OSHAcademy™
Occupational Safety & Health Training

Fall Protection in Construction

Elements for 29 CFR 1926.500-503

In the U.S. construction industry, falls are the leading cause of worker fatalities and one of OSHA's most commonly cited violations. On average, between 150 and 200 workers are killed and more than 100,000 are injured as a result of falls at construction sites each year. This course looks at how to identify fall hazards, fall protection systems, the importance of training, inspection and maintenance of equipment, and rescuing at height.

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OSHAcademy Course 805 Study Guide

Fall Protection in Construction

This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 805.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

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Course Introduction

Go to any construction site and watch those who are working above a lower level. Should they be wearing fall protection? Should they be protected by fall protection systems? Should they be using fall-protection methods? Do they need fall protection training? Are they following fall protection rules? Fall protection is a concept that's hard to describe. Ask 10 people what fall protection means and you're likely to get 10 different answers. Is it possible to make sense of fall protection? We think so.

It's important that you be familiar with OSHA's fall protection standards to help save lives and avoid OSHA citations.

Take a look at OSHA's top 10 most cited violations for Fiscal Year 2013 and you will see that fall protection ranks as the number one most commonly cited violation!

1. Fall protection
2. Hazard communication
3. Scaffolding
4. Respiratory protection
5. Electrical, wiring methods, components and equipment
6. Powered industrial trucks
7. Ladders, construction
8. Control of hazardous energy (lockout/tagout)
9. Electrical systems design, general requirements
10. Machine guarding (machines, general requirements, general industry)

OSHA 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.

OSHA has revised its construction industry safety standards 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 construction worksite 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
- 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
- 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.

This course is intended primarily for construction-industry employers, employees, and others who don't have a professional background in fall protection and who want to see the "big picture." Generally, the course covers the safe practices in 29 CFR 1926, the primary fall protection rules for construction-industry employers. To complete the picture, the course also highlights fall protection requirements for work on ladders and scaffolds.

This course is organized so you can read each module in the order presented or move about as you choose.

Credits:

Special thanks to Oregon OSHA Technical Resources for producing the primary source document for this training, Fall Protection for the Construction Industry.

Module 1: Falling: Truths and Consequences

Introduction

We need protection because even those of us with experience working at heights can lose our balance or grip; we can slip, trip, or misstep at any time. Even if we have great balancing and motor skills, we are at risk of falling. We've been falling since Day One. Until we get better at landing, we'll need protection from falling.

And, as the photo to the right illustrates, some workers just don't understand fall hazards. Consequently they do things at work and home that defy good sense. The information in this course will help alert and prevent workers from falls.

Falling Causes

Construction is a potentially high hazard industry for those who work in it, with falls at the top of the hazards list. In fact, falls are the most frequent cause of fatalities at construction sites and annually account for one of every three construction-related deaths. Although there are commonly available methods for preventing falls, the number of construction workers who fall to their deaths has increased in recent years. According to the Bureau of Labor Statistics (BLS), falls, slips, or trips took the lives of 668 workers in 2012. Falls to a lower level accounted for just more than 80% of those fatalities in that same year.

Falls from roofs are one specific concern at construction sites and the most frequent cause for fatal falls in construction. In fact, BLS reports from 2003 to 2007 construction worker falls from roofs resulted in 686 fatalities.

Below is a prioritized list showing the types of falls that cause the most non-fatal injuries. As you can see, most fall injuries are caused by falls from ladders.

1. Falls from ladders
2. Falls to lower level, unspecified
3. Falls from roofs
4. From scaffolds or staging

5. Falls from non-moving vehicles
6. Falls from floors, docks, or ground level
7. Falls down stairs
8. Falls from girders or structural steel
9. Falls from piled or stacked material

Preventing Falls

For many in the construction industry, fall protection equipment is the first thing that comes to mind: personal fall-arrest systems, safety nets, or guardrails, for example. But fall protection means more than equipment. Fall protection is what you do to eliminate fall hazards, to prevent falls, and to ensure that workers who may fall aren't injured.

Although fall hazards are common at construction worksites, fall-related injuries and fatalities are preventable. Fall hazards can be addressed in two main ways:

1. **Fall prevention:** preventing workers from falling by using engineering controls (e.g., guardrails and hole covers) or restraint systems.
2. **Fall arrest/rescue:** preventing injury during and after a fall by using personal fall arrest systems (PFAS) or safety nets and having an effective rescue plan in place.

You accomplish fall protection by doing the following:

- Make fall protection part of your construction worksite safety and health program.
- Identify and evaluate fall hazards.
- Eliminate fall hazards, if possible.
- Train workers to recognize fall hazards.
- Use appropriate equipment to prevent falls and to protect workers if they do fall.
- Inspect and maintain fall-protection equipment before and after using it.
- Become familiar with OSHA and company fall-protection rules.

Fall Protection Roles

Everyone in the construction worksite has a role to play in preventing falls.

- **Employers***:* Identify fall hazards at the site. Eliminate the hazards, prevent falls from occurring, or ensure that if falls occur, employees aren't injured. Make sure that employees follow safe practices, use fall protection equipment properly, and are trained to recognize fall hazards.

- **Employees***:* Follow safe work practices, use equipment properly, and participate in training. Learn to recognize unsafe practices, know the tasks that increase the risk of falling, and understand how to control exposure to fall hazards.

- **Architects and engineers***:* Educate employers about hazards that could expose workers to falls during each phase of the project. When designing buildings and structures, consider fall protection and other safety needs of those who will do the construction work.

- **Building owners and managers***:* Ensure that those who do exterior construction or maintenance work know how to protect themselves from falls, are aware of installed anchorages, and know how to use their fall protection equipment.

- **Equipment manufacturers***:* Ensure that fall protection equipment meets federal OSHA and ANSI safety requirements and protects workers when they use it properly. Warn workers through instruction manuals and on equipment labels about the danger of using equipment improperly.

- **Lawyers***:* Review your client's construction bids to ensure that they comply with OSHA requirements. The documents should clearly state the client's responsibilities for protecting workers from falls and for identifying and controlling hazards that cause falls.

Scenario

On a Friday in June, an estimator arrived at a remodel job to look at a cedar-shake roof and estimate the cost of an addition that a construction crew was building. He spoke to the supervisor at the site and climbed to the roof through an open skylight, using a metal extension ladder.

However, he was unaware that the contractor had used a sheet of thin insulating material to cover three 2-by-6-foot skylight openings in the roof (it had rained the day before). He stepped onto the insulating material, fell through one of the skylights, and landed on his back, 15 feet below.

The supervisor and two subcontractors heard the estimator fall and rushed to the accident. One of the subcontractors used his cell phone to call emergency medical services. EMTs arrived about five minutes later, stabilized the victim and took him to a hospital where he underwent emergency surgery for spinal injuries.

Findings: The employer failed to properly cover the skylight openings on the roof or warn workers about the hazard.

Module 1 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Falls account for _____ construction-related deaths.**

    a. less than half
    b. one of every three
    c. more than half
    d. all

2. **Which of the following cause the most fall injuries?**

    a. falls down stairs
    b. falls from ladders
    c. falls from roofs
    d. falls from scaffolds

3. **What should you do to accomplish effective fall protection?**

    a. be familiar with OSHA and company fall-protection rules
    b. identify and evaluate fall hazards
    c. inspect and maintain fall-protection equipment
    d. do all of the above

4. **Who is responsible for making sure fall protection equipment is used properly?**

    a. employers
    b. employees
    c. owners
    d. building managers

5. **Employees must learn to recognize _____ practices and know the tasks that _____ the risk of falling.**

    a. safe, eliminate
    b. safe, remove
    c. unsafe, decrease
    d. unsafe, increase

Module 2: Preparing to Prevent Falls

Fall Protection Program

A construction fall protection program is what you and your coworkers do to achieve and maintain a safe, healthful construction worksite. There are as many types of safety and health programs as there are construction worksites, but not all programs are successful. What makes a successful safety and health program? There are seven elements:

1. **Commitment**: All employees- including company executive officers, managers, and supervisors- are committed to making the program succeed.

2. **Accountability**: All employees - including company executive officers, managers, and supervisors - are held accountable for following safe work practices.

3. **Involvement**: All employees, including managers and supervisors, participate in making the program succeed.

4. **Hazard identification**: All employees are trained to identify hazards, and there are procedures for conducting hazard inspections and reporting hazards.

5. **Accident investigation**: Managers and supervisors promptly investigate all accidents and near misses, and then determine how to eliminate their causes.

6. **Training**: All employees receive training in identifying construction worksite hazards and learning safe work practices.

7. **Evaluation**: Managers and supervisors, with help from other employees, evaluate the program's strengths and weaknesses at least once a year.

It's interesting to note, of all the seven elements, the element that usually results in more OSHA citations due to inadequate implementation is the training element. OSHA compliance officers (and lawyers in lawsuits) will look long and hard at your training program because they know it is the area more likely lacking in due diligence.

Prepare a Safety and Health Policy

Does your company have a written safety and health policy? It should. A written policy reflects commitment to a safe, healthful construction worksite, summarizes management and employee responsibilities, and emphasizes the safety and health program's role in achieving that goal. Keep the policy brief, commit to it, and enforce it. Take a look at a sample policy.

Designate Competent and Qualified Persons

You'll find activities throughout OSHA's construction worksite safety and health rules that are required to be conducted by competent and qualified persons.

Competent person and *qualified person* are terms that federal OSHA created to designate individuals who have the training and expertise to evaluate hazardous conditions, inspect equipment, evaluate mechanical systems, or train others how to work safely.

OSHA offers the following definitions:

- *The **competent person**:* A competent person is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. [1926.32(f)]

- *The **qualified person**:* A qualified person is one who, by possession of a recognized degree, certificate, or professional standing or who, by extensive knowledge, training, and experience, has successfully demonstrated his or her ability to solve or resolve problems relating to the subject matter, the work, or the project. [1926.32(m)]

Choosing a Competent or Qualified Person

Although Federal OSHA defines competent and qualified persons, it doesn't provide specifics for determining who can assume these roles. The following guidelines may help:

- Know the OSHA rules that apply to your construction worksite. The rules will tell you if you need to designate a competent or a qualified person.

- If an OSHA rule that applies to your construction worksite requires a competent or a qualified person, note duties and responsibilities that the rule requires the person to perform.

- If an OSHA rule that applies to your construction worksite requires a competent person, that person must have the authority to take prompt corrective measures to eliminate hazards.

- Determine the knowledge, training, and experience the competent or qualified person needs to meet the rule's requirements.

- Designate a person who has the knowledge, training, and experience that meets the rule's requirements.

Duties and Responsibilities

The Competent Person

- Serves as the monitor in a safety-monitoring system and is responsible for recognizing hazards that cause falls and warning workers about them.
- Determines that safety nets meet minimum requirements.
- Inspects a personal fall-arrest system after it arrests a fall and determines if the system is undamaged and can be used again.
- Evaluates any alteration in a personal fall-arrest system and determines if the system is safe to use.
- Supervises the installation of slide-guard systems.
- Trains employees to recognize hazards that cause falls and to follow procedures that minimize the hazards.

The Qualified Person

- Supervises design, installation, and use of horizontal lifeline systems to ensure that they can maintain a safety factor of at least two - twice the impact of a worker free-falling 6 feet.
- Supervises design, installation, and use of personal fall-restraint anchorages.
- Supervises design, installation, and use of personal fall-arrest anchorages.

