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Fall Protection Introduction

#33462

June 2016

Los Alamos
NATIONAL LABORATORY
EST. 1943

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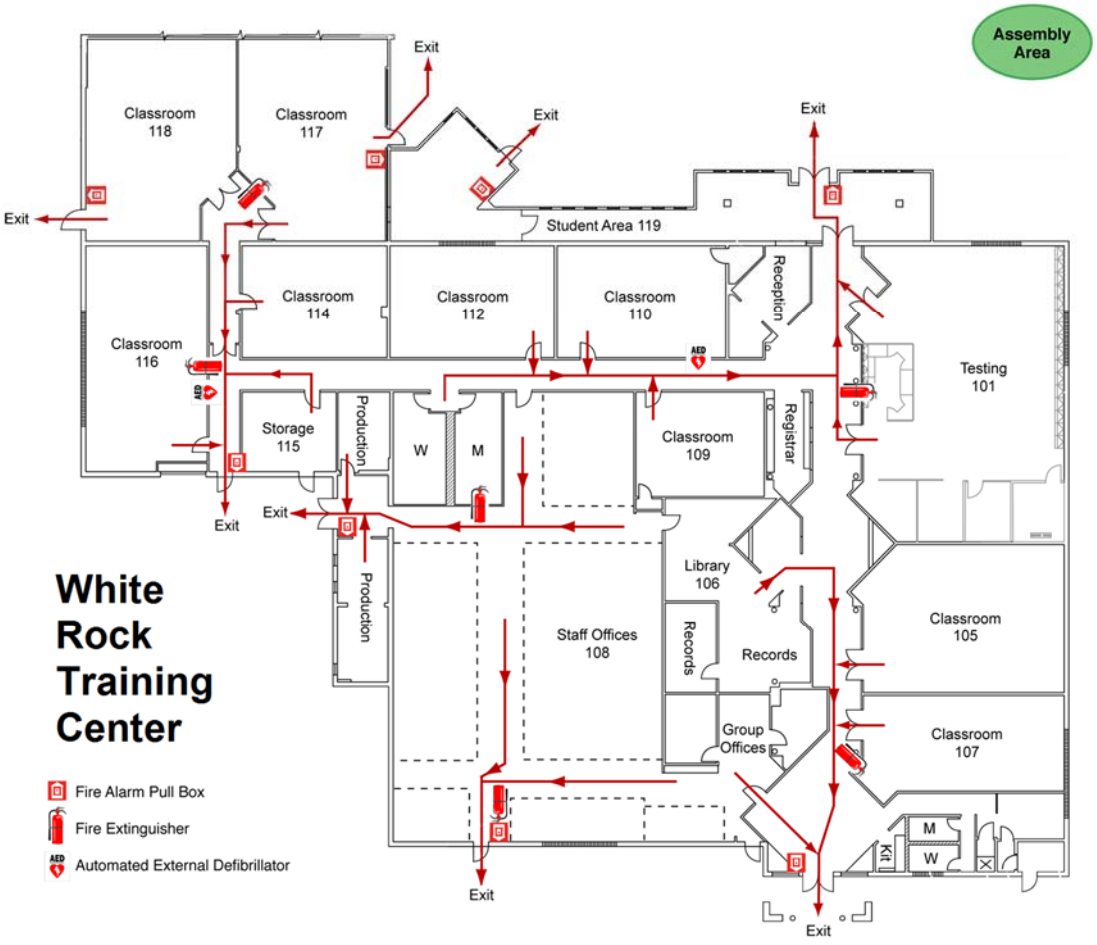

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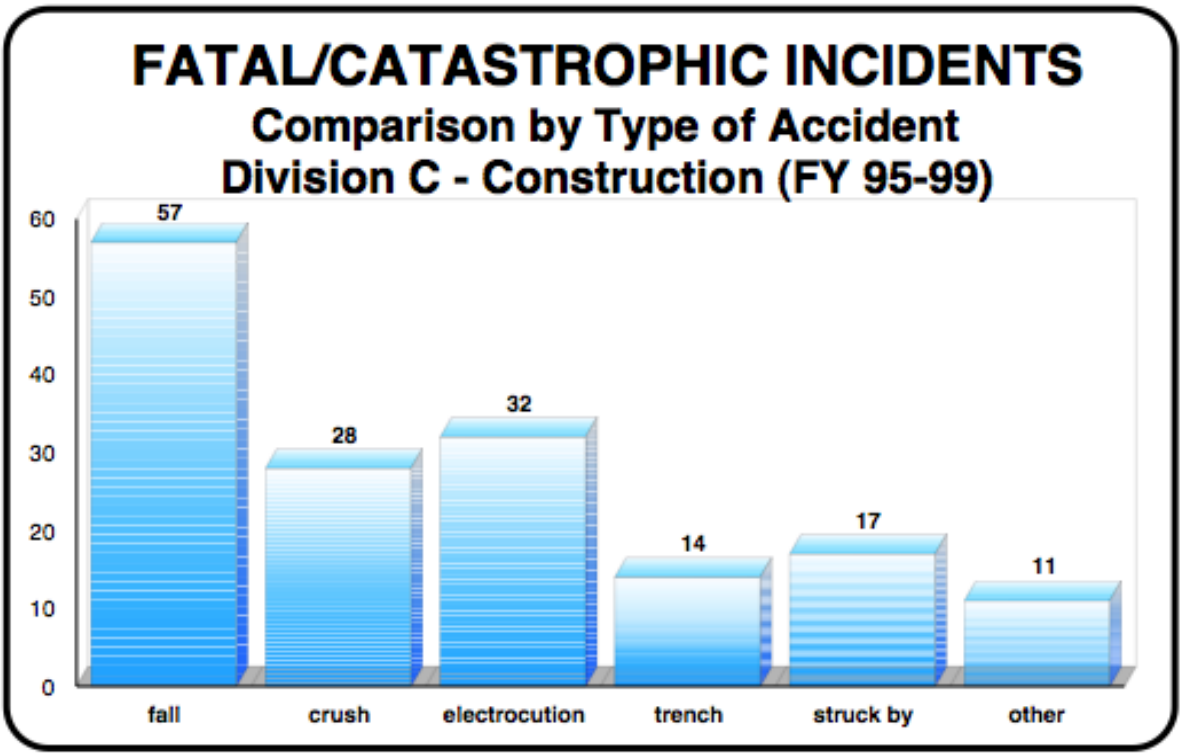
Introduction

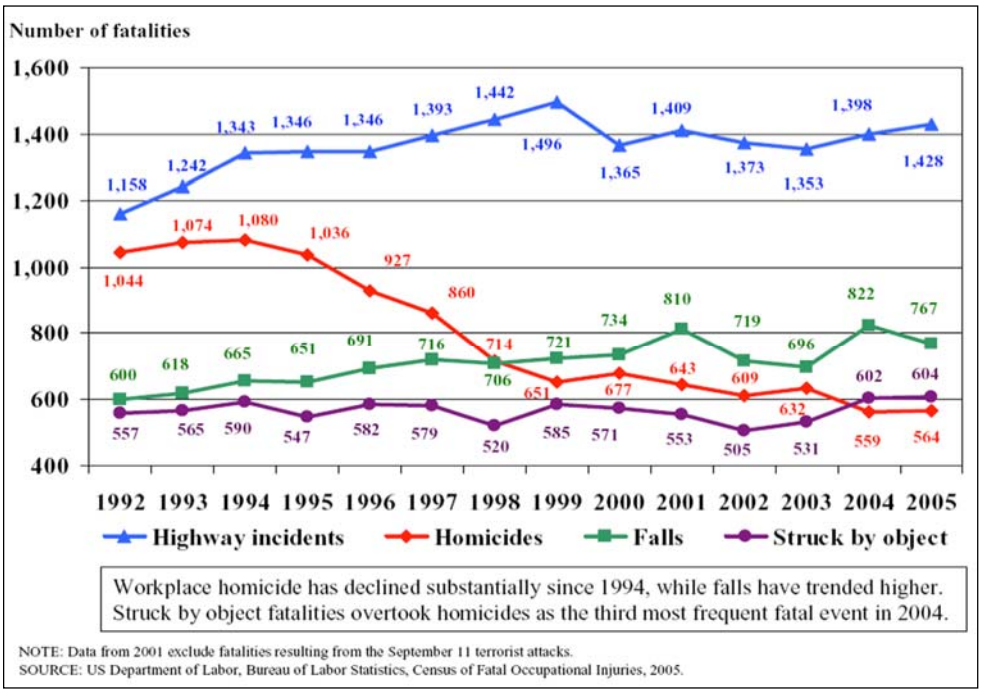
Course Introduction

In 1995, 1048 construction workers died on the job; 32% of those fatalities (335 total) resulted from falls. Falls repeatedly account for the greatest number of fatalities in the construction industry and are a major concern in general industry, as well. The costs of a fall-induced fatality can easily exceed $1 million and can change your life forever.



