(9)

Each employee performing overhand bricklaying and related work 6 feet (1.8 meters) or more above lower levels shall be protected by guardrail systems, safety net systems, or personal fall arrest systems, or shall work in a controlled access zone. All employees reaching more than 10 inches (25 centimeters) below the level of a walking/working surface on which they are working shall be protected by a guardrail system, safety net system, or personal fall arrest system.

❖ Precast Concrete Erection - 1926.501(b)(12)

Each employee who is 6 feet (1.8 meters) or more above lower levels while erecting precast concrete

members and related operations such as grouting of precast concrete members shall be protected by guardrail systems, safety net systems, or personal fall arrest systems. Where the employer can demonstrate, however, that it is infeasible or creates a greater hazard to use those systems, the employer must develop and implement a fall protection plan that meets the requirements of 29 CFR 1926.502(k).

❖ Protection from Falling Objects - 1926.502(j)

When guardrail systems are used to prevent materials from falling from one level to another, any openings must be small enough to prevent passage of potential falling objects. No materials or equipment except masonry and mortar shall be stored within 4 feet (1.2 meters) of working edges. Excess mortar, broken or scattered masonry units, and all other materials and debris shall be kept clear of the working area by removal at regular intervals.

During roofing work, materials and equipment shall not be stored within 6 feet (1.8 meters) of a roof edge unless guardrails are erected at the edge, and materials piled, grouped, or stacked near a roof edge must be stable and self-supporting.

Canopies - 1926.502(j)(8)

When used as protection from falling objects canopies must be strong enough to prevent collapse and to prevent penetration by any objects that may fall onto them.

Toeboards - 1926.502(j)(2), (3), and (4)

When toeboards are used as protection from falling objects, they must be erected along the edges of the overhead walking or working surface for a distance sufficient to protect persons working below. Toeboards shall be capable of withstanding a force of at least 50 pounds applied in any downward or outward direction at any point along the toeboard. Toeboards shall be a minimum of 3.5 inches (9 centimeters) tall from their top edge to the level of the walking/working surface, have no more than 0.25 inches (0.6 centimeters) clearance above the walking/working surface, and be solid or have openings no larger than 1 inch (2.5 centimeters) in size.

Where tools, equipment, or materials are piled higher than the top edge of a toeboard, paneling or screening must be erected from the walking/working surface or toeboard to the top of a guardrail system's top rail or midrail, for a distance sufficient to protect employees below.

❖ Training - 1926.503

Employers must provide a training program that teaches employees who might be exposed to fall

hazards how to recognize such hazards and how to minimize them. Employees must be trained in the following areas: (a) the nature of fall hazards in the work area; (b) the correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems; (c) the use and operation of controlled access zones and guardrail, personal fall arrest, safety net, warning line, and safety monitoring systems; (d) the role of each employee in the safety monitoring system when the system is in use; (e) the limitations on the use of mechanical equipment during the performance of roofing work on low-slope roofs; (f) the correct procedures for equipment and materials handling and storage and the erection of overhead protection; and, (g) employees' role in fall protection plans; and (h) the standards in this Subpart.

Employers must prepare a written certification that identifies the employee trained and the date of the training. The employer or trainer must sign the certification record. Retraining also must be provided when necessary.

❖ Ramps, Runways, and Other Walkways - 1926.501(b)(6)

Each employee using ramps, runways, and other walkways shall be protected by guardrail systems against falling 6 feet (1.8 meters) or more.

ROOFING

Low-Slope Roofs - 1926.501(b)(10)

Each employee engaged in roofing activities on low-slope roofs with unprotected sides and edges 6 feet (1.8 meters) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, personal fall arrest systems or a combination of a warning line system and guardrail system, warning line system and safety net system, warning line system and personal fall arrest system, or warning line system and safety monitoring system. On roofs 50 feet (15.25 meters) or less in width, the use of a safety monitoring system without a warning line system is permitted.

Steep Roofs - 1926.501(b)(11)

Each employee on a steep roof with unprotected sides and edges 6 feet (1.8 meters) or more above lower levels shall be protected by either guardrail systems with toeboards, a safety net system, or a personal fall arrest system.

❖ Wall Openings - 1926.501(b)(14)

Each employee working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall opening is 6 feet

(1.8 meters) or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches (1.0 meter) above the walking/working surface must be protected from falling by the use of either a guardrail system, a safety net system, or a personal fall arrest system.