Scenario

On September 5, 2006, a 30-year-old construction laborer (the victim) was fatally injured when he fell through a floor opening to a concrete floor approximately 10 feet, 10 inches below.

The victim had spent the majority of his work shift cutting plywood sheathing and handing it up to coworkers who were sheathing the roof. He was working from the second floor of a

two-story, single-family home under construction where he and other workers had completed most, but not all, of the subfloor (plywood sheathing secured over floor joists) on previous workdays.

They had left a floor area open in an attic space where a walk-in closet was to be constructed later. At the end of the shift, the victim's lead worker asked two workers to complete the second story subfloor in the attic space. One of these workers joined the roofers to lay roofer's felt. The other co-worker joined the victim and together, they cut two sheets of plywood sheathing and placed them over the joists in the open area in the attic space.

This photograph shows the two-story home workers were framing when the accident occurred.

Photo: Courtesy: NCDOL/OSH

They were not wearing fall protection. The co-worker reported he was looking down at the sheets of unsecured plywood sheathing trying to make the pieces fit into an opening that was not square and when he looked up the victim was gone. The victim had apparently stepped onto a piece of the unsecured plywood sheathing that covered part of the floor opening, and when the plywood sheathing pivoted on the floor joist, he fell through the opening.

Conclusion

- Ensure all employees are provided with and use appropriate fall protection when exposed to fall hazards.
- Ensure through employee training and job-site inspection that correct construction procedures, such as use of appropriate fasteners, are followed during all phases of construction.
- Develop, implement, and enforce a comprehensive, written fall protection program that, at a minimum, complies with applicable OSHA fall prevention standards.
- Assign a competent person to inspect the worksite before work begins to identify fall hazards and to determine the appropriate fall prevention systems for workers.

Module 2 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Which program element usually results in more OSHA citations due to inadequate implementation?**

   a. commitment
   b. training
   c. accident investigation
   d. hazard identification

2. **Which of the following is accomplished by a written fall protection policy?**

   a. reflects management commitment
   b. summarizes manager and employee responsibilities
   c. emphasizes the safety and health program's role
   d. all of the above

3. **A competent person is one who is can _____ hazards and is authorized to _____ them.**

   a. correct, report
   b. mitigate, monitor
   c. identify, correct
   d. view, mitigate

4. **A _____ person is one who has successfully demonstrated his or her ability to solve or resolve problems relating to the subject matter, the work, or the project.**

   a. qualified
   b. authorized
   c. competent
   d. designated

5. **If OSHA regulations require a competent person, that person must have the authority to take prompt corrective measures to eliminate hazards.**

    a. true
    b. false

Module 3: Identifying and Evaluating Fall Hazards

Fall Hazard Definition

A fall hazard is anything in the construction worksite that could cause an unintended loss of balance or bodily support and result in a fall. Fall hazards cause accidents such as the following:

- A worker walking near an unprotected leading edge trips over a protruding board.
- A worker slips while climbing an icy stairway.
- A makeshift scaffold collapses under the weight of four workers and their equipment.
- A worker carrying a sheet of plywood on a flat roof steps into a skylight opening.

Fall hazards are foreseeable. You can identify them and eliminate or control them before they cause injuries.

Evaluating Fall Hazards

The purpose of evaluating fall hazards is to determine how to eliminate or control them before they cause injuries. Below are important factors to consider in conducting an evaluation.

Involve Others

You may need others to help you evaluate fall hazards. Involve those who may be exposed to fall hazards and their supervisors; they'll help you identify the hazards and determine how to eliminate or control them. Involving others also strengthens your safety and health program. Your workers' compensation insurance carrier and OSHA will also help you evaluate fall hazards. Contact your insurance carrier to request a consultation.

Accessing Elevated Surfaces

In accessing elevated surfaces, you need to ask if workers will be using portable ladders, supported scaffolds, aerial lifts, or suspension platforms to reach their work areas. Which ones will they use? How and where will they use the equipment?

Falling Risks

Here are some questions to ask before starting work on a construction site: Will tasks expose workers to overhead power lines? Will they need to use scaffolds, ladders, or aerial lifts on unstable or uneven ground? Will they be working during hot, cold, or windy weather? Make

sure you consider ergonomics. Will workers need to frequently lift, bend, or move in ways that put them off balance? Will they be working extended shifts that could contribute to fatigue?

Other factors that could increase the risk of falls include:

When working at heights, make sure you are using acceptable fall protection equipment, such as the harness in this photo.

- holes in walking/working surfaces that they could step into or fall through
- elevated walking/working surfaces 10 feet or more above a lower level
- skylights and smoke domes that workers could step into or fall through
- wall openings such as those for windows or doors that workers could fall through
- trenches and other excavations that workers could fall into
- walking/working surfaces from which workers could fall onto dangerous equipment
- hoist areas where guardrails have been removed to receive materials
- sides and edges of walking/working surfaces such as established floors, mezzanines, balconies, and walkways that are 6 feet or more above a lower level and not protected by guardrails at least 39 inches high
- ramps and runways that are not protected by guardrails at least 39 inches high
- leading edges - edges of floors, roofs, and decks - that change location as additional sections are added
- wells, pits, or shafts not protected with guardrails, fences, barricades, or covers

Identify Potential Falling Issues

For construction sites, use a set of worksite plans to review the entire construction project.

- Evaluate each phase of the project from the ground up.
- Ensure that all walking/working surfaces have the strength to support workers and their equipment, and then identify all tasks that could expose workers to falls.
- Use a walking/working surface for any surface, horizontal or vertical, on which a person walks or works.

The more frequently a worker is exposed to a fall hazard; the more likely it is the worker could fall.

Determine If and How Workers Need to Move

Determine whether workers need to move horizontally, vertically, or in both directions to do their tasks. How workers move to perform tasks can affect their risk of falling. Knowing how they move to perform tasks can help you determine how to protect them.

Hazardous Walking/Working Surfaces

Identify walking/working surfaces that could expose workers to fall hazards. Some examples include floors, roofs, ramps, bridges, runways, formwork, beams, columns, trusses, and rebar.

Fall Distances

Determine fall distances from walking/working surfaces to lower levels. Generally, workers must be protected from fall hazards on walking/working surfaces where they could fall six feet or more to a lower level.

Here are some examples of fall hazards from which employees must be protected by the “six foot rule:”

- holes and skylights in walking/working surfaces
- wall openings that have an inside bottom edge less than 39 inches above a walking/working surface
- established floors, mezzanines, balconies, and walkways with unprotected sides and edges
- excavations with edges that are not readily seen because of plant growth or other visual barriers

- wells, pits, shafts and similar excavations

At any height workers must also be protected from falling onto or into dangerous equipment. Guardrails must be designed and built to meet the requirements of 1926.502(b). Covers must meet the requirements of 1926.502(i). See OSHAcademy course: Ladder and Stairway Safety here for more information on the requirements of guardrails.

Identifying and Eliminating Fall Hazards

Eliminating a fall hazard is the most effective fall-protection strategy. Here are some ways to eliminate fall hazards:

- Perform construction work on the ground before lifting or tilting it to an elevated position.
- Install permanent stairs early in the project so that workers don't need to use ladders between floors.
- Use tool extensions to perform work from the ground.
- Identify fall hazards that you can't eliminate. If you can't eliminate fall hazards, you need to prevent falls or control them so that workers who may fall are not injured.
- To prevent falls, use covers, guardrails, handrails, perimeter safety cables, and personal fall-restraint systems.
- Use methods to control falls, which include personal fall-arrest systems, positioning-device systems, and safety-net systems. Use these fall-protection systems only when you can't eliminate fall hazards or prevent falls from occurring.

Administrative Controls

Administrative controls help prevent falls by influencing the way people work. Examples include substituting a safe work practice for a risky one, training workers how to do their jobs safely, and disciplining those who don't follow safe practices.

Necessity of Anchorages

If workers use personal fall-arrest or restraint systems, they'll need secure anchorages for their lifelines or lanyards. Anchorages for personal fall-arrest systems must be able to support at least 5,000 pounds per attached worker or be designed with a safety factor of at least two -

twice the impact force of a worker free-falling 6 feet. Anchorages for personal fall-restraint systems must be able to support at least 3,000 pounds per attached worker or be designed with a safety factor of at least two - twice the peak anticipated dynamic load.

Scenario

On September 17, 1997, a 32 year old male project engineer was fatally injured when he fell 29 feet from a roof while measuring the roof for an insulation cost estimate. The victim was walking backwards while measuring when he fell over the edge of the roof. A maintenance person from the building who had accompanied the victim and two co-workers to the roof immediately ran downstairs and called 911 from the office and proceeded to the victim to offer assistance. Emergency medical services arrived immediately. The victim was transported to a nearby local hospital where he was pronounced dead on arrival.

Employers should:

- employ alternative controls for fall hazards when personal fall arrest systems are not required nor appropriate
- develop, implement, and enforce a comprehensive safety program that includes, but is not limited to, training all employees in fall hazard recognition

Building owners should:

- consider the installation of guardrails at the perimeter of flat roofs wherever possible

Module 3 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **The purpose of evaluating fall hazards is to determine how to eliminate or control them after they cause injuries.**

   a. true
   b. false

2. **Which of the following might be able to help you identify fall hazards in your construction worksite?**

   a. those exposed to hazards
   b. insurance carrier
   c. OSHA consultants
   d. any of the above

3. **Generally, workers must be protected from fall hazards on walking/working surfaces where they could fall _____ feet or more to a lower level.**

   a. 2
   b. 4
   c. 6
   d. 10

4. **Anchorages for personal fall-arrest systems must be able to support at least _____ pounds per attached worker or be designed with a safety factor of at least _____.**

   a. 5,000, two
   b. 3,000, three
   c. 2,000, four
   d. 1,000, five

5. Ramps and runways should be protected by guardrails at least _____ high.

a. 24 inches
b. 3 feet
c. 39 inches
d. 4 feet

Module 4: Supported and Suspended Access

Supported Access

Portable ladders, supported scaffolds, and aerial lifts let you get to a work area and support you while you work. They make getting to a work area easy, but they can cause falls when they're not used properly.

Portable Ladders

Portable ladders are versatile, economical, and easy to use. However, workers sometimes use them without thinking about using them safely. Each year, most workers are injured when they fall from ladders. Most of the falls are less than 10 feet.

Types of portable ladders: We use ladders to do all sorts of tasks, so it's not surprising that many types of ladders are available. Let's look at the most common types.

Straight Ladder (left)

The most common type of portable ladder. Length cannot exceed 30 feet. Available in wood, metal, and reinforced fiberglass. Supports only one worker.

Standard Folding Ladder (right)

Folding ladders have flat steps, a hinged back, and is not adjustable. For use only on firm, level surfaces. Available in metal, wood, or reinforced fiberglass. Must have a metal spreader or locking arm and cannot exceed 20 feet. Supports only one worker.

Extension Ladder (left)

Extension ladders offer the most length in a general-purpose ladder. They have two or more adjustable sections. The sliding upper section must be on top of the lower section. Made of wood, metal, or fiberglass. Maximum length depends on material. Supports only one worker.