Data Source: OSHA Integrated Management Information System (03/00)

The following graph shows the four most frequent work-related fatal events for 1992–2005. By 2005, falls became the second most common cause of occupational death.

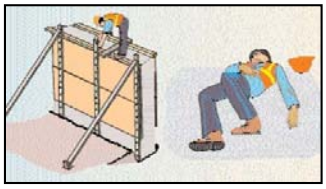


Physics of a Fall

Within seconds, a person who falls can be traveling faster than an automobile on the highway, unless the fall is prevented or arrested.

Time (seconds)	Distance (feet)	Force* (pounds)	Velocity (miles per hour)
0.5	4	1600	10.9
1.0	16	6400	21.8
1.5	36	14,400	32.7
2.0	64	25,600	43.6
2.5	100	40,000	54.5
3.0	144	57,600	65.5
4.0	256	102,400	87.3
**Assuming a 200-pound person and a stopping distance of 0.5 feet (~one-half body width)*			

Course Overview



The proper use of fall prevention and fall protection controls can reduce the risk of deaths and injuries caused by falls. This course, *Fall Protection Introduction* (#33462), is designed as an introduction to various types of recognized fall prevention and fall protection systems at Los Alamos National Laboratory (LANL), including guardrail systems, safety net systems, fall restraint systems, and fall arrest systems. Special emphasis is given to the components, inspection, care, and storage of personal fall arrest systems (PFASs). This course also presents controls for falling object hazards and emergency planning considerations for persons who have fallen.

Course Objectives

This knowledge-level course provides an overview of

- regulations and training requirements that address fall protection;
- the uses and limitations of different types of fall protection systems;
- the components of a PFAS;
- inspection, storage, and maintenance requirements for fall protection equipment;
- controls that should be considered to protect personnel from falling objects;
- emergency planning considerations in case a person should fall; and
- the hazards, definitions, regulations, and controls associated with slips, trips, and falls in the workplace.

Employee Killed in 14-Foot Fall from Tank

Employee #1 was approximately 14 feet above the floor, cleaning the top of a production run tank. He either slid off the top of the tank or fell when exiting the tank onto an unsecured 28-foot fiberglass extension ladder. He landed on the concrete floor and was killed. Employee #1 was not using fall protection. There were no witnesses to the accident.

–OSHA Accident Investigation Search 014380968

Target Audience

This course is designed for personnel whose work at LANL exposes them to the hazard of falls from elevation.

Target audiences for whom this course is designed are employees who reasonably may be exposed to unguarded fall hazards greater than 4 feet.

Course Limitations

Note the following limitations of this course:

- This course does not make the trainee a competent or qualified person.
- This course does not address fall hazards associated with work on scaffolds or ladders. Employees who must use a portable ladder during their work (excluding step stools of three steps or fewer) must be trained in ladder use, care, inspection, and maintenance; this course does not meet that requirement. Employees should also complete *Ladder Safety*, course #12985, on ladder care, use, and inspection.
- Personnel who use fall protection devices during confined space entry and work should also complete LANL courses #40438, *Confined Space Nonentry Gear Rescue Training,* and #40439, *Confined Space Entrant/Attendant,* or the equivalent.
- In addition to this course, you may also be required to have site-specific and on-the-job fall protection training. This course is not a substitute for such training.

Employee Killed in Fall from Top of Water Tower

Employee #1, age 20, was repainting an approximately 96-foot-high water tower. He rode the spider to the top of the water tank to move the rigging. He fell from the top of the tower and was killed. Although the employees had been supplied with, and were required to wear, fall protection in the form of safety belts, Employee #1 was not wearing one at the time of the accident.

–OSHA Accident Investigation Search 201270154

Acronyms

CAZ	controlled access zone
CFR	Code of Federal Regulations
EWSP	Elevated Work Surface Permit
FPP	fall protection plan
HPI	human performance improvement
LANL	Los Alamos National Laboratory
OSHA	Occupational Safety and Health Administration
OSH-ISH	Occupational Safety and Health Division-Industrial Hygiene and Safety Group
P	procedure
PFAS	personal fall arrest system
RLM	responsible line manager

Do You See Any Fall Hazards in This Photo?

Do You See Any Fall Hazards in This Photo?

Module 1: Regulations and Training

Module Overview

This module presents examples of activities that require fall protection, regulations and requirements concerning fall protection, key definitions associated with fall protection, and training requirements for employees engaged in activities that require fall protection.

Module Objectives

After completing this module, you will be able to recognize

- examples of activities that require fall protection,
- regulations and requirements that address fall protection,
- the definitions of *competent person* and *qualified person*, and
- the training requirements for employees engaged in activities that require fall protection.

Activities Requiring Fall Protection

Areas or activities where fall protection is required or may be required include work on or near

- excavations;
- formwork and reinforcing steel work;
- hoist areas;
- holes;
- leading edges;
- pre-cast concrete erection;
- roofing work;
- unprotected sides and edges;
- articulating man-lifts;
- wall openings; and
- ramps, runways, and other walkways.

Regulations

Occupational Safety and Health Administration (OSHA) standards that address fall protection are found in the Code of Federal Regulations (CFR) for both Construction (29 CFR 1926) and for General Industry (29 CFR 1910). OSHA regulations that address or apply to fall protection in the workplace include

- OSHA 29 CFR 1910, Subpart D, "Walking-Working Surfaces," which addresses floor and wall openings and open-sided floors, platforms, and runways where falls of **4 feet** or greater could occur;
- OSHA 29 CFR 1926, Subpart M, "Fall Protection," which addresses construction activities where falls of **6 feet** or greater could occur and where falling-object hazards exist; and
- OSHA 29 CFR 1926, Subpart E, "Personal Protective and Life Saving Equipment," which addresses the use of safety belts, lifelines, lanyards, and safety nets.

LANL's fall protection Procedure (P) 101-20, *Fall Protection Program*, identifies how OSHA's fall protection requirements are implemented at LANL.

Note: *Certain activities at LANL have exemptions from fall protection requirements. If you are not sure which of the above standards apply to your work, if any, ask your supervisor or site health and safety professional.*

Definitions

A list of terms used with fall protection is found in the glossary. Two key terms that are used throughout the manual are *competent person* and *qualified person*. *Competent persons* and *qualified persons* are involved in many aspects of work requiring fall protection at LANL.

- **competent person:** one who is capable of identifying existing and predictable hazards in the workplace and who is authorized to take prompt corrective measures to eliminate them.
- **qualified person:** one who, by possession of a recognized degree, certificate, or professional standing, or who, by extensive knowledge, training, and experience, has successfully demonstrated his (*sic*) ability to solve or resolve problems relating to the subject matter, the work, or the project.

Note: *Taking and getting credit for this course DOES NOT confer status as a competent person or a qualified person.*

Training Requirements

The OSHA driver for fall protection training for construction workers is 29 CFR 1926.503 (a), which states that "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 to minimize these hazards."

Subpart M of 29 CFR 1926 requires that training on the hazards and controls associated with fall protection address the following issues:

- how to recognize and minimize fall hazards;
- the nature of the fall hazards in the work area;
- procedures for erecting, maintaining, disassembling, and inspecting the specific fall protection systems used;
- the use, operation, and limitations of fall protection systems; and
- the user's role in fall protection systems.

Note: *Some, but not all, of the training requirements listed above are met by this course. Site-specific and/or on-the-job training are necessary to address the fall hazards and controls for each work site.*

Initial Training

Training must be provided by a *competent person* and must be documented in accordance with LANL P101-20, *Fall Protection Program.*

Retraining

According to P101-20, workers are required to take fall protection retraining whenever

- workers do not recognize fall hazards at a particular work site,
- changes in procedures or equipment make the previous training obsolete,
- workers fail to use fall protection equipment properly, or
- workers fail to follow the fall protection plan.

Additional Fall Protection Regulations

Fall Protection Situations Not Covered by 29 CFR 1910.26 Subpart M

The provisions of 29 CFR 1926, Subpart M, do not apply when employees are making an inspection, investigation, or assessment of workplace conditions before the construction work actually starts or after all construction work has been completed.