GLOSSARY

Anchorage — A secure point of attachment for lifelines, lanyards or deceleration devices.

Body belt — A strap with means both for securing it about the waist and for attaching it to a lanyard, lifeline, or deceleration device.

Body harness — Straps that may be secured about the person in a manner that distributes the fall-arrest forces over at least the thighs, pelvis, waist, chest, and shoulders with a means for attaching the harness to other components of a personal fall arrest system.

Connector — A device that is used to couple (connect) parts of a personal fall arrest system or positioning device system together.

Controlled access zone — A work area designated and clearly marked in which certain types of work (such as overhand bricklaying) may take place without the use of conventional fall protection systems—guardrail, personal arrest or safety net—to protect the employees working in the zone.

Deceleration device — Any mechanism—such as rope, grab, ripstitch lanyard, specially-woven lanyard, tearing or deforming lanyards, automatic self-retracting lifelines/lanyards—which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limits the energy imposed on an employee during fall arrest.

Deceleration distance — The additional vertical distance a falling person travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which a deceleration device begins to operate.

Guardrail system — A barrier erected to prevent employees from falling to lower levels.

Hole — A void or gap 2 inches (5.1 centimeters) or more in the least dimension in a floor, roof, or other walking/working surface.

Lanyard — A flexible line of rope, wire rope, or strap that generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage.

Leading edge — The edge of a floor, roof, or formwork for a floor or other walking/working surface (such as the deck) which changes location as additional floor, roof, decking, or formwork sections are placed, formed or constructed.

Lifeline — A component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and that serves as a means for connecting other components of a personal fall arrest system to the anchorage.

Low-slope roof — A roof having a slope less than or equal to 4 in 12 (vertical to horizontal).

Opening — A gap or void 30 inches (76 centimeters) or more high and 18 inches (46 centimeters) or more wide, in a wall or partition, through which employees can fall to a lower level.

Personal fall arrest system — A system including but not limited to an anchorage, connectors, and a body harness used to arrest an employee in a fall from a working level.

Positioning device system — A body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning backwards.

Rope grab — A deceleration device that travels on a lifeline and automatically, by friction, engages the lifeline and locks to arrest a fall.

Safety-monitoring system — A safety system in which a competent person is responsible for recognizing and warning employees of fall hazards.

Self-retracting lifeline/lanyard — A deceleration device containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under minimal tension during normal employee movement and which, after onset of a fall, automatically locks the drum and arrests the fall.

Snaphook — A connector consisting of a hook-shaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released automatically closes to retain the object.

Steep roof — A roof having a slope greater than 4 in 12 (vertical to horizontal).

Toeboard — A low protective barrier that prevents material and equipment from falling to lower levels and which protects personnel from falling.

Unprotected sides and edges — Any side or edge (except at entrances to points of access) of a walking/working surface (e.g., floor, roof, ramp, or runway) where there is no wall or guardrail system at least 39 inches (1 meter) high.

Walking/working surface — Any surface, whether horizontal or vertical, on which an employee walks or works, including but not limited to floors, roofs, ramps, bridges, runways, formwork, and concrete reinforcing steel. Does not include ladders, vehicles, or trailers on which employees must be located to perform their work duties.

Warning line system — A barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge and which designates an area in which roofing work may take place without the use of guardrail, body belt, or safety net systems to protect employees in the area.

ANSWER SHEET

First Name: _____ Last Name: _____ Date: _____

Address: _____ City: _____ State: _____ ZIP: _____

Phone: _____ Email: _____

Oregon License #: _____

Construction Site Safety Practices - Course #SRA0166

1. (A) (B) (C) (D)

2. (A) (B) (C) (D)

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9. (A) (B) (C) (D)

10. (A) (B) (C) (D)

ANSWERSHEET

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Phone: _____ Email: _____

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Construction Site Safety Practices – Course #SRA0166

1. (A) (B) (C) (D)

2. (A) (B) (C) (D)

3. (A) (B) (C) (D)

4. (A) (B) (C) (D)

5. (A) (B) (C) (D)

6. (A) (B) (C) (D)

7. (A) (B) (C) (D)

8. (A) (B) (C) (D)

9. (A) (B) (C) (D)

10. (A) (B) (C) (D)