Platform Ladder (right)

Platform ladders have a large, stable platform near the top that supports one worker. Length cannot exceed 20 feet.

Trestle Ladder (left)

Trestle ladders have two sections that are hinged at the top and form equal angles with the base. Used in pairs to support planks or staging. Rungs are not used as steps. Length cannot exceed 20 feet.

Tripod (Orchard) Ladder (right)

Tripod ladders have a flared base and a single back leg that provides support on soft, uneven ground. Length cannot exceed 16 feet. Metal and reinforced fiberglass versions are available. Supports only one worker.

How Falls From Ladders Occur

Most workers fall from unstable ladders that shift or tilt when the workers climb too high or reach too far beyond the side rails. Workers also fall when they slip on rungs while they're climbing or descending and when vehicles strike the ladders. Workers can reduce their risk of falling by doing the following:

- Inspect ladders frequently and maintain them.
- Match work tasks to appropriate ladders.
- Set up ladders correctly. Use the 1 to 4 rules. One foot out from wall for every four feet of height.
- Climb and descend ladders properly. Both hands should be free to grasp rungs.
- Always use the three-point rule. "Two feet - One hand" or "Two hands - One foot" making contact at all times.

Before workers use ladders, a competent person must train them so that they understand the following:

- the nature of the fall hazards in the work area
- how to use, place, and care for ladders
- maximum intended load-carrying capacities of the ladders

Safe Ladder Practices

Keep the following in mind when you use a portable ladder:

- Select the most appropriate ladder for the task.
- Inspect the ladder before using it; make sure it's in good condition.
- Angle straight ladders and extension ladders properly. It should have a 4-to-1 slope (height to base).
- Protect the base of a ladder to prevent others from accidentally striking it.

- Select a ladder that will extend at least 36 inches above the access area, or provide a grab rail so that workers can steady themselves as they get on or off. Make sure that the ladder is stable. If the ladder could be displaced by work activities, secure it.
- Face the ladder when you climb or descend it, keeping at least one hand on the rails.
- Stay within the side rails when climbing or working from the ladder. You can reach out, but keep the rest of your body within the rails.
- Raise and lower heavy loads with a hand line or a hoist.
- Make sure metal ladders have steps and rungs with skid-resistant surfaces.
- Allow only one person on the ladder. Use a scaffold if two or more people need to work together.
- Never stand on top of a portable ladder.
- Never use ladders that have conductive side rails near exposed energized equipment.

Supported Scaffolds

A supported scaffold is simply an elevated platform that has a rigid means of support. When you lay a board across a couple of tall buckets, you have a supported scaffold - but not a safe one. Most supported scaffolds used for construction work are complex structures and workers need to know how to erect them, dismantle them, and work from them safely.

Of the many types of supported scaffolds, fabricated frame scaffolds are the most common. Like portable ladders, they're versatile, economical, and easy to use. You'll see them on construction sites as single supported platforms and multiple platforms stacked several stories high on modular frames.

How Falls from Scaffolds Occur

Workers fall from scaffolds when components fail, planks break, handrails give way, and scaffold supports collapse. However, most scaffold accidents can be traced to untrained or improperly trained workers.

When Fall Protection Systems are Required

If you work on a supported scaffold more than 10 feet above a lower level, you must be protected from falling. Guardrails at least 42 plus or minus 3 inches high are appropriate for

most scaffold platforms. If you can't use a guardrail system, then you must use a personal fall-arrest system or restraint system. We'll discuss personal fall-arrest systems later in the course.

Scaffold Training

Those who work from scaffolds must be trained to recognize fall hazards and to control or minimize the hazards. Training must cover the following:

- Scaffold load capacity and the types of loads appropriate for the scaffold.
- When fall protection is required, the appropriate protection to use, and how to use it.
- How to use scaffold components.
- How to reach access areas.
- How to protect those below the scaffold from falling objects.
- How to avoid electrical hazards.

Safe Practices on Scaffolds

- Use ladders or stairs to reach platforms that are more than 2 feet above or below the access point.
- Don't climb cross-braces to reach a scaffold platform.
- Scaffolds must be able to support their own weight and at least four times the maximum intended load. The maximum intended load includes workers, equipment, and supplies.
- Platforms must not deflect more than 1/60 of the span when they are loaded.
- Platforms must be fully decked or planked between the front uprights and the guardrail supports.
- Don't use damaged scaffold components; repair or replace them immediately.
- Make sure a competent person inspects the components before each work shift.
- Don't modify components.

- Scaffold components made by different manufacturers may be mixed, provided they fit together without force and maintain structural integrity.
- Watch for slippery surfaces. Don't work on platforms covered with snow and ice.
- Stay off scaffolds during storms and strong winds unless a competent person determines that it's safe.
- Keep a safe distance from power lines and any other conductive source. Minimum clearance distances:

Insulated lines

Some overhead power lines are installed with a covering that insulates the voltages in the line. The insulation usually deteriorates over time.

Voltage	Minimum distance	Alternatives
Less than 300 volts	3 feet	–
300 volts to 50 kv	10 feet	–
More than 50 kv	10 feet plus 0.4 inches for each 1 kv over 50 kv	Two times the length of the line insulator, but never less than 10 feet

Uninsulated lines

Voltage	Minimum distance	Alternatives
Less than 50 kv	10 feet	–
More than 50 kv	10 feet plus 0.4 inches for each 1 kv over 50 kv	Two times the length of the line insulator, but never less than 10 feet

- Scaffolds must be erected, dismantled, or moved only under the supervision of a competent person.
- The competent person must be on site to direct and supervise the work.

Aerial Lifts

Aerial lifts are designed to position workers and handle materials when a work surface isn't easy to reach. The American National Standards Institute (ANSI) classifies aerial lifts as "vehicle-mounted elevating and rotating work platforms" (ANSI A92.2-1969).

Types of Aerial Lifts

Most aerial lifts have extensible or articulating mechanisms that can position workers up, down, or sideways. ANSI defines and sets operating standards for four different types of aerial lifts:

- vehicle-mounted elevating and rotating lifts (ANSI A92.2 devices)
- manually propelled elevating work platforms (ANSI A92.3 devices)
- boom-supported elevating work platforms (ANSI A92.5 devices)
- self-propelled elevating work platforms and scissor lifts (ANSI A92.6 devices)

How Aerial Lift Falls Occur

Most accidents involving aerial lifts can be traced to untrained or improperly trained workers. Reasons for falls:

- hydraulic cylinder fails and causes the boom to drop
- outriggers are not used or improperly placed and the lift vehicle overturns
- workers are not tied off while they are in the bucket
- workers fall or are pulled off the platform when the lift vehicle is struck by another vehicle or moves unexpectedly

Appropriate Fall Protection

If you work from an aerial lift, you must be protected from falling. The type of fall protection you need depends on the type of lift you use. Most platforms must have a guardrail and each worker may be required to use a personal fall-arrest system: a full-body harness and lanyard attached to the boom or the platform.

Safe Practices On Aerial Lifts

Keep in mind the following when you use an aerial lift:

- Use the lift only for its intended purpose and follow the manufacturer's instructions. Keep the operating manual with the lift.
- Keep the lift level and stable; use outriggers and intermediate stabilizers.

- Never move the lift when the boom is up and workers are on the platform.
- Stand on the platform floor. Don't sit or climb on the edge of the basket, guardrail, or midrail.
- Be sure to close the access gate while you're working from the platform.
- Inspect the lift before using it to make sure that it's working properly and is in good condition.
- Know the lifts rated load capacity and don't exceed it.
- Stay at least 10 feet away from electrical power lines.
- Never use the lift during severe weather.
- Use warning signs or barricades to keep others out of the work area.
- Never tie off to equipment or to a structure next to the platform.

Portable ladders, supported scaffolds, and aerial lifts provide easy access to most elevated work areas. When they're not feasible or safe, however, the alternative is a suspended platform.

Suspended Access

Suspended access is a means of getting to difficult-to-reach work areas on a suspended platform. Usually the platform is an adjustable-suspension scaffold. The scaffold, typically suspended by wire rope from a rooftop anchor, has a hoist that workers use to reach the work area.

In some cases, however, even adjustable-suspension scaffolds may not be feasible or safe. When there is no other safe way to reach work area, a crane or a derrick can provide suspended access by hoisting a personnel platform to reach the work area.

Adjustable-Suspension Scaffolds

A suspension scaffold is a temporary elevated platform that hangs by wire rope. Add a hoist to move the platform up or down, and you have an adjustable-suspension scaffold - but not necessarily a safe one. Suspension ropes, lifelines, platforms, hoists, overhead support devices, and tieback systems are critical to the safety of adjustable-suspension scaffolds.

How Suspended Scaffold Falls Occur

Most accidents involving adjustable suspension scaffolds happen when a primary suspension rope breaks. Workers die because they don't use personal fall-arrest systems or they use them incorrectly. Steel suspension ropes rarely break if they're correctly rigged, maintained, and inspected regularly. When the ropes aren't maintained, they weaken. If an ascending platform snags, an electric hoist that continues to operate can easily snap a weak rope. Pressure from the two steel discs that clamp to the support rope in sheave-type hoist motors can also break a weak rope.

Failing anchors also cause serious accidents. Too often, untrained workers attach lifelines and suspension ropes to "secure-looking" rooftop fixtures for convenience. These anchors fail because they aren't designed to support suspended loads.

Lifelines fail because workers hang them over unpadded edges, don't inspect them, or use ropes not designed for personal fall-arrest systems.

Using Adjustable Suspension Scaffolds

Before you use an adjustable-suspension scaffold, you need to know the engineering principles for anchoring and suspending the scaffold, how to rig the scaffold, how to operate the hoist, how to work safely from the scaffold, and what to do in an emergency.

In addition, a competent person must examine all direct connections that are part of the system and confirm that the connections will support the platform loads. You must also wear a personal fall-arrest system to protect yourself if a connection fails. Most fatal falls from suspended platforms result when a support rope fails and workers aren't wearing personal fall-arrest gear.

When Fall Protection Systems Are Required

If you work on an adjustable-suspension scaffold more than 10 feet above a lower level, you must be protected from falling.

- Single-point and two-point adjustable-suspension scaffolds: Personal fall-arrest systems and guardrail systems are required on single-point or two-point adjustable-suspension scaffolds. The top edge of the guardrail must be between 36 inches and 45 inches above the platform surface. (The top edge can exceed 45 inches when necessary.)

- Boatswain's chairs: Personal fall-arrest systems are required for workers who use boatswain's chairs.

- Multipoint adjustable-suspension scaffolds: Personal fall-arrest systems and guardrail systems are required on multipoint adjustable-suspension scaffolds. The top edge of the guardrail must be between 36 inches and 45 inches above the platform surface. (The top edge can exceed 45 inches, when necessary.)

Descent-control Devices

A descent-control device lets you descend a primary support rope - typically from a boatswain's chair - then lock the device when you reach the work area. The device works by friction, engaging the support rope and controlling the descent speed. Most workers start from the roof and work down the face of the building. When they reach the ground, they remove the descent equipment from the support rope and return to the roof for another drop.

How Falls Occur

Most falls result from failure of the primary support rope or a supporting anchor, not the descent device. Support ropes fail because workers don't inspect them regularly or they misuse them. Anchors fail when workers simply assume they are secure. Descent devices, support ropes, and anchors rarely fail when workers know how to use them.