Section 1926.502 of Subpart M sets forth the requirements for the installation, construction, and proper use of fall protection required by Part 1926, except as follows:

- Section 1926.502 does not apply to the erection of tanks and communication and broadcast towers.
- Requirements relating to fall protection for employees engaged in the erection of tanks and communication and broadcast towers are provided in Section 1926.105.
- Performance requirements for guardrail systems used on scaffolds and performance requirements for falling object protection used on scaffolds are provided in Subpart L.
- Requirements relating to certain cranes and derricks are provided in Subpart N.
- Fall protection requirements for employees performing steel erection work (except for towers and tanks) are provided in Subpart R.
- Section 1926.104 sets the criteria for body belts, lanyards, and lifelines used for fall protection during tank and communication and broadcast tower erection. Paragraphs (b), (c), and (f) of Section 1926.107 provide definitions for the pertinent terms.
- Requirements relating to fall protection for employees engaged in the construction of electric transmission and distribution lines and equipment are provided in Subpart V. Additional performance requirements for personal climbing equipment, lineman's body belts, safety straps, and lanyards are provided in Subpart V.
- Requirements relating to fall protection for employees working on stairways and ladders are provided in Subpart X.

The following table lists other OSHA regulations that address those potential fall hazards that are exempted in Subpart M:

Regulations for . . .	can be found in . . .
working on scaffolds	29 CFR 1926, Subpart L.
working on certain cranes and derricks	29 CFR 1926, Subpart N.
performing steel-erection work	29 CFR 1926, Subpart R.
erecting tanks and communication and broadcast towers	29 CFR 1926.105.
constructing electric transmission and distribution lines	29 CFR 1926, Subpart V.
working on stairways and ladders	29 CFR 1926, Subpart X.

Notes. . . .

Module 2: Types of Fall Protection Systems

Module Overview

This module presents some of the factors that affect the selection of fall protection systems, along with general categories of fall protection. Module 2 also presents specific types of fall protection systems and the requirements and limitations of each system.

Module Objectives

After completing this module, you will be able to recognize

- factors to consider in selecting a fall protection system,
- four general categories of fall protection, and
- specific types of fall protection systems and some of the requirements and limitations of each.

Factors to Consider in Selecting a Fall Protection System

Some of the factors that must be considered before choosing a fall protection system include

- the height at which the worker will be performing the job;
- the job site and specific task to be done (for example, a job that requires considerable up-and-down work may require a different fall protection system than a job that requires considerable side-to-side work);
- rescue methods, backup systems, length of time at workstations, dryness or wetness of conditions, number of workers needed on the job site, and environmental factors; and
- the economic and/or engineering *feasibility* (see note below) of removing the fall hazard or of implementing a conventional fall protection system. In other words, “Can it be done with existing technology?” or “Will it cost too much to be economically feasible?”

Note: *In this context,* feasibility *means capable of being successfully accomplished from an engineering or economic perspective.*

Recognized Methods of Fall Protection

Categories of fall protection include

- **fall elimination:** to engineer out the fall hazard during design or remove the need for the worker to access those areas where a fall could occur. For example,
  - design a building so that subsequent maintenance and repair can be performed without fall hazards, and
  - assemble a roof truss on the ground and then lift it into place instead of assembling the truss from an elevated position.
- **fall prevention:** to prevent a fall from occurring. Examples of prevention systems include hole covers, guardrails, and fall restraint systems.
- **fall arrest:** to reduce the impact of a fall after it has occurred. Examples of fall arrest systems include safety net systems and PFASs.
- **administrative controls:** procedures used to reduce the likelihood of a fall. Examples of work procedures used in fall protection include warning lines, safety monitors, controlled access zones, and fall protection plans.

Types of Fall Protection Systems

Many different systems are used to provide fall protection. Each system has limitations, such as cost and/or time to set up, ease of movement, and feasibility. The following table categorizes fall protection systems that are addressed in this course:

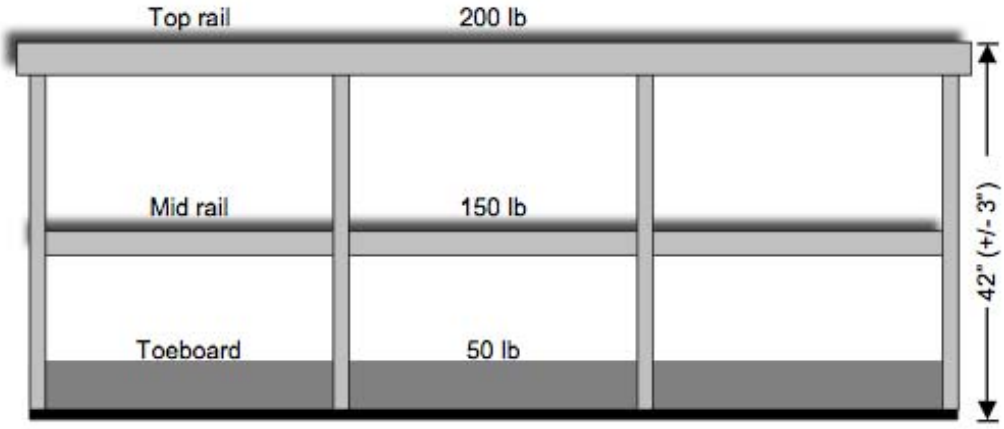
Fall Prevention and Fall Protection Systems			
System	Prevention	Arrest	Admin
Guardrail	✓		
Cover	✓		
Fall restraint	✓		
Safety net		✓	
Personal fall arrest		✓	
Warning line			✓
Safety monitor			✓
Controlled access zone (CAZ)			✓
Fall protection plan [at LANL called at *Elevated Work Surface Permit (EWSP)]*			✓

Guardrail Systems

A guardrail system is a barrier erected to prevent employees from falling to lower levels. Standard guardrails have a top rail that is 42 inches (plus or minus 3 inches) above the walking/working surface and a midrail or wall that is at least 21 inches high. Screens and mesh may be used to replace the midrail if they extend from the top rail to the floor.

The top rail of a guardrail must be able to withstand a 200-pound force at the top edge in any outward or downward direction. Steel or plastic banding is not allowed for use as top rails or midrails. Toeboards must be used when materials on the walking/working surface are a falling object hazard to personnel below.

Because guardrails are designed to prevent workers from falling, they are often the preferred fall protection system. However, in some situations, guardrails may not be technically or economically feasible.



Guardrail labeled with minimum force requirements of each rail and required top rail height.

Photo of a guardrail with a painted access gate.

Covers

A cover is a rigid object fastened over a hole in a floor, roof, or other walking/working surface to prevent falls. A cover must support at least twice the weight of the employee(s) and equipment that may be imposed on the cover at any given time. Floor hole covers must be secured and color coded or be marked "HOLE" or "COVER."

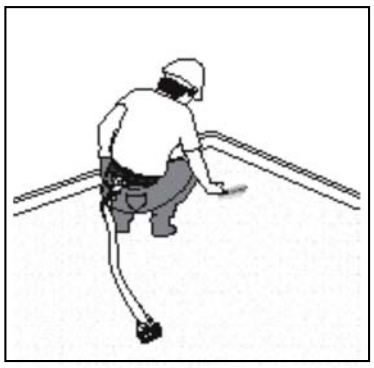
Note: *Manhole covers and road grates do not require cover markings.*

Many falls to lower levels occur through unprotected skylights.

Employee Killed in Fall through Skylight

Employee #1 was on the roof of a warehouse installing roof panels and insulation. Kneeling on a roof panel, he attempted to flip over a piece of insulation that had become caught on the framework of a skylight. Employee #1 reached out 18 to 24 inches to grab the insulation, which he mistakenly believed was supported by a truss, [and] fell 36 feet through the skylight opening. He broke his neck and was killed instantly. The company had not developed a fall protection plan or designated CAZs for this type of leading edge work.

–OSHA Accident Investigation Search 170758916



A fall restraint system is designed to prevent a worker from free falling.

Fall Restraint Systems

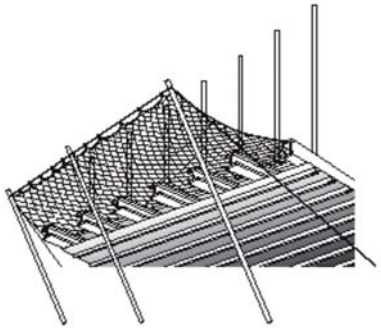
A fall restraint system is designed to prevent a worker from reaching a position where he or she could fall to a lower level (unlike a PFAS, which is designed to stop a fall that is already in progress). A fall restraint system consists of an anchor, a body harness, and connectors. The anchor must support at least 3000 pounds. Fall restraint is preferable to a fall arrest system but may limit the worker's ability to perform work by preventing access to areas where work must be performed.

Safety Net Systems

Safety nets can be tested using a drop test: a 400-pound bag of sand having a 30-inch diameter is dropped from the working surface above the net. The net must be able to withstand the impact without breaking or touching anything below.