Crane- and Derrick-Suspended Personnel Platforms

In some cases, workers may not be able to reach the work area with stairways, ladders, scaffolds, or aerial lifts. When there is no other safe way to reach the area, it may be necessary to use a crane or a derrick and a personnel platform to lift workers to the area. Employee safety - not practicality or convenience - must be the basis for your decision to use this method.

How Injuries Occur

Workers rarely fall from suspended personnel platforms. Rather, most accidents happen when the boom or another part of the crane contacts an energized power line. Other causes of serious accidents:

- Instability: Unstable ground or support surface causes the crane to tip over.

- Lack of communication: The crane operator can't see the suspended platform while it is moving.
- Rigging failure: Platform loads are not properly rigged.
- Boom failure: The weight of the loaded platform exceeds the boom's load limit.

Safe Practices

Safe practices for riding personnel platforms to the work area:

- Stay within the platform while it's moving.
- Wear a body belt or harness and use a lanyard; attach the lanyard to the lower load block or overhaul ball or to a structural member of the platform.
- Stay in view of the crane operator or signal person while you're on the platform.
- Before leaving the platform for the work area, secure it to the structure.

Scenario

On August 17, 1998, a 15-year-old window washer's helper (the victim) died after falling 40 feet from the roof of a medical office building. The helper was stationed on the roof to move a window washing carriage and assist the window washer, who worked from a boatswain's chair as he cleaned the windows of the 4-story building.

On the afternoon of the incident, the window washer seated himself in the boatswains' chair and positioned himself over the edge of the roof's parapet. He then "bounced" in the boatswain's chair to make sure it was set to go. Because the carriage was not tied down and did not have counterweights attached, the carriage was pulled over the rooftop's parapet. Both workers had their fall arrest harnesses secured to the carriage. The window washer fell straight down while the helper was pulled from the roof by the carriage and struck the ground head-first. The local emergency medical unit was summoned immediately. The window washer's helper died from his injuries at the scene and the window washer suffered multiple severe injuries.

Recommendations:

- Anyone working on, or from a roof with a fall exposure should be tied off with a safety line. The safety line should be attached to a specifically engineered independent anchorage point.
- All persons who work at heights, should be trained, educated, and knowledgeable in all aspects of the safe use of their tools and equipment and be made aware of all the hazards related to their job.
- Work safety and fall protection plans should be developed and implemented at all work sites.
- Employers need to effectively supervise and coach employees who have little or no experience in performing high-risk jobs.

Module 4 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Each year, most workers are injured when they fall from ladders from a height that is _____.**

    a. more than 15 feet
    b. less than two feet
    c. less than 10 feet
    d. more than 10 feet

2. **What causes most workers to fall from ladders?**

    a. ladders that buckle under too much weight
    b. unstable ladders that shift or tilt
    c. ladders that are too small for the task
    d. ladders are cracked or split

3. **Most scaffold accidents can be traced to _____.**

    a. improperly constructed scaffolds
    b. improper use of fall protection
    c. lack of common sense
    d. untrained or improperly trained workers

4. **When using an aerial lift, stay at least 10 feet away from electrical power lines.**

    a. true
    b. false

5. **What causes most falls from suspended scaffolds?**

    a. failure of adjustable connectors
    b. failure of control-descent device
    c. failure of emergency descent device
    d. failure of primary support rope or supporting anchor

Module 5: Fall Protection Systems

Introduction

If workers will be exposed to fall hazards that you can't eliminate, you'll need to prevent falls from occurring or ensure that if workers do fall, they aren't injured. A fall-protection system is designed to prevent or arrest falls.

Types of Fall Protection Systems

There are seven general fall-protection systems:

- personal fall-arrest system (PFAS) arrests (limits) a fall
- personal fall-restraint system prevents a fall
- positioning-device system positions a worker and limits a fall to 2 feet
- guardrail system prevents a fall
- safety-net system arrests a fall
- warning-line system for roofing work warns a worker of a fall hazard

Other Fall Protection Methods

The following methods may also be appropriate for preventing falls:

- Safety monitoring for roofing work: A method in which a person - rather than a mechanical system - warns roofers when they are in danger of falling. The monitor, who must be a competent person, is responsible for recognizing the hazards and warning workers about them.
- Catch platforms: Though not covered in OSHA standards, catch platforms are an acceptable method of protecting workers from falls.
- Covers for holes: Simple and effective when they're properly installed, rigid covers prevent workers from falling through temporary holes, openings, and skylights in walking/working surfaces.

- Fences and barricades: Use a fence or similar barricade to keep people away from wells, pits, and shafts.

Identify and Evaluate Fall Hazards

Wherever possible, you need to try to eliminate fall hazards. In many situations, you won't be able to eliminate fall hazards. Make sure you identify hazards that you can't eliminate and evaluate each one. The evaluation will help you determine appropriate fall-protection systems for your work site. Consider the following:

- What is the fall distance from the walking/working surface to the next lower level?
- How many workers are exposed to the hazard?
- What tasks and work areas are associated with the hazard?
- How will the workers move - horizontally, vertically, or in both directions - to do their tasks?
- Are secure anchorages available or can they be easily installed near the hazard?
- Are there other hazards near the work area, such as overhead power lines?
- How will workers be promptly rescued if they are suspended in a personal fall-arrest system?

Personal Fall Arrest Systems (PFAS)

A personal fall-arrest system consists of an anchorage, connectors, and a full-body harness that work together to stop a fall and to minimize the arrest force. Other parts of the system may include a lanyard, a deceleration device, and a lifeline.

- Ensure that personal fall arrest systems will, when stopping a fall:
    - Limit maximum arresting force to 1,800 pounds.
    - Be rigged such that an employee can neither free fall more than 6 feet nor contact any lower level.
    - Bring an employee to a complete stop and limit maximum deceleration distance to 3½ feet.

- Have sufficient strength to withstand twice the potential impact energy of a worker free falling a distance of 6 feet, or the free fall distance permitted by the system, whichever is less

- Remove systems and components from service immediately if they have been subjected to fall impact, until inspected by a competent person and deemed undamaged and suitable for use.

- Promptly rescue employees in the event of a fall, or assure that they are able to rescue themselves.

- Inspect systems before each use for wear, damage, and other deterioration, and remove defective components from service.

- Do not attach fall arrest systems to guardrail systems or hoists.

- Rig fall arrest systems to allow movement of the worker only as far as the edge of the walking/working surface, when used at hoist areas.

Body Harness

Body harnesses are designed to minimize stress forces on an employee's body in the event of a fall, while providing sufficient freedom of movement to allow work to be performed. Harnesses, and components must be used only for employee protection (as part of a personal fall arrest system) and not to hoist materials.

Keep the following in mind:

- The harness must be made from synthetic fibers.

- The harness must fit the user. It should be comfortable and easy to adjust.

- According to ANSI/ASSE Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components, the harness must have an attachment point, usually a D-ring, in the center of the back at about shoulder level. A D-ring may also be used in the front of the harness. However, connection at the front D-ring is limited to systems that restrict free fall distance to 2 ft. or less and limit the maximum fall arrest loads on the front D-ring to 900 lb. of force or less. The D-ring should be large enough to easily accept a lanyard snap hook.

- Chest straps should be easy to adjust and strong enough to withstand a fall without breaking.
- Use only industrial full-body harnesses (not recreational climbing harnesses).
- The harness must be safe and reliable. It should meet ANSI and CSA standards and the manufacturer should have ISO 9001 certification, which shows the manufacturer meets international standards for product design, development, production, installation, and service.

Body Belts

As of January 1, 1998, body belts are not acceptable as part of a personal fall arrest system, because they impose a danger of internal injuries when stopping a fall. Body belts may only be used as part of a positioning system.

The Anchorage

An anchorage is a secure point of attachment for lifelines, lanyards, or deceleration devices. How can you be sure that an anchorage is secure? An anchorage for a personal fall-arrest system must support at least 5,000 pounds. Anchorages that can't support 5,000 pounds must be designed and installed under the supervision of a qualified person and must be able to maintain a safety factor of at least two - twice the impact force of a worker free-falling 6 feet. If you don't know how much weight an anchorage will support, have a qualified person check it before you trust your life to it.

Anchorage strength is critical, but is not the only factor to consider. Also important:

- Anchorage connector: Unless an existing anchorage has been designed to accept a lanyard or lifeline, you'll need to attach an anchorage connector - a device that provides a secure attachment point. Examples include tie-off adapters, hook anchors, beam connectors, and beam trolleys. Be sure that the connector is compatible with the lanyard or lifeline and appropriate for the work task.
- Attachment point: The anchorage can be used only as the attachment point for a personal fall-arrest system; it can't be used to support or suspend platforms.
- Location: The anchorage should be located directly above the worker, if possible, to reduce the chance of a swing fall.

- Fall distance: Because a personal fall-arrest system doesn't prevent a fall, the anchorage must be high enough above a worker to ensure that the arrest system, and not the next lower level, stops the fall. Consider free-fall distance, lanyard length, shock-absorber elongation, and body-harness stretch in determining the height of an anchorage. Free-fall distance is the distance a worker falls before a personal fall-arrest system begins to stop the fall.

- Connectors: An anchorage, a lanyard, and a body harness are not useful until they're linked together. Connectors do the linking; they make the anchorage, the lanyard, and the harness a complete system. Connectors include carabiners, snap hooks, and D-rings.

- Carabiner: This high-tensile alloy steel connector has a locking gate and is used mostly in specialized work such as window cleaning and high-angle rescue. Carabiners must have a minimum tensile strength of 5,000 pounds.

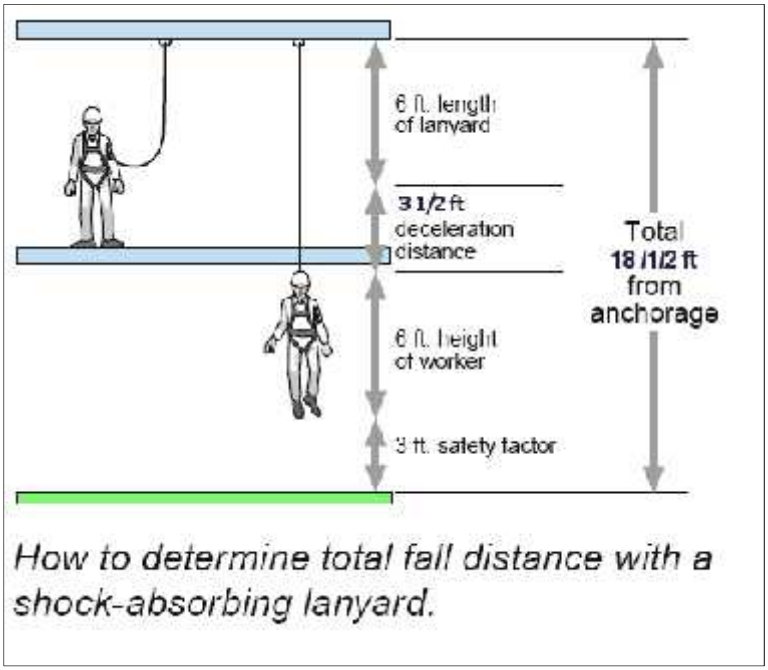
- Snap hook: A hook-shaped member with a keeper that opens to receive a connecting component and automatically closes when released. Snap hooks are typically spliced or sewn into lanyards and self-retracting lifelines. Snap hooks must be high-tensile alloy steel and have a minimum tensile strength of 5,000 pounds. Use only locking snap hooks with personal fall-arrest systems; locking snap hooks have self-locking keepers that won't open until they're unlocked.