A safety net system is a fall arrest system of mesh nets, including panels, connectors, and other impact-absorbing components. Safety net requirements include the following criteria:

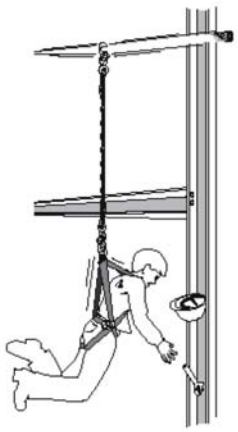
- Safety nets should be installed as close as practicable under the walking/working surface but never more than 30 feet below the working surface.
- The mesh opening of the net must not exceed 6 × 6 inches.
- Safety nets must be installed with sufficient clearance to ensure that a worker falling into the net will not impact with any object beneath the net.
- Safety nets must be inspected at least once each week for damage, wear, and deterioration.
- Materials and tools that have fallen into the net must be removed as soon as possible.
- The minimum distance from the edge of the working surface to the outer edge of the safety net varies, depending on how far the net is below the working surface. Minimum distances are shown in the following table.



Safety net systems are examples of fall arrest systems because they are not designed to prevent a fall.

Vertical Distance from Working Level to Net	Minimum Horizontal Distance from Outer Edge of Net to Edge of Working Surface
Up to 5 feet	8 feet
5–10 feet	10 feet
More than 10 feet	13 feet

Personal Fall Arrest System (PFAS)



A PFAS is used to stop the fall of an employee from a working level. A PFAS is designed to stop a free fall of up to 6 feet while limiting the forces imposed on the wearer. Components of a PFAS include a body harness, lanyard, lifeline, connector, and an anchorage point capable of supporting at least 5000 pounds. Requirements and guidelines governing the inspection, use, storage, and maintenance of PFAS components are presented in Module 5.

Warning Line Systems

A warning line system is a barrier made of lines or ropes that warns employees when they are approaching an unprotected roof side or edge. Unlike a guardrail system, a warning line system will not prevent a worker from falling.

Do not use a warning line system for routine/scheduled work. Warning line systems consist of temporary barriers that delineate an area or areas in which work may take place without guardrails or safety nets. Warning lines provide visual and tactile warnings to employees that they are close to an unprotected or leading edge. These lines must be used in conjunction with a safety monitor.

For roofing work, warning lines are erected around all four sides of a work area no less than **6 feet** from the roof edge when mechanical equipment is not in use and no less than **10 feet** from the roof edge in the direction of any mechanical equipment (other than powered hand tools) in use.

When approved, all other work using warning lines as fall protection must be at least **6 feet** from any fall hazard and must meet LANL warning line construction/erection requirements.

Two parallel warning lines, connected from a general working area to a designated working area, are used to create a safe path to the designated area. A barricade must be placed across the access path at the point of entry to the designated work area to keep unauthorized employees from entering the designated work area.

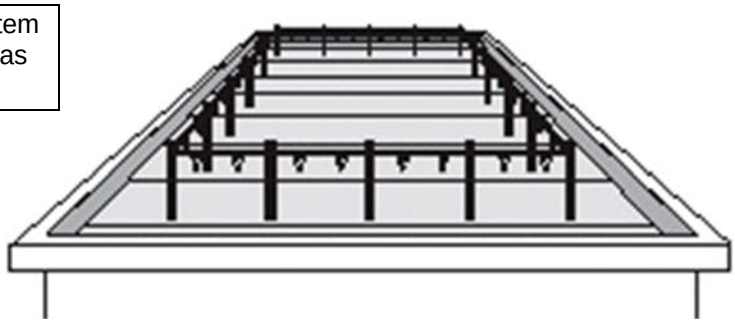
Warning lines must be

- flagged at 6-foot intervals,
- be between 34 and 39 inches in height,
- have a tensile strength of at least 500 pounds, and
- be attached to stanchions in such a manner that pulling on one section does not draw up slack from an adjacent section. Warning line stanchions must have a resistance force to toppling over of at least 16 pounds.

Never enter the area between a roof edge/fall hazard and a warning line unless you are provided with fall protection. Always follow the specific construction and installation requirements specified in OSHA Subpart M-1926.502 (f), “Warning Line Systems.”

Do not use a warning line system for routine/scheduled work. On construction projects, warning lines can be used only on roofing projects. Contact the Industrial Hygiene and Safety Group if you are considering using a warning line system.

A warning line system is NOT the same as a guardrail!



Controlled Access Zone

A CAZ is an area where certain work may take place without the use of guardrail systems, PFASs, or safety net systems; access to the zone is restricted to certain personnel.

The control line of a CAZ must

- extend the entire length of the designated work area,
- be 39 to 45 inches above the working surface,
- be flagged every 6 feet, and
- have a breaking strength of at least 200 pounds.

Note: *Breaking strength does NOT mean withstanding a lateral force of 200 pounds, as with a guardrail.*

Safety Monitors and the Safety Monitoring System

A safety monitoring system is a set of procedures used by a safety monitor who is trained to monitor others as they work on elevated surfaces and warn them of any fall hazards. A safety monitoring system is to be used only as a last resort when all other fall protection systems are infeasible. A fall protection plan is required when a safety monitor is used.

At LANL, a safety monitor must

- be trained to perform safety monitor duties,
- be approved by a *competent person*,
- be on the same working level and within sight of the employees being monitored,
- warn employees if they get too close to an unprotected edge,
- warn employees if they are acting in an unsafe manner, and
- have no other responsibilities while performing monitoring duties.

Fall Protection Plan (FPP) for Roofing Work

A fall protection plan (FPP) must be used for roofing work where the use of conventional fall protection equipment is infeasible or creates a greater hazard. The reasons must be documented as to why the use of conventional fall protection equipment is infeasible or creates a greater hazard.

An FPP must be prepared by a *qualified person* and implemented by a *competent person*. An FPP is developed specifically for the site where the work will be performed and must be kept at the job site. At LANL the EWSP serves the same purpose and is used as an FPP when a regulatory requirement for an FPP exists.

An FPP may combine controls. For example, a plan may call for a warning line system and a safety monitor to warn personnel when they are approaching fall hazards.

Positioning devices are NOT fall protection systems and can NEVER be used as fall protection.

For nonroofing work, no regulatory requirement specifies the need for documentation or who has to write it. Therefore, unless engineering work is required for the fall protection, a competent person may write an EWSP, as long as it is not used for roofing work. If engineering is needed, a qualified person must write the EWSP because of the regulatory requirement. In that case, the EWSP may be used for roofing work.

Positioning Device Systems

A positioning device system uses a harness that provides support and allows work on an elevated vertical surface, such as a wall, with both hands free. A positioning device system must limit a fall to 2 feet.

Notes. . . .

Module 3: Protection from Falling Objects

Module Overview

This module presents the hazards of falling objects and the controls that can be implemented to reduce the risk of injury from falling objects.

Module Objectives

After completing this module, you will be able to recognize controls that can be used to reduce the risk of falling object hazards.

Falling Objects

OSHA Construction Regulation 1926.501(c) requires protecting personnel from falling objects. Each employee exposed to falling objects must wear a hardhat, AND the employer must implement

- toeboards, screens, or guardrail systems; OR
- a canopy and storage of objects away from the edge; OR
- a barricade around the area to which objects could fall, prevention of employees from entering the barricaded area, and storage of objects away from the edge.

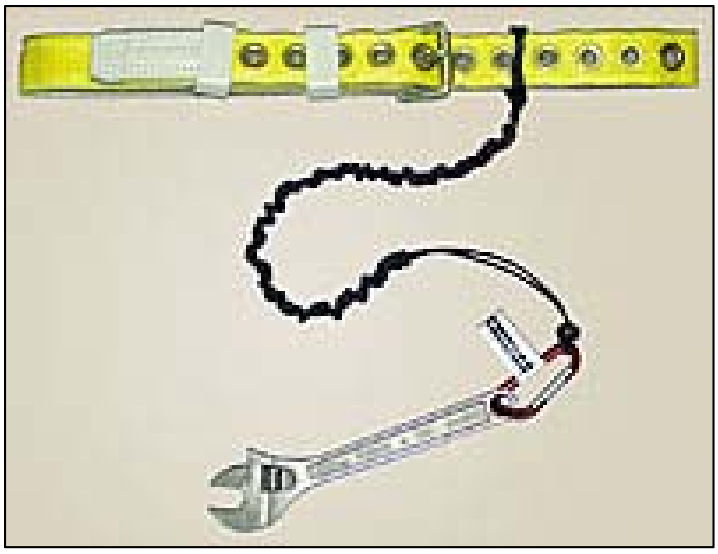
Controls for Falling Objects

Use signs to warn people that a falling object hazard exists.

Regardless of whether your work falls under construction regulations, consider one or more of the following methods to reduce the risk of falling object hazards:

- Erect **gantries or canopies** as necessary over commonly traveled areas (such as public footpaths), where falling objects present a risk to people.
- Install **signs** and other warning devices to warn people that a falling object hazard exists.
- Create **exclusion zones** to prevent people or vehicles from entering areas into which objects may fall.

- Install **floor hole covers and toeboards** to prevent objects from being inadvertently kicked to a lower level. If toeboards are used, they must be strong enough to withstand a force of at least 50 pounds applied in any downward or outward direction and be at least 4 inches high (29 CFR 1910.23(e)(4).
- Use **tool lanyards** to prevent a dropped tool from becoming a falling object hazard to personnel and equipment below.
- Store **materials away from edges** to reduce the possibility of their being knocked or dropped over the edge.
- Perform regular **housekeeping** to keep work surfaces clear of material and debris.
- Provide **personal protective equipment**, such as hardhats, safety shoes, and approved eyewear, to employees and visitors who enter or work in areas where falling objects are a hazard.



Tool lanyards can be used to prevent a dropped tool from becoming a falling object hazard to personnel and equipment below.

Human Performance Improvement – Falling Construction Rubble

Human Performance Improvement (HPI) is an approach that is used to address human error in the workplace. HPI treats human error as a symptom or a result of deeper problems within a system. One of the five basic principles of HPI is that people are fallible and that even the best make mistakes.

One of the most important approaches used in HPI to address errors in the workplace is called defense in depth. For defenses against human error to be effective, they must

- create an understanding and awareness of hazards,
- give clear guidance on how to operate safely,
- provide alarms and warnings when danger is imminent,
- restore the system to a safe state in an off-normal situation,
- set up safety barriers between the hazards and the potential losses,
- contain and eliminate the hazards in case safety barriers fail, and
- provide the means of escape and rescue for workers in case hazard containment fails.

Read the incident below and see if you can identify defenses that would have reduced the likelihood of this incident.

Near Miss to Personnel Safety from Falling Construction Rubble

A research employee exiting a building was struck on the shoulder by a baseball-sized rock, which caused a minor contusion. The rock fell approximately 22 feet before striking the employee. A second softball-sized rock subsequently fell and narrowly missed the employee's head. The rocks were dislodged by an employee assigned to clean clumps of rock and dirt off the building's roof after an access hatch installation job was completed. Investigators determined that the exclusion-area boundary tape used to establish a safety barrier in the area near the building exit had been removed by a building occupant who apparently assumed it was no longer necessary because the heavy equipment used during the hatch installation work had been removed from the roof.

-ESH-7 LANL Operating Experience Summary Issue 97-3

Question 1. What are some of the defenses in depth that could have been used to prevent this incident?

_____

_____

_____

Question 2. If you were assigned to clean the roof, what could you do if you felt the defense in depth was not adequate?

_____

_____

Answers are on the following page.

Answers

Human Performance Improvement – Falling Construction Rubble

Question 1. What are some of the defenses in depth that could have been used to prevent this incident?

- Install nets or barriers to prevent rocks and clumps of dirt from hitting the ground below.
- Hold a pre-job briefing to review hazards and controls.
- Design the operation so that rocks and dirt are collected and not pushed over the roof edge. Close off the exit and establish an alternate exit (if access/egress requirements allow).
- Set up postings to indicate the nature of the hazards.
- Set up a warning system, such as a flashing light, to indicate ongoing operations.
- Set up a spotter with communications to observe operations from the ground and alert passersby of the hazard.
- Determine why such large rocks were located on the roof in the first place so that such hazards could be addressed more effectively in subsequent operations.

Question 2. If you were assigned to clean the roof, what could you do if you felt the defense in depth was not adequate?

You could discuss your concerns with other workers on the job. You could pause or stop work, and tell your supervisor.

For more information about HPI, register for *Human Performance for Workers* (#43428) through the UTrain link on the LANL homepage.

Module 4: Emergency Planning

Module Overview

The time to think about what to do if a worker who is attached to a fall arrest system falls is **before** the worker falls, not after. This module presents preparations that can be made to assist in the response to a fall and actions to take if a fall should occur.

Module Objectives

After completing this module, you will be able to recognize

- preparations that can be made to assist in the response to a fall before a fall occurs and
- actions to take if a fall should occur.

Preparing for a Fall

Before beginning work with any fall arrest system, consider what to do if a worker falls. Workers who have fallen, especially those who are suspended by their PFAS, should be retrieved as soon as possible. Motionless suspension is not safe and can rapidly lead to a loss of consciousness and serious blood circulation problems.

Before a Fall Occurs

The following precautions should be taken in situations in which a fall could occur:

- Know what the rescue procedures are and who the contacts are. This information should be identified in your fall protection plan or activity hazard analysis.
- Consider how a rescue will be performed if more than one person falls or if the work is taking place within a secured area (where it may take longer for rescue personnel to enter).
- Identify onsite equipment that could be used for rescue and retrieval, such as aerial lifts, forklifts, and ladders.

If a Fall Occurs

The following actions should be taken in the event of a fall:

- Talk to the victim(s), and try to determine his/her condition.
- If the person(s) is injured or unconscious, call 911 immediately.
- Ensure that only *qualified persons* attempt a technical rescue.

Module 5: Personal Fall Arrest Systems

Module Overview

This module presents information about components that make up a basic PFAS, along with some of the requirements and guidelines for using a PFAS.

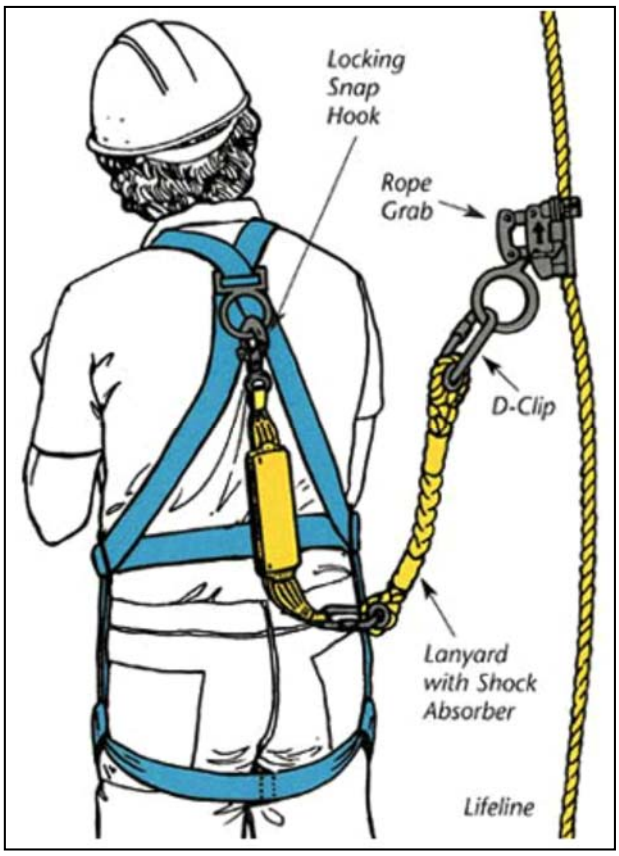
Module Objectives

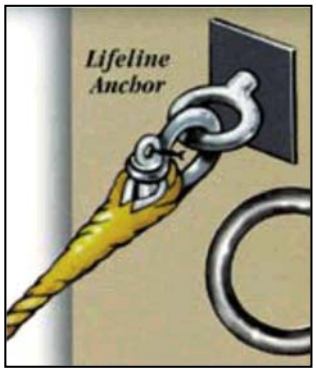
After completing this module, you will be able to recognize the

- components of a PFAS and
- requirements and guidelines for using a PFAS.

Components of a Personal Fall Arrest System

A PFAS is a system used to arrest an employee during a fall from a working level.





A PFAS is *not designed to prevent falls,* and a PFAS is no guarantee against injury caused by a fall. In many cases, other fall prevention methods can also be used with a PFAS to further reduce the risk of falls.

At a minimum, a PFAS consists of an anchorage, connectors, and a body harness. These and other PFAS components are described as follows.

Anchorages

An anchorage is a secure point of attachment for lifelines, lanyards, or deceleration devices. An anchorage must support a minimum load of 5000 pounds.

Anchorage points should be located so that lanyards can be attached before the user moves into a position where he or she would be at risk from a fall. Ideally, during the design phase of a project, engineers should consider anchor locations that can be used, both during and after construction (such as for maintenance activities).

D-ring eyebolt fall rated in every direction.

If you are not sure how much weight an anchor will hold, DO NOT use it until a ***qualified person*** has assessed the suitability of the anchor. Unacceptable anchorage points include fire protection piping, chemical lines, gas lines, and electrical conduit.

If an eyebolt is used for an anchorage, consider that most eyebolts are strength rated along one axis only. This means that the working load is reduced when force is applied at an angle to the vertical axis of the bolt. However, some eyebolts, such as the D-ring anchorage shown at left, are fall rated in all directions.