- D-ring: D-rings are the attachment points sewn into a full-body harness. D-rings must have a minimum tensile strength of 5,000 pounds.

- The full-body harness: The full-body harness has straps that distribute the impact of a fall over the thighs, waist, chest, shoulders, and pelvis. Full-body harnesses come in different styles, many of which are light and comfortable. Before you purchase any harness, make sure they fit those who will use them, they're comfortable, and easy to adjust. A full-body harness should include a back D-ring for attaching lifelines or lanyards and a back pad for support.

Lanyards

A lanyard is a specially designed flexible line that has a snap hook at each end. One snap hook connects to the body harness and the other connects to an anchorage or a lifeline. Lanyards must have a minimum breaking strength of 5,000 pounds. They come in a variety of designs, including self-retracting types that make moving easier and shock-absorbing types that reduce fall-arrest forces. Don't combine lanyards to increase length or knot them to make them shorter.



How to determine total fall distance with a shock-absorbing lanyard.

Deceleration Devices

Deceleration devices protect workers from the impact of a fall and include shock-absorbing lanyards, self-retracting lifelines or lanyards, and rope grabs.

Shock-absorbing Lanyard

A shock absorber reduces the impact on a worker during fall arrest by extending up to 3.5 feet to absorb the arrest force. OSHA rules limit the arrest force to 1,800 pounds but a shock-absorbing lanyard can reduce the force even more - to about 900 pounds.

Because a shock-absorbing lanyard extends up to 3.5 feet, it's critical that the lanyard stops the worker before the next lower level. Allow about 20 vertical feet between the worker's anchorage point and the level below the working surface. Always estimate the total distance of a possible fall before using a shock-absorbing lanyard. Example: Lanyard length (6 feet) + deceleration distance (3.5 feet) + worker's height (6 feet) + safety margin (3 feet) = 18.5 vertical feet from anchorage to lower level.

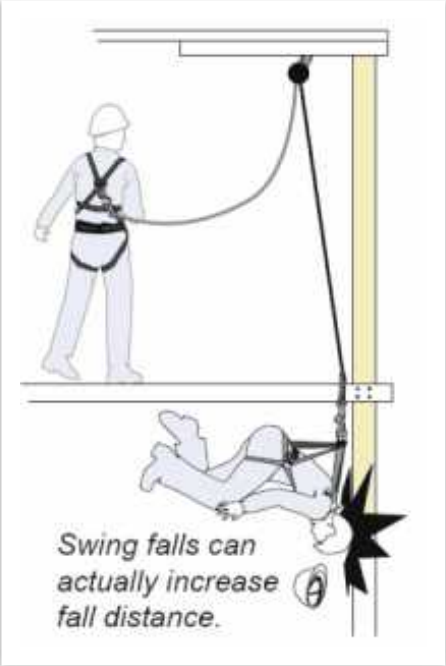
Never use a shock-absorbing lanyard if the shock absorber is even partially extended or if the lanyard has arrested a fall.

Self-retracting lanyard/lifeline: Self-retracting lanyards and lifelines offer more freedom to move than shock-absorbing lanyards. Each has a drum-wound line that unwinds and retracts as the worker moves. If the worker falls, the drum immediately locks, which reduces free-fall distance to about 2 feet - if the anchorage point is directly above the worker. Some self-retracting lanyards will reduce free-fall distance to less than one foot. Self-retracting lanyards are available in lengths up to 20 feet. Self-retracting lifelines, which offer more freedom, are available in lengths up to 250 feet.

- Self-retracting lanyards and lifelines that limit free-fall distance to 2 feet or less must be able to hold at least 3,000 pounds with the lanyard (or lifeline) fully extended.
- Self-retracting lanyards that don't limit free-fall distance to 2 feet must be able to hold at least 5,000 pounds with the lanyard (or lifeline) fully extended.

Swing Falls

If you use a self-retracting lanyard or lifeline, work below the anchorage to avoid a swing fall. The farther you move away from the anchorage, the farther you will fall and the greater your risk of swinging back into a hard object. Swing falls are hazardous because you can hit an object or a lower level during the pendulum motion.



Rope Grab

A rope grab allows a worker to move up a vertical lifeline but automatically engages and locks on the lifeline if the worker falls. When using a rope grab, keep the following in mind.

- The rope grab must be compatible with the lifeline.
- The rope grab must be correctly attached to the lifeline (not upside down).
- Keep the lanyard (between the rope grab and the body harness) as short as possible.
- Keep the rope grab as high as possible on the lifeline.

Lifelines

A lifeline is a cable or rope that connects to a body harness, lanyard, or deceleration device, and at least one anchorage. There are two types of lifelines, vertical and horizontal.

This worker is attached to a vertical lifeline with a lanyard and rope grab. The lifeline was anchored to the top of the column while it was on the ground.

Vertical lifeline: A vertical lifeline is attached to an overhead anchorage and must be connected directly to a worker's full-body harness, lanyard, retractable device, or rope grab; it must have a minimum breaking strength of 5,000 pounds. When a worker needs to move horizontally, however, a vertical lifeline can be hazardous due to the potential for a swing fall - the pendulum motion that results when the worker swings back under the anchor point. A swing fall increases a worker's risk of striking an object or a lower level during the pendulum motion.

Horizontal lifeline: Unlike a vertical lifeline, the horizontal lifeline stretches between two anchorages. When you connect a lanyard or rope grab to the horizontal lifeline, you can move about freely, thus reducing the risk of a swing fall. However, horizontal lifelines are subject to much greater loads than vertical lifelines. If they are installed incorrectly, horizontal lifelines can fail at the anchorage points. For this reason, horizontal lifelines must be designed, installed, and used under the supervision of a qualified person.

Horizontal lifelines and sag angles: Any load on a horizontal lifeline will cause it to deflect, or sag. The sag angle is a horizontal lifeline's angle of deflection when it's subjected to a load, such as a falling worker. Reducing the sag angle (making a horizontal lifeline too tight) actually increases the force on the line during a fall. As you tighten a horizontal lifeline, you increase the impact load dramatically!

Example: When the sag angle is 15 degrees, the force on the lifeline and anchorages subjected to a load is about 2:1. However, if you decrease the sag angle to 5 degrees, the force increases to about 6:1. To reduce loads on a horizontal lifeline, increase the sag angle or connect to the lifeline with a shock-absorbing lanyard.

Safe practices for personal fall-arrest systems

- Don't tie knots in rope lanyards and lifelines; knots can reduce strength by 50%.

- Don't tie lifelines or lanyards directly to I-beams; the cutting action of beam edges can reduce the rope's strength by 70%.
- Know how the sag angle of a horizontal lifeline can affect arrest forces on the anchorages. Remember that horizontal lifelines must be designed, installed, and used under the supervision of a qualified person.
- Think about the potential for a swing fall whenever you connect a lifeline to a personal fall-arrest system.
- Remember that a shock-absorbing lanyard will elongate before arresting a fall. The fall distance includes lanyard length (before the shock absorber extends), deceleration distance (shock-absorber extension), worker height, and a safety margin (allow 3 feet).

Scenario

Five roofing-company workers had been removing cedar shingles and replacing them with plywood sheeting and composition roofing at a two-story home on an afternoon in mid-January.

The crew had stopped work for lunch and returned to work about 1:30 p.m. While four of the crew went up on the roof, the victim remained on the ground to push plywood sheets up an extension ladder to crew members on the roof. When all the plywood sheets were on the roof, the victim climbed the ladder and got on the roof. Then he bent down near the top of the ladder, apparently to adjust it.

Another worker on the roof heard a loud noise, rushed over to the ladder, and discovered that the victim had fallen 17 feet to the ground.

The workers climbed down to assist the victim and the supervisor called 911 on his cell phone. The workers administered first aid and immobilized the victim's neck. EMTs took the victim to a hospital where he died later that day of traumatic head injuries.

Findings: The victim, who was hired the day of the accident, had no fall-protection training or instruction in ladder use. Workers at the site had fall-protection equipment but were not using it according to the manufacturer's instructions; the victim was not using the equipment. The roof edge was more than 17 feet above the ground and the ladder was not tied off.

Module 5 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **A fall-arrest system _____ the fall and the fall-restraint system _____ the fall.**

    a. allows, prevents
    b. prevents, limits
    c. limits, prevents
    d. holds, limits

2. **Which of the following is not one of the major components of a personal fall-arrest system?**

    a. anchorage
    b. net
    c. full-body harness
    d. connector

3. **Anchorages that can't support 5,000 pounds must be designed and installed under the supervision of _____.**

    a. the site project manager
    b. an OSHA consultant
    c. the safety manager
    d. a qualified person

4. **In the U.S., a body belt may be used as part of a personal fall-arrest system if a full-body harness is defective.**

    a. true
    b. false

5. Which of the following is true regarding lanyards?

a. they have a snap hook at each end
b. do not combine lanyards
c. minimum breaking strength is 5000 pounds
d. each of the above is true

Module 6: Fall Protection Systems (Continued)

Personal Fall Restraint Systems

Unlike the personal fall-arrest system, which is designed to stop a fall, a personal fall-restraint system prevents a worker from reaching an unprotected edge and thus prevents a fall from occurring. The system consists of an anchorage, connectors, and a body harness or a body belt. The attachment point to the body belt or full body harness can be at the back, front, or side D-rings.

The anchorage for a fall-restraint system must support at least 3,000 pounds or be designed and installed with a safety factor of at least two. If you're not sure how much an anchorage will support, have a qualified person evaluate it.

Positioning Device Systems

Positioning-device systems make it easier to work with both hands free on a vertical surface such as a wall or concrete form. Positioning-device systems are also called Class II work-positioning systems and work-positioning systems.

The components of a positioning-device system - anchorage, connectors, and body support - are similar to those of a personal fall-arrest system. However, the systems serve different purposes. A positioning-device system provides support and must stop a free fall within 2 feet; a personal-fall-arrest system provides no support and must limit free-fall distance to 6 feet.

A positioning-device system with a self-retracting lifeline.

- Anchorage: Positioning-device systems must be secured to an anchorage that can support at least twice the potential impact of a worker's fall or 3,000 pounds, whichever is greater.

- Connectors: Connectors must have a minimum strength of 5,000 pounds. Snap hooks and D-rings must be proof-tested to a minimum load of 3,600 pounds without deforming or breaking.

- Body support: A body belt is acceptable as part of a positioning-device system. However, it must limit the arresting force on a worker to 900 pounds and it can only be used for body support. A full-body harness is also acceptable and must limit the arrest

force to 1,800 pounds. Belts or harnesses must have side D-rings or a single front D-ring for positioning.

Guardrail Systems

A guardrail system consists of a top rail, midrail, and intermediate vertical member. Guardrail systems can also be combined with toeboards that prevent materials from rolling off the walking/working surface.

If a guardrail system is required, be sure to comply with the following provisions:

- Top edge height of top rails, or equivalent guardrail system members, must be 42 inches plus or minus 3 inches above the walking/working level, except when conditions warrant otherwise and all other criteria are met (e.g., when employees are using stilts, the top edge height of the top rail must be increased by an amount equal the height of the stilts).

- Midrails, screens, mesh, intermediate vertical members, or equivalent intermediate structures, must be installed between the top edge and the walking/working surface when there is no wall or other structure at least 21 inches high.

    - Midrails must be midway between the top edge of the guardrail system and the walking/working level.

    - Screens and mesh must extend from the top rail to the walking/working level, and along the entire opening between rail supports.

    - Intermediate members (such as balasters) between posts must be no more than 19 inches apart.

    - Other structural members (such as additional midrails or architectural panels) must be installed so as to leave no openings wider than 19 inches.

- Guardrail systems must be capable of withstanding at least 200 pounds of force applied within 2 inches of the top edge, in any direction and at any point along the edge, and without causing the top edge of the guardrail to deflect downward to a height less than 39 inches above the walking/working level.

- Midrails, screens, mesh, and other intermediate members must be capable of withstanding at least 150 pounds of force applied in any direction at any point along the midrail or other member.
- Guardrail systems must not have rough or jagged surfaces that would cause punctures, lacerations, or snagged clothing.
- Top rails and midrails must not cause a projection hazard by overhanging the terminal posts.

Safety Net Systems

Many times the nature and location of the work will dictate the form that fall protection takes. If the employer chooses to use a safety net system, he must comply with the following provisions:

- Safety nets must be installed as close as practicable under the surface on which employees are working, but in no case more than 30 feet below.
- When nets are used on bridges, the potential fall area must be unobstructed.
- Safety nets must extend outward from the outermost projection of the work surface as follows:

Vertical Distance	Horizontal Distance
From working level to horizontal plane of net	From outer edge of net to the edge of the working surface
Up to 5 feet	8 feet
5 to 10 feet	10 feet
More than 10 feet	13 feet

- Safety nets must be installed with sufficient clearance to prevent contact with the surface or structures under them when subjected to an impact force equal to the drop test described below.
- Safety nets and their installations must be capable of absorbing an impact force equal to the drop test described below.
- Safety nets and safety net installations must be drop-tested at the jobsite:
    - after initial installation and before being used
    - whenever relocated
    - after major repair
    - at 6-month intervals if left in one place
- The drop test consists of a 400 pound bag of sand 28-32 inches in diameter dropped into the net from the highest surface at which employees are exposed to fall hazards, but not from less than 42 inches above that level.
- When the employer can demonstrate that it is unreasonable to perform the drop-test described above, the employer or a designated competent person will certify that the net and net installation have sufficient clearance and impact absorption by preparing a certification record prior to the net being used as a fall protection system. The certification must include:
    - identification of the net and net installation
    - date it was determined the net and net installation were in compliance
    - signature of the person making the determination and certification
- The most recent certification record for each net and net installation must be available at the jobsite for inspection.
- Safety nets must be inspected for wear, damage, and other deterioration at least once a week, and after any occurrence which could affect the integrity of the system.

- Defective nets shall not be used, and defective components must be removed from service.
- Objects which have fallen into the safety net, such as scrap pieces, equipment, and tools, must be removed as soon as possible from the net and at least before the next work shift.
- Maximum mesh size must not exceed 6 inches by 6 inches. All mesh crossings must be secured to prevent enlargement of the mesh opening, which must be no longer than 6 inches, measured center-to-center.
- Each safety net, or section thereof, must have a border rope for webbing with a minimum breaking strength of 5,000 pounds.
- Connections between safety net panels must be as strong as integral net components, and must not be spaced more than 6 inches apart.

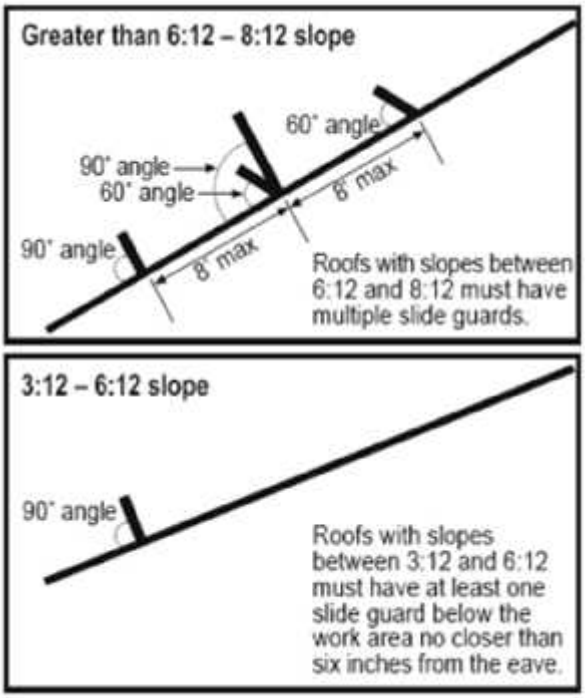
Warning Line Systems for Roofing Work

Roofing work refers to hoisting, storing, applying, and removing roofing materials and equipment; it includes work on related insulation, sheet metal, and vapor barriers, but does not include the construction of the roof deck or leading-edge work. A warning-line system for roofing work consists of ropes, wires or chains, and supporting stanchions that mark off an area within which roofing work can be done without guardrails, personal fall-arrest systems, restraint systems, or safety nets. Warning-line systems can only be used for roofing work on roofs that have slopes of 2:12 or less, vertical to horizontal. The purpose of the line is to warn roofers that they are near an unprotected edge.

The warning line must be at least 6 feet from an unprotected edge and meet the following criteria:

- be flagged at least every 6 feet with high-visibility material
- be rigged so the line is 34 to 39 inches from the walking/working surface
- have a minimum tensile strength of 500 pounds and don't use plastic caution tape for a warning line

- Be attached to each stanchion so that tension on one section of the line will not cause an adjacent stanchion to tip over. Stanchions must be able to support a force of at least 16 pounds applied horizontally in the direction of the roof edge without tipping over.



Those who do roofing work between the warning line and an unprotected roof edge must be protected with personal fall-arrest systems, restraint systems, guardrail systems, safety monitoring systems, or safety nets.

Slide-Guard Systems

A slide-guard system prevents workers from sliding down a sloped roof. The system consists of a slide guard (typically 2-by-6-inch lumber) and at least two roof brackets and must be installed under the supervision of a competent person. Roof brackets are available from roofing-equipment suppliers. A slide-guard system can also be made at the work site without manufactured roof brackets. Slide-guard systems cannot be the only means of fall protection on roofs with a ground-to-eave height greater than 25 feet.

Requirements for Slide-Guard Systems

- Slide-guard systems can be used only on roofs with slopes between 3:12 and 8:12 and ground-to-eave height of 25 feet or less.
- Roofs with slopes between 3:12 and 6:12 must have at least one slide guard below the work area, no closer than 6 inches from the eave.
- Roofs with slopes between 6:12 and 8:12 must have multiple slide guards no more than 8 feet apart vertically. The lowest slide guard must be no closer than 6 inches from the eave.
- The slide guard closest to the eave must be perpendicular to the roof surface. All other slide guards must be set at an angle not less than 60 degrees to the roof surface.
- Slide guards must provide continuous protection along the length of the roof.

- Manufactured roof brackets: Install manufactured roof brackets according to the manufacturer's directions. Keep the information at the job site for those who want to review it.

- Each bracket must be 6 inches or larger and all brackets must mount on a solid surface. The horizontal space between brackets cannot exceed the manufacturer's specifications - or 8 feet - whichever is less.

Attaching slide guards: Use 2-by-6-inch lumber for slide guards. Secure the slide guards to the roof brackets or use another method to prevent them from cantilevering and failing due to material flex.

Job-made slide-guard systems: Use 2-by-6-inch lumber for a job-made slide-guard system. Vertical members must be backed to horizontal flat members.

Anchor horizontal members to solid bearing surfaces with two 16-penny common nails or the equivalent every 4 feet. Anchor vertical members to horizontal members with one 16-penny common nail or the equivalent every 2 feet.

Vertical members must have full-support bracing every 8 feet, horizontally.

Safety Monitoring for Roofing Work

This is a method in which a person, rather than a mechanical system, warns roofers when they are in danger of falling. The monitor, who must be a competent person, is responsible for recognizing fall hazards and warning workers about them.

Safety monitoring can be used only to protect those who do roofing work on roofs that have slopes no greater than 2:12 and widths no greater than 50 feet. Safety monitoring on roofs wider than 50 feet is not permitted unless a warning-line system also protects the workers.

The safety monitor's responsibilities:

- recognize fall hazards

- warn employees when they are unaware of hazards or aren't working safely

- stay on the same walking/working surface as the workers to see them and to communicate with them while they are working

- avoid any other work or distracting activity while monitoring the workers

Only those who are doing roofing work are permitted in the area controlled by the safety monitor. Mechanical equipment can't be used or stored in the area.

Skylight covers are necessary to protect workers. Courtesy: Simplified Safety www.simplifiedsafety.com

Catch Platforms

Catch platforms, which consist of a stable platform and an attached standard guardrail, can protect roofers when other systems or methods are not feasible. Platform guidelines:

- The platform should not be more than 18 inches below the eave line of the roof.
- The platform should extend horizontally at least 2 feet beyond the eave line of the roof.
- The platform must have a standard guardrail and toeboard. The top guardrail should rise substantially (at least 12 inches) above the eave line of the roof. Install intermediate rails or a solid barrier between the top rail and the platform to prevent a worker from sliding under the top rail.

Hole Covers

Simple and effective when they're properly installed, rigid covers prevent workers from falling through skylights or temporary openings and holes in walking/working surfaces.

Safety criteria for covers:

- Covers will support at least twice (2 times) the maximum expected weight of workers, equipment, and materials. Skylights are not considered covers unless they meet this strength requirement.
- They are secured to prevent accidental displacement.
- They have full edge bearing on all four sides.
- They are painted with a distinctive color or marked with the word HOLE or COVER.

Fences and Barricades

Fences and barricades are warning barriers. They are usually made from posts and wire or boards that keep people away from hazards such as wells, pits, and shafts.

Protecting Workers from Falling Objects

You need to protect yourself from falling when you work on an elevated surface and be aware of those working above or below you. Protect yourself and others from falling objects with one of the following methods:

- Canopies: Make sure canopies won't collapse or tear from an object's impact.
- Toeboards: Toeboards must be least 3½ inches high and strong enough to withstand a force of at least 50 pounds applied downward or outward.
- Panels and screens: If you need to pile material higher than the top edge of a toeboard, install panels or screens to keep the material from dropping over the edge.
- Barricades and fences: Use them to keep people away from areas where falling objects could hit them.

When doing overhand bricklaying, keep materials and equipment (except masonry and mortar) at least 4 feet from the working edge. When doing roofing work, keep materials and equipment at least 6 feet from the roof edge unless there are guardrails along the edge. All piled, grouped, or stacked material near the roof edge must be stable and self-supporting.