Specific requirements for anchorage at the Laboratory are included in the following section from P101.20, *Fall Protection Program*:

> ***3.3.7.d Anchors*** *Anchorage systems must be properly planned, maintained, and support 5,000 lb., or be designed by a qualified person documenting that it supports a fall of 6 ft, using a weight of 310 lb. per attached person and including a safety factor of at least two. Anchor points for positioning systems must support a minimum of 3,000 lb. Fall restraint anchors must withstand 3000 lb. of force or twice the maximum force expected to restrain the person from the fall hazard.*

The anchorage system cannot be secured to a guardrail system. A qualified person must approve and supervise anchor installations. If permanently installed, they are part of the facility and the FOD must ensure they are inspected annually by a competent person. They must be inspected at each use by the user. If there are signs of wear, corrosion, fatigue, or damage, workers must not use the anchor until a qualified person approves it for use.

Standing Seam Anchors

One type of anchor is a standing seam anchor. A standing seam anchor, or metal roof anchor, is designed for use on roofs that have "standing seams" (see figure below). Standing seams come in various configurations, and the anchor used must be compatible with and be designed for the type of seam on which it will be used. Standing seam anchors can be permanent or temporary. The temporary anchor is the most common type used at the Laboratory and is issued from the tool room.

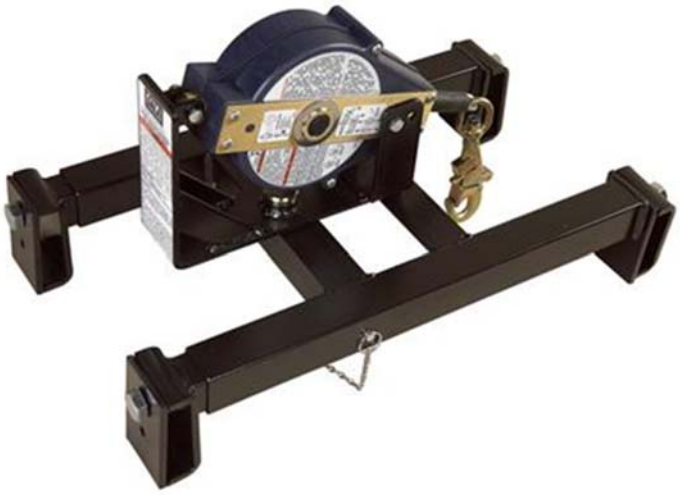
An example of one type of standing seam. One feature that most standing seam roofs and standing seam anchors have in common is that standing seam roofs have clips, as shown above; for most seam anchors, anchors are attached at the clip.

The standing seam anchor is clamped to the standing seam of a roof. The following examples show some anchor designs.

One type of standing seam anchor showing the use of different brackets on many styles of standing seam.

Another brand of standing seam anchor. Seam anchors attached to multple seams are more common than single seam anchors.

Most commercial clamps are reusable and are designed for use on most standing seam roofs. However, a LANL-qualified person must certify any brand of seam anchor with any specific seam style before use. Qualified persons must certify any anchor.



One seam anchor that is available at the tool room is the DBI Sala, model 2103675.

Standing seam anchors from different manufacturers will have very different attachment instructions and may also have different precautions. For example, some seam anchors cannot be used on a sloped roof and can be used only on a flat roof. Just because you have been trained on one seam anchor does not qualify you to use every type. Never assume that there are any similarities among seam anchors.

Caution: *You must receive training on the specific type of seam anchor you will use before you use it. The training can be as simple as a briefing from a competent person. General Laboratory Fall Protection training does NOT qualify you to install ANY temporary anchor.*

Warning: *A competent person must inspect and approve any temporary anchor installation and application before use. A qualified person must review the type of anchor, the roof, and its method of attachment and determine that the roof standing seams can support the expected load. Temporary anchors must be certified by a qualified person in the same way as any other type of anchor.*

Some roof material can be scratched or dimpled/dented/bent by using these anchors, especially if workers pull or push on their anchorages, are rough in the placement/removal of same, or are arresting a fall. Generally, this damage is preferable to fall exposures. The facility manager is responsible for making the choice to use this method on the buildings/roofs and should be consulted to approve its use. Repairing marks, scratches, or other damage to roofs may become an issue and should be considered when choosing this method of anchoring.

Full body harness.

Body Harnesses

A body harness consists of straps that distribute fall arrest forces over the thighs, waist, chest, shoulders, and pelvis so that an arresting force of no more than 1800 pounds is exerted on the falling worker. A variety of harness types, sizes, and fastening mechanisms is available. A body harness fits around the torso of your body and supports your weight. If you intend to use another type, contact the Industrial Hygiene and Safety Group. Regardless of what type of harness is selected, it must always be worn snug to the body.

Note: *Body belts are NOT allowed to be used as part of a PFAS.*

Considerations that affect body harness selection include

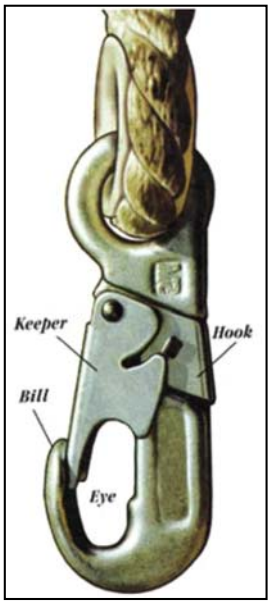
- the type of work that will be performed;
- the possible free-fall distance;
- the proximity of open electrical sources, which can affect the type of equipment selected and the location of harness D-rings; and
- the presence of acids, dirt, oil, grease, moisture, heat, and cold, which can cause early failure of some types of materials.

Examples of body harnesses.

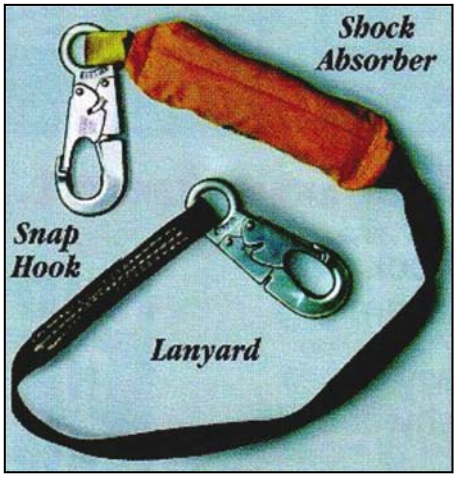
Connectors

A connector is a device used to connect the parts of the PFAS and *positioning device systems* together. A connector must be corrosion resistant, with smooth surfaces and edges that will not damage other parts of the PFAS. Examples of connectors include snap hooks and D-rings. All snap hooks and D-rings used as parts of a PFAS must have a minimum breaking strength of 5000 pounds.

Snap hooks must be self-closing to prevent *roll out*, a condition in which a load on the hook (usually from a mismatching connector or rope) places a load on the latch that causes it to open and release the connector. Refer to manufacturer's guidelines when selecting connectors.



Connectors include snap hooks *(left)* and D-rings *(above).*



Shock-absorbing lanyard with self-closing snap hooks.

Employee Killed in Fall from Scaffold

Employee #1 was erecting a guardrail/scaffold under a bridge when he unhooked his fall protection lanyard and walked approximately 9 feet to help a coworker straighten an upright leg of the bridge. While they were putting on the leg, the plank on which he was standing slipped, and he fell 22 feet onto riprap (rocks). Employee #1 died of a massive baseline skull fracture.

–OSHA Accident Investigation Search 014373146

Lanyards

A lanyard is a flexible rope, wire, or strap used to connect a body harness to a deceleration device, lifeline, or anchorage.

The length of the lanyard may differ, depending on the type of lifeline used. The selection of a lanyard will depend on the type of work, the location of the anchorage, and the type of lifeline used.

A shock-absorbing lanyard is designed to expand, thus reducing the force to the wearer during the fall. A shock-absorbing lanyard is not needed with a self-retracting lifeline.

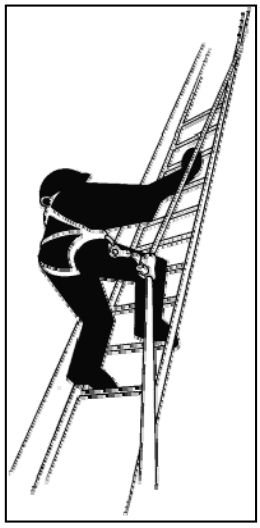
A shock-absorbing lanyard used to connect a body harness to a lifeline.

In some cases, a lanyard with three snap hooks can be used, allowing the worker to hook onto another lifeline or anchorage point with one snap hook while leaving the other snap hook attached to the original anchorage or lifeline. This method allows the worker to move from anchorage point to anchorage point and always remain attached.