Module 6 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **In a fall-restraint system, the attachment point to the body belt or full body harness can be at the back, front, or side D-rings.**

   a. true
   b. false

2. **The top rail of a guardrail must be _____ plus or minus _____ inches above the walking/working surface.**

   a. 39, 3
   b. 42, 3
   c. 47, 5
   d. 49, 5

3. **Safety nets must not be installed more than ____ below the working surface.**

   a. 6 feet
   b. 10 feet
   c. 20 feet
   d. 30 feet

4. **The warning line must be at least _____ from an unprotected edge.**

   a. 6 feet
   b. 10 feet
   c. 20 feet
   d. 30 feet

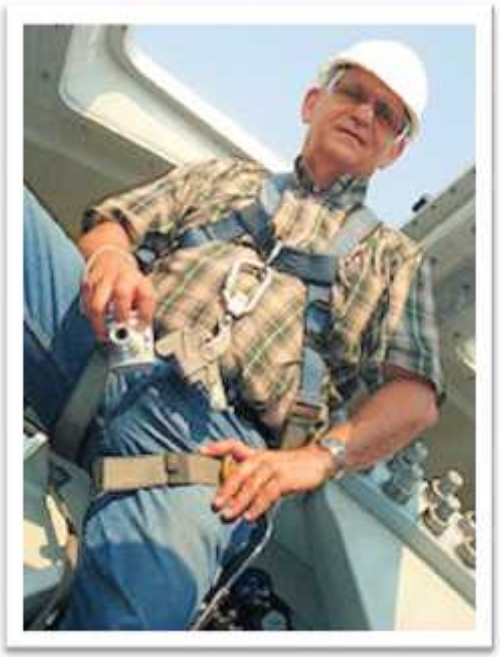
5. **Hole covers must support at least _____ the maximum expected weight of workers, equipment, and materials.**

    a. 1.5 times
    b. 2 times
    c. 3 times
    d. 4 times

Module 7: Fall Protection Training

The Importance of Training

Workers need to know about construction worksite hazards to which they may be exposed, how to recognize the hazards, and how to minimize their exposure. The best way for them to learn is through training. Training ensures they know about the hazards and can demonstrate how to protect themselves from falling.



OSHAcademy founder, Steve Geigle, is 300 ft up inside a Vestas wind turbine under construction in Manitoba, Canada.

Some employers assume they can train their employees simply by showing them a fall-protection training video or online course (like this one!). But videos, lectures, online courses, etc., are not adequate because they do not provide the "hands-on" component of the training. Unfortunately, these training methods only provide instruction.

Employers: Your Responsibility

If you're an employer, you're responsible for ensuring your employees can recognize fall hazards and that they know how to protect themselves before they're exposed to the hazards. You can't assume they know how to protect themselves from falls. If they're starting work on a new site, for example, they might not recognize fall hazards or know how to protect themselves unless you train them.

Required Training

Workers who could be exposed to fall hazards must be trained to recognize the hazards and to know the procedures that minimize the hazards.

OSHA requires the following minimum fall-protection training:

Fall Protection -- Training Requirements in Construction 1926.503(a)(1) and (2)(ii) through (vii)

(a) Training Program:

(1) The employer shall provide a training program for each employee who might be exposed to fall hazards. The program shall enable each employee to recognize the hazards of falling and shall train each employee in the procedures to be followed in order to minimize these hazards.

(2) The employer shall ensure that each employee has been trained, as necessary, by a competent person qualified in the following areas:

(i) The nature of fall hazards in the work area;

(ii) The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used;

(iii) The use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, controlled access zones, and other protection to be used;

(iv) The role of each employee in the safety monitoring system when this system is used;

(v) The limitations on the use of mechanical equipment during the performance of roofing work on low-slope roofs;

(vi) The correct procedures for the handling and storage of equipment and materials and the erection of overhead protection; and

(vii) The standards contained in this subpart.

The Training Format

As an employer, you can determine the training format. However, it’s important your employees can recognize fall hazards and know procedures to minimize the hazards.

Who can do the training? It's also important the trainer knows the hazards at the worksite, knows how to eliminate or control the hazards, and knows how to teach workers to protect themselves. That's why the trainer must be a competent person. (Recall a competent person is one who can identify work-site hazards and who has management authority to control them.) The trainer must know and be able to explain the following:

- the nature of fall hazards at the work site
- procedures for erecting, maintaining, and disassembling fall protection systems
- how to use and operate fall-protection systems
- the role of each employee who may be affected by a safety-monitoring system
- restrictions that apply to mechanical equipment used during roofing work
- procedures for handling and storing materials and for erecting protection from falling objects
- requirements detailed in OSHA standards
- company policies and procedures

When to Train

Employees must be trained before they begin tasks which could expose them to fall hazards or before they use fall-protection systems. They must be retrained when you have reason to believe they don't recognize fall hazards, when they don't follow safe practices for using fall-protection systems, and when changes in the construction worksite or in the fall-protection systems used make their previous training obsolete.

Certification

The employer must keep a written record (certification) of each employee's fall-protection training. As a minimum, you need to include the employee's name, the training date, and the trainer's signature. Since this training involves procedures and practices that are used to

prevent serious injury or death, it is recommended to “certify” the employee as qualified to use the fall protection equipment and that they know the procedures. Remember, to certify the employee as qualified, the employee must prove to the trainer or competent person they have adequate knowledge and skills to perform the procedure or practice. A formal certification record should be developed to document any training that requires employees to know and use procedures and practices for dangerous tasks.

Model Training Strategy

The "show and tell" model for on-the-job training (OJT) has been, and is still, the best method for training specific fall-protection safety procedures. Measurement knowledge and skills occurs throughout the OJT process while keeping the employee safe from injury while learning. If, in using this training method, the employee is not exposed to hazards that could cause serious injury, you may be able to delete step 3. Otherwise do not skip a step.

Step 1: Introduction- The instructor tells the trainee about the training. At this time, the instructor emphasizes the importance of the procedure to the success of the production/service goals, invites questions, and emphasizes accountability.

Step 2: Instructor show and tell- The instructor demonstrates the process. The instructor first explains and demonstrates safe work procedures associated with the task. In this step the trainee becomes familiar with each work practice and why it is important.

Trainer: Demonstrates and Explains

Trainee: Observes and Questions

Step 3: Instructor show and ask- The trainee tells the instructor how to do the procedure, while the instructor does it. This step is actually optional. It's important to include this step if injury is possible. There is an opportunity for the instructor to discover whether there were any misunderstandings, but protects the trainee because the instructor still performs the procedure.

Trainer: Demonstrates and Questions

Trainee: Explains and Observes

Step 4: Trainee tell and show- Now it's the trainee's turn. To further protect the employee, the Instructor must give permission for the trainee to perform each step. The trainee carries out the procedure but remains protected because the trainer explains the process before actually performing the procedure.

Trainer: Gives permission, Observes and Questions

Trainee: Gets permission, Explains and then Demonstrates

Step 5: Conclusion- The instructor recognizes accomplishment, reemphasizes the importance of the procedure, and how it fits into the overall process. The instructor also reviews the natural consequences (the injury/illness) and system consequences (reward/discipline) related to performance.

Step 6: Document- The trainee certifies (1) training accomplished, (2) questions were answered, (3) opportunities provided to do procedure, (4) accountabilities understood, and (5) intent to comply. The instructor certifies that the trainee has (6) demonstrated adequate knowledge and skill to complete the procedure.

What's wrong with this picture?

Take a look at the photo below. See if you can determine the safety hazards associated with each number in the photo. Go online and click on the photo to get the answers.

Photo: OSHA Training Institute, Southwest Education Center

Module 7 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Why does OSHA consider relying solely on videos, online courses, and classroom lectures inadequate for fall protection training?**

    a. lacks the required 10-hour training requirement
    b. limits the size of the class
    c. does not contain the hands-on component
    d. takes too much time

2. **According to OSHA, which of the following is false regarding fall protection training?**

    a. The employer provide training to employees exposed to fall hazards.
    b. The training must help enable employees to recognize fall hazards.
    c. The training must show employees how to minimize hazards.
    d. The employer must correct all fall hazards prior to training.

3. **What is the response if the employer believes an employee who has been trained doesn't recognize fall hazards?**

    a. discipline the employee
    b. reassign the employee
    c. retrain the employee
    d. terminate the employee

4. **Documentation of fall protection training must include which of the following at a minimum?**

    a. employee name, training date, trainer signature
    b. trainer name, training topic, employee signature
    c. employee name, training date
    d. training date, trainer signature

5. What is the best method for training specific fall-protection safety procedures?

a. group exercise
b. guided discussion
c. lecture
d. show and tell

Module 8: Inspection and Maintenance

Caring for Equipment

When you use ladders, scaffolds, aerial lifts, and fall-protection systems you expect to get your job done safely. But do you pay attention to the condition of the equipment? Inspect the equipment frequently, keep it clean, store it properly, and it won't let you down.

Inspecting Systems

It is very important that you inspect the components of personal fall-arrest, restraint, or positioning-device systems for damage or excessive wear before and after each use. Replace any component that looks damaged. Don't use a personal fall-arrest system that has arrested a fall unless a competent person has determined that the system is safe to use.

Harness, Lifeline, and Anchorage

Inspect these components regularly.

Review the table below that highlights what to look for:

Component	What to look for
Harness webbing	Frayed edges, broken fibers, pulled stitches, cuts, burns and chemical damage.
Harness D-rings	Cracks, breaks, and rough or sharp edges; the D-ring should pivot easily.
Harness buckles	Excessive wear, frayed or cut fibers, broken stitching.
Harness grommets	Loose, bent, or broken grommets, and punched holes not made by the manufacturer.
Lifelines	Wear or deterioration.
Anchorages and anchorage connectors	Look for abrasion and damaged threads or swages. Inspect stitching and loops on synthetic slings for cuts, cracks, or

	frayed and broken stitching. Look for excessive kinks or damaged steel fibers.

Snaphooks

Look for cracks, excessive wear, and corrosion. The snaphooks should open easily and close firmly. Keeper locks must prevent the keeper from opening when it's closed.

Lanyards

Type of lanyard	What to look for
Wire rope lanyard	Cuts, frayed strands, or excessive wear.
Web lanyard	Cuts, discoloration, cracks, frayed or broken stitching.
Rope lanyard	Frayed or cut fibers. The entire length of the rope should have the same diameter.
Shock-absorbing lanyard	Cuts, discoloration, cracks, frayed or broken stitching. Remove a lanyard from service if any part of the warning label is exposed.

Self-retracting Lifelines

Look for cuts, frayed strands, or excessive wear in the line and damage to the housing. If the unit needs service, check the manufacturer's recommendations. Don't try to repair it yourself.

Guardrail Systems

Frequently inspect manila, plastic, or synthetic rope used for top rails or midrails to ensure that the rope meets the minimum strength and rail height requirements. [See 1926.502(b)]

Safety-net Systems

Inspect safety nets for damage or deterioration weekly and after any event that could damage them. Remove defective components from service.

Ladders

Remember, not just anyone can or should inspect ladders or fall protection equipment. A competent person must inspect ladders periodically. He or she must also inspect them immediately after any event that could damage them.

General Ladders: When inspecting ladders, generally look for loose steps or rungs (considered loose if they can be moved at all with the hand), loose nails, screws, bolts, or other metal parts. Look for cracked, spilt, or broken uprights, braces, or rungs, slivers on uprights, rungs, or steps. Also look for damaged or worn non-slip bases.

Step Ladders: On step ladders, make sure they are not wobbly (from side strain), have loose, bent or broken hinge spreaders, or loose hinges. Make sure the stop on hinge spreaders are not broken. Finally make sure the steps are not broken, split or worn.

Extension Ladders: On extension ladders, make sure the extension locks are not loose, broken, or missing. Make sure locks seat properly while extended, and make sure the rope is not worn, rotted, cut, or defective in any way.

Scaffolds

A competent person must inspect a scaffold and its components after it has been erected, before each shift, and after any event - including severe weather - that could damage it. The inspection should include the foundation, platform, guardrails, and access areas.

Suspension Scaffolds

A competent person must inspect suspension ropes before each shift and after any event that could damage them. Inspect and tighten wire rope clips to the manufacturer's recommendations at the start of each shift. Inspect manila or synthetic rope used for toprails or midrails frequently to ensure that it meets the minimum strength and rail height requirements. [See 1926.502(b)].

Crane- and Derrick-Suspended Personnel Platforms

- Immediately after a trial lift, a competent person must inspect the rigging, personnel platform, and the base that supports the crane or derrick.
- A competent person must inspect the platform and rigging immediately after they have been proof tested.

Summary: Inspecting, Cleaning, and Storing Fall Protection Equipment

- Always follow manufacturers' instructions and warnings.
- Always inspect equipment before using it. Look for damaged or missing parts. Labels, warnings, and other instructions should be readable.
- If equipment looks like it needs repair, remove it from service and have a competent person examine it.
- Have a competent person inspect equipment regularly.
- Mark equipment with a unique code or item number. Identification numbers make it easier to keep track of the equipment and to document maintenance or repair.
- Wash synthetic rope and body harnesses in soapy water to remove dirt; rinse them with clean water. Air-dry at room temperature. Don't use cleaning solvents; solvents can damage synthetic material.
- Don't lubricate moving parts unless the manufacturer requires it; lubricants attract dirt.
- Don't remove information labels and warnings; make sure they're still legible after cleaning.
- Follow manufacturer's instruction for storing equipment.
- Store equipment in an area that is clean, dry, and moisture-free; avoid excessive heat, light, oil, and corrosive chemicals.

Module 8 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **When should you inspect the components of personal fall-arrest, restraint, or positioning-device systems for damage or excessive wear?**

    a. once a week
    b. once a day
    c. before and after each use
    d. as needed or directed

2. **Do not use a personal fall-arrest system that has arrested a fall unless a competent person has determined that the system is safe to use.**

    a. true
    b. false

3. **Which of the following should be looked for when inspecting harness webbing?**

    a. frayed edges
    b. broken fibers and pulled stitches
    c. cuts, burns, and chemical damage
    d. all of the above

4. **When inspecting snap-hooks, which of the following defects should be looked for?**

    a. cracks, excessive wear, and corrosion
    b. broken fibers and pulled stitches
    c. chemical damage
    d. cuts and burns

5. **Which of the following does not need to be looked at while inspecting scaffolds?**

    a. platform
    b. guardrails
    c. foundation
    d. warning zone

Module 9: Rescue at Height

Prompt Rescue Required

The best strategy for protecting workers from falls is to eliminate the hazards that cause them. When you can't eliminate the hazards, you must protect workers with an appropriate fall-protection system or method. If a worker is suspended in a personal fall-arrest system, you must provide for a prompt rescue using one of the following basic methods:

1. **Self-rescue** - the preferred method using techniques to relieve pressure on legs.

2. **Assisted-rescue** - if self-rescue is not possible, one or more trained rescuers with appropriate equipment perform assisted rescue of the worker.

OSHA is rather vague in defining precisely what "Prompt" means and does not specify a time. It basically means without delay. ANSI Z359 encourages at least verbal contact within six minutes. However, a worker suspended in a harness after a fall can lose consciousness within minutes if the harness puts too much pressure on arteries. The Air force studied how long a physically fit person could hang in a full-body harness without extreme discomfort and found that the average times were between 17 and 28 minutes. However, tolerance varies greatly from person to person, and in fact, suspension trauma can occur in as little as 10 minutes.

If a fall-related emergency could happen at your work site, you should have a plan for responding to it promptly. Workers who use personal fall-arrest systems must know how to promptly rescue themselves after a fall or they must be promptly rescued.

Check out this great resource, Fall Protection: Responding to Emergencies - WISHA, that covers the various techniques of self-rescue and aided rescue after a worker falls using a personal fall-arrest system (PFAS).

Developing an Emergency-Response Plan

The following guidelines will help you develop a plan for responding promptly to falls and other emergencies.

- Effective plans don't need to be elaborate. Your plan should show you've thought about how to eliminate and control hazards and workers know how to respond promptly if something goes wrong.

- Get others involved in planning. When other workers participate, they'll contribute valuable information, take the plan seriously, and be more likely to respond effectively during an emergency. Key objectives for an effective emergency-response plan include:
    - identify the emergencies that could affect your site
    - establish a chain of command
    - establish procedures for responding to the emergencies
    - identify critical resources and rescue equipment
    - train on-site responders
- Identify emergencies that could affect your construction worksite. Identify any event that could threaten worker safety or health. Two examples:
    - worker suspended in a full-body harness after a fall
    - worker on a scaffold who contacts an overhead power line
- Identify critical resources and rescue equipment. Prompt rescue won't happen without trained responders, appropriate medical supplies, and the right equipment for the emergency.
    - First-aid supplies: Every work site needs medical supplies for common injuries. Does your site have a first-aid kit for injuries that are likely to occur? Store the supplies in clearly marked, protective containers and make them available to all shifts.
- Rescue equipment: Identify on-site equipment that responders can use to rescue a suspended worker. Extension ladders and mobile lifts are useful and available at most sites. Determine where and how each type of equipment would be most effective during a rescue. Make sure the equipment will permit rescuers to reach a fall victim, that it's available when rescuers need it, and that rescuers know how to use it.
- Will your longest ladder reach a suspended worker? If not, what equipment will reach the worker? When equipment is needed for a rescue, will workers know where it is and how to use it? Think about seasonal and environmental conditions and how they may affect rescue equipment and those who use it. Equipment that works for summer rescues may not work for winter rescues.

- Train on-site responders: An effective emergency-response plan ensures that on-site responders know emergency procedures, know how to use available rescue equipment, and - if necessary - know how to contact off-site responders. Workers who use personal fall-arrest systems and who work alone must know how to rescue themselves. Those who work at a remote site may need a higher level of emergency training than those who work near a trauma center or a fire department.

- Establish a chain of command: All workers must know their roles and responsibilities during an emergency. A chain of command links one person with overall responsibility for managing an emergency to those responsible for carrying out specific emergency-response tasks. Make sure that back-up personnel can take over when primary responders aren't available.

- Establish procedures for responding to emergencies. Procedures are instructions for accomplishing specific tasks. Emergency procedures are important because they tell workers exactly what to do to ensure their safety during an emergency. Your emergency-response plan should include the following procedures - preferably in writing - that describe what people must know and do to ensure that a fallen worker receives prompt attention:

    - how to report an emergency
    - how to rescue a suspended worker
    - how to provide first aid

After an emergency, review the procedures; determine if they should be changed to prevent similar events and revise them accordingly.

Responding to Falls

Before on-site work begins, you need to:

- Identify emergencies that could affect your work site.
- Establish a chain of command.
- Document procedures for responding to emergencies and make sure they're available at the site.

- Post emergency-responder phone numbers and addresses at the work site.
- Identify critical resources and rescue equipment.
- Train on-site responders.
- Identify off-site responders and inform them about any conditions at the site that may hinder a rescue effort.
- Identify emergency entry and exit routes.
- Make sure responders have quick access to rescue and retrieval equipment, such as lifts and ladders.

During on-site work, you need to:

- Identify on-site equipment that can be used for rescue and retrieval, such as extension ladders and mobile lifts.
- Maintain a current rescue-equipment inventory at the site. Equipment may change frequently as the job progresses.
- Re-evaluate and update the emergency-response plan when on-site work tasks change.

When an emergency occurs

- First responders should clear a path to the victim. Others should direct emergency personnel to the scene. You can use 911 for ambulance and medical service; however, most 911 responders are not trained to rescue a worker suspended in a personal fall-arrest system. Make sure only trained responders attempt a technical rescue.
- Prohibit all nonessential personnel from the rescue site.
- Talk to the victim; determine the victim's condition, if possible.
- If you can reach the victim, check for vital signs, administer CPR, attempt to stop bleeding, and make the victim comfortable.

After an emergency, you must:

- Report fatalities and catastrophes to OSHA within eight hours.
- Report injuries requiring overnight hospitalization and medical treatment (other than first aid) to OSHA within 24 hours.
- Identify equipment that may have contributed to the emergency and put it out of service. Have a competent person examine equipment. If the equipment is damaged, repair or replace it. If the equipment caused the accident, determine how and why.
- Document in detail the cause of the emergency.
- Review emergency procedures. Determine how the procedures could be changed to prevent similar events; revise the procedures accordingly.

Scenario

A farm worker suffocated to death after being engulfed in flowing grain while trying to clear a blocked auger. Two workers were emptying a grain bin at a grain elevator owned by a large farm in northeastern Iowa. The auger had stopped moving corn indicating there was a blockage at the auger intake inside the bin.

Both men entered the bin from the access door at the top of the 50-foot tall bin. They had probes and shovels with them for the clearing work. They had left the auger running and probed the corn with metal bars around the auger opening in the middle of the bin floor. The corn was approximately 10 feet deep at the sides and 6-8 feet deep in the middle of the 36-foot diameter bin.

The blockage suddenly cleared and the flowing corn immediately began to suck one of the workers down. The other worker was looking the other way and was alerted by his co-worker yelling for help. He tried to assist his co-worker to get out but struggled to save himself from being pulled down as well. He scrambled out of the bin, turned off the auger and summoned for help. The controls for the auger were outside the bin and during the time it took to get out of the flowing corn, climb to the top access door, and down to the ground controls, the victim was engulfed in corn.

No fall protection devices or lifelines were used and there was no emergency stop system for the auger. The rescue crews arrived and had some difficulty accessing the 50-foot tall bin. There was a side door at the bottom of the bin, but it was still under corn and not used

during rescue. The victim was taken to a regional health center but was pronounced dead on arrival.

Recommendations:

- Employers should provide rescue equipment, training and adequate supervision to ensure that safe practices are followed while workers are entering grain bins.
- Grain handling facility owners should install "chairs" over the center unloading auger openings.
- Farmers and grain storage operators should ensure adequate measures are taken to avoid spoilage of grain during storage.

Module 9 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **If a worker is suspended in a personal fall-arrest system, you must provide for a prompt rescue. "Prompt" means _____.**

   a. within 15 minutes
   b. as soon as possible
   c. without delay
   d. when emergency services arrive

2. **Which of the following is a key planning objective in an effective emergency-response plan?**

   a. a chain of command
   b. response procedures
   c. on-site responder training
   d. each of the above

3. **To ensure a fallen worker receives prompt attention, your emergency-response plan should include all of the following, EXCEPT _____.**

   a. how to provide first aid

b. how to rescue a suspended worker
c. how to report an emergency
d. how to discipline for non-compliance

4. All 911 emergency responders are trained to rescue a worker suspended in a personal fall-arrest system.

a. true
b. false

5. An effective fallen worker emergency-response strategy primarily relies on _____.

a. fire department responders
b. emergency medical services
c. on-site responders
d. air rescue services