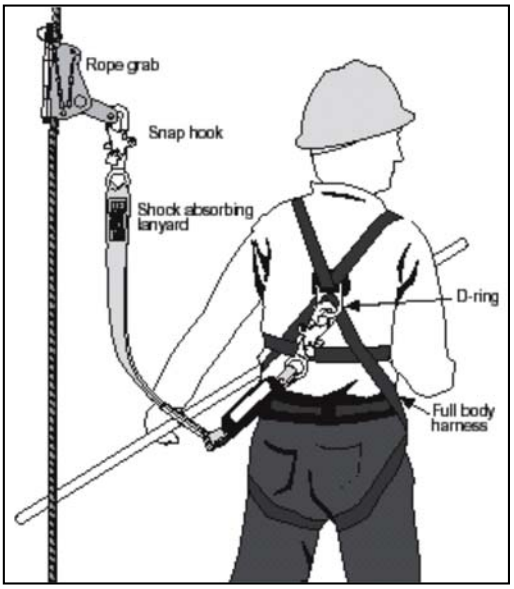
Lifelines

A lifeline is a flexible line connected between one or more anchorage points that allows other components of a PFAS to be connected to the anchorage. The two types of lifelines are *vertical* and *horizontal*.

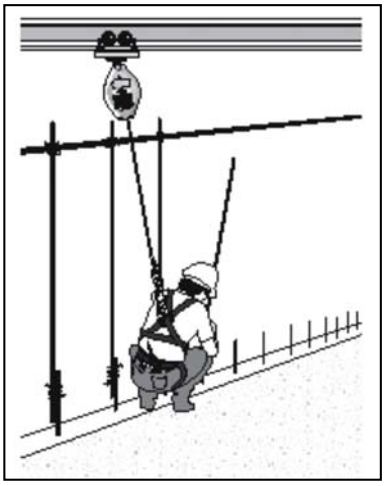
A *vertical lifeline* attaches directly to a body harness, lanyard, or decelerating device and at least one anchor. The minimum required break strength for a vertical lifeline is 5000 pounds. A rope grab is a decelerating device designed to move along a vertical lifeline and automatically engage and lock on the lifeline when a worker falls. A vertical lifeline with a rope grab is shown below.



Worker using a vertical lifeline *(above and right)*.



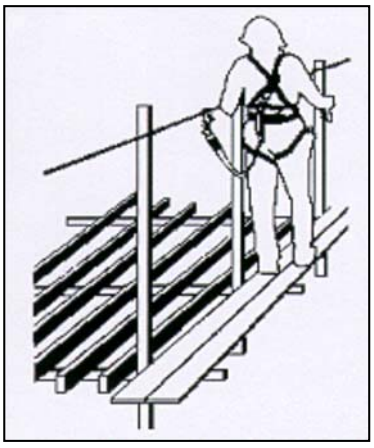
A *self-retracting lifeline* (also known as a self-retracting lanyard) is a type of vertical lifeline consisting of a drum-wound line that unwinds from and retracts back into the drum as a worker moves. If the worker falls, the drum automatically locks, thus limiting the distance of the fall. A self-retracting lifeline must be anchored above the head to minimize the potential for a *swing fall*.



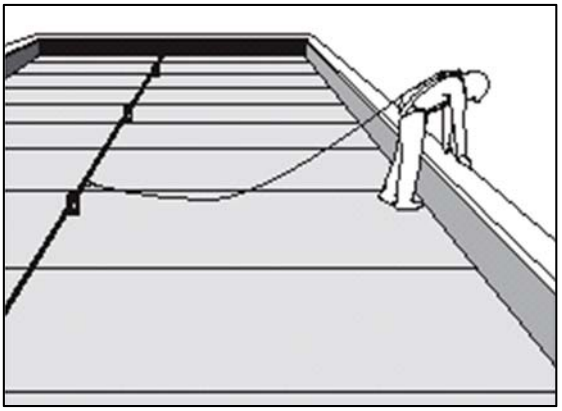
Worker using a self-retracting lifeline *(left and right)*.

A *horizontal lifeline* stretches between two anchors and must be designed to support at least 5000 pounds per attached worker. Because horizontal lifelines are subject to greater loads than vertical lifelines, they must be designed, installed, and used under the supervision of a *qualified person*.

Note: *Never confuse a horizontal lifeline PFAS with a fall restraint system. Horizontal lifelines are designed to arrest falls, NOT prevent falls.*



Examples of horizontal lifelines. Note in the figure at left that a shorter lanyard is used when the lifeline is not above the worker's head.



Human Performance Improvement – Fall from Forklift Platform

Human Performance Improvement (HPI) is an approach that is used to address human error in the workplace. HPI treats human error as a symptom or a result of deeper problems within a system. One of the five basic principles of HPI is that people are fallible, and even the best make mistakes.

HPI recognizes two types of errors: active and latent. ***Active errors*** trigger immediate unwanted events. For example, a worker loses balance and falls through a skylight. ***Latent errors*** result in unseen organizational weaknesses. Examples of latent errors include

- poor design,
- gaps in supervision,
- undetected manufacturing defects,
- maintenance failures,
- unworkable procedures,
- clumsy automation,
- shortfalls in training, and
- inadequate tools and equipment.

Employee Killed in Fall from Forklift Platform

Employee #1 and a coworker were performing the routine task of stocking shelves with boxes that contained furniture. These employees were using a stockpicker forklift to move the boxes and lift them to the shelving units. The forklift was equipped with a standard 8-foot-by-4-foot platform on which the boxes were stacked. Employee #1 was authorized to stand on this platform only when loading or unloading. The stockpicker had a caged area where both employees could safely stand while traveling, and it was equipped with a point for attaching a fall protection lanyard. Employee #1 was standing at the farthest end of the platform, approximately 4 inches from the edge, when the coworker began to raise it. When the coworker set it at the appropriate height (104 inches), the platform gave a jolt and Employee #1 lost his balance. He fell off the platform to the floor, suffering fatal head injuries. Employee #1 did not have his lanyard secured to the tie-off point.

-OSHA Accident Investigation Search 014492623

Question 1. What was the active error in this incident?

_____

Question 2. What were the actual and potential latent errors in this incident?

_____

_____

Question 3. What would you do to prevent such an incident from occurring again?

_____

_____

Answers

Question 1. What was the active error in this incident?

Failure to secure the lanyard to the tie-off point.

Question 2. What were the actual and potential latent errors in this incident?

Latent errors:

- Standing on the platform as it was being raised.
- Failing to train the worker not to stand on the platform during raising and lowering operations.
- Failing to train the forklift operator not to allow anyone to stand on the platform during raising and lowering operations.
- Lacking supervision.
- Failing to enforce requirements.
- Accepting deviations by employee work culture.

Question 3. What would you do to prevent such an incident from occurring again?

Look out for latent errors and report them to the supervisor before someone is hurt. Foster a culture in which people are rewarded for reporting problems and deviations.

For more information about HPI, register for *Human Performance for Workers* (#43428) through the UTrain link on the LANL homepage.

PFAS Requirements and Guidelines

General requirements and guidelines for using PFASs are listed below. Guidelines vary according to the type of PFAS selected and the conditions in which it is being used.

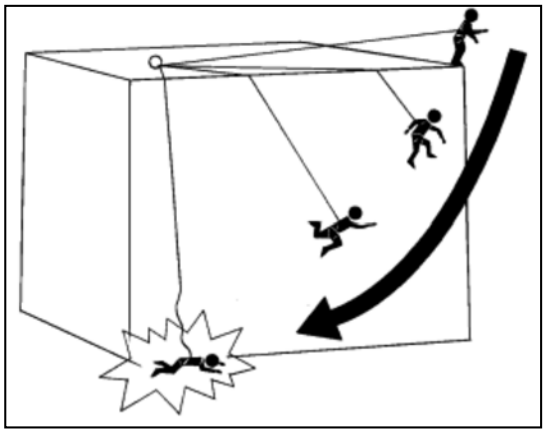
- Select the correct equipment for the task. Use only approved PFAS equipment, and ensure that separate components of your PFAS are compatible with each other. Whenever possible, avoid hardware with exposed springs, which can be disabled or removed easily.
- Ensure that anchorage points are satisfactory before you begin. If you are unsure about the anchorage points, have a *qualified person* reevaluate the suitability of the anchorage points before you begin work.

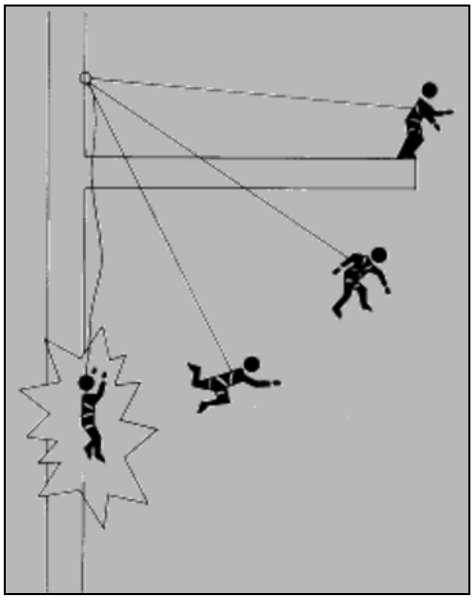
The maximum allowable free-fall distance is 6 ft!

- Remove obstructions from the fall path area before beginning work.
- Consider free-fall distances; try to reduce the free-fall distance as much as possible. The farther the free-fall distance, the greater the risk of hitting an obstruction.

Many fall injuries are made worse because the victim wore their harness too loosely.

- Always wear your harness as it is designed to be worn, which includes having leg straps attached during use and having the pelvic strap in place (below the buttocks).
- Assess the potential for a swing fall (shown below) before and during PFAS use. To reduce the risk of a swing fall, keep the lanyard assembly as short as possible.

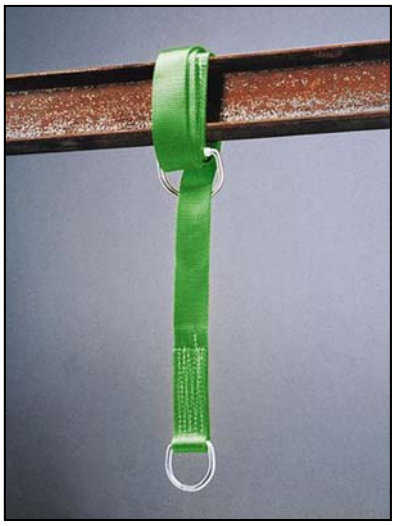




Swing fall hazards should be evaluated before work begins and as work progresses so that changing conditions do not increase the swing-fall risk.

- Inspect your PFAS before every use. General inspection requirements are addressed in Module 6.
- If you will be wearing both a fall arrest harness and a tool belt, put on your harness first, then your tool belt.
- Consider the use of shock-absorbing lanyards to reduce the arresting forces of a fall (unless conditions do not permit the use of such a lanyard).
- Use care when working around rough surfaces that could scratch or tear the fabric parts of your PFAS equipment.
- Try not to work alone when using a PFAS. If a fall occurs, you may need to seek help for your buddy, or your buddy may need to seek help for you.
- DO NOT add holes to the straps of a harness.
- DO NOT attach a PFAS to a guardrail system! Guardrails are NOT designed to withstand the force requirements for a PFAS.
- DO NOT tie knots in lanyards or lifelines. Knots can reduce lanyard and lifeline strength by as much as 50%.
- DO NOT tie lifelines or lanyards directly to an I-beam. Use other methods of attachment, such as pass-through adapters (also known as anchor slings).

Pass-through adapters, also known as anchor slings, should be used to avoid tying lanyards directly to an I-beam.



Reducing Impact Force

OSHA's fall protection requirements are based on a person's combined weight (person and tools) not exceeding 310 pounds. If the combined weight exceeds 310 pounds, then the employer must make appropriate adjustments to the criteria and protocols of 29 CFR 1926, Subpart M, Appendix C. A 255-pound person carrying 60 pounds of tools and equipment exceeds the limits of most PFASs. If the limits are exceeded, the shock absorption may be used up, subjecting a falling worker to several thousand pounds of force.

If a potential fall cannot be prevented (as with a fall restraint system), consider ways to reduce the impact force of a fall before you begin work. In general, three methods reduce the impact force of a fall.

- **Decrease the weight.** Carry fewer tools and less equipment, or consider using a positioning device system for heavy tools.
- **Decrease the free-fall distance.** The free-fall distance is the vertical distance a worker falls *before* a PFAS begins to stop the fall. To decrease the free-fall distance, use the shortest lanyard possible that still allows the work to be safely performed, or consider the use of a self-retracting lifeline.
- **Increase the stopping distance.** The stopping distance is the vertical distance a worker falls after a PFAS begins to stop a fall. To increase the stopping distance, use a shock-absorbing lanyard to dissipate force, as long as an allowance is made for the extra distance needed to stop.

Note: *NEVER confuse free-fall distance with stopping distance! Free-fall distance is the distance fallen before the arresting device is activated.*

Improperly using your fall protection harness can give you a false sense of security and increase the risk of injury, even if the harness works as it should. Examples of improper harness use include

- leg straps that are not used or are rolled up and taped,
- leg straps that are too loose,
- shoulder straps that have been removed, and
- subpelvic straps that ride above the buttocks.

PFAS Total Fall Distance

Before any PFAS is used, the total fall distance must be calculated by a *competent/qualified person*. The total fall distance is the sum of the free-fall distance, deceleration distance, harness effects, and vertical elongation of the PFAS. A safety factor is then added to further reduce the risk. Each of these terms is explained as follows:

To keep free-fall distance to a minimum, always try to keep your anchor point as far above the back D-ring of the harness as possible.

- **Free-fall distance:** The vertical distance a worker travels between the onset of a fall until just before the point where the PFAS begins to arrest the fall. Federal OSHA requirements limit this distance to 6 feet or less.
- **Deceleration distance:** The vertical distance a worker travels between the activation of the PFAS and final fall arrest. Federal OSHA requirements limit this distance to 3.5 feet or less. The deceleration distance that each shock-absorbing, fall-arrest device will permit is typically stated on the product label.
- **Harness effects:** The stretch of a harness during fall arrest, which is typically 1 foot or less for a properly fitted harness. However, some harnesses use elastic-type webbing that can increase the harness effects to 2 feet or more.

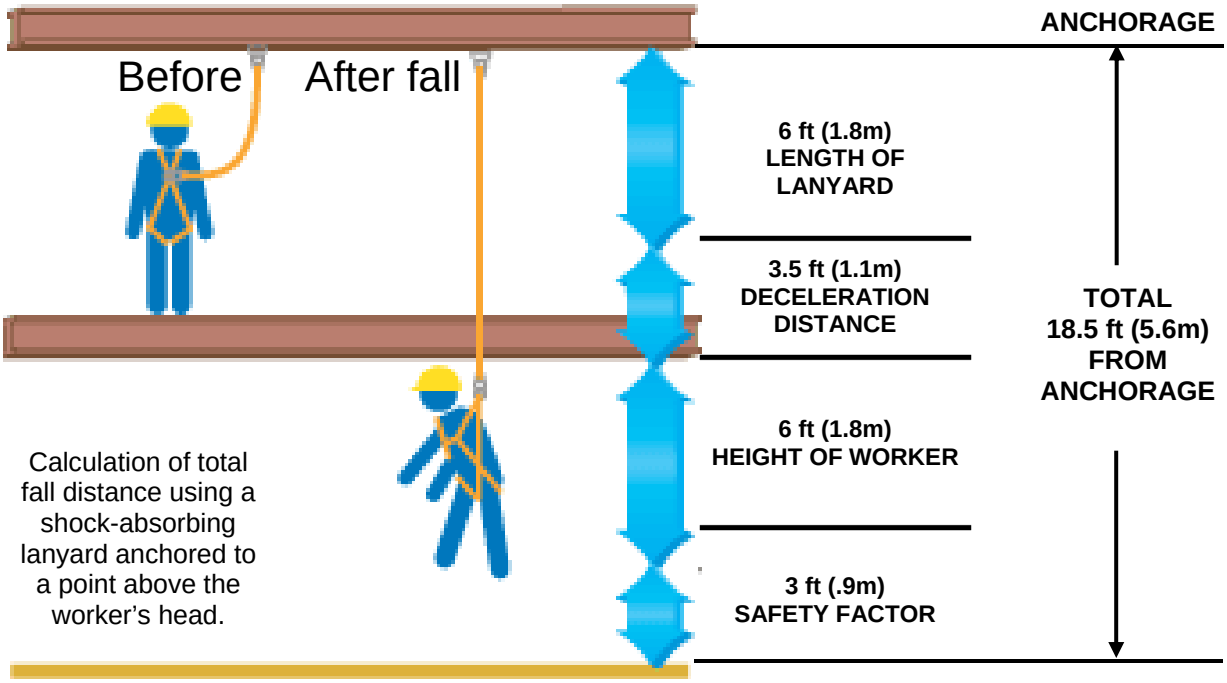
The manufacturer of the product should be able to provide information on harness stretch and vertical elongation.

- **Vertical elongation:** The stretch in the lifeline of the PFAS. Vertical elongation is measured on the part of the lifeline that is under tension during deceleration and final fall arrest. This variable will change, depending on the type of PFAS being used. For example, most shock-absorbing lanyards are designed to have a maximum deceleration distance of 3.5 feet, which includes the vertical elongation of the lanyard.
- **Safety factor:** An additional factor of safety to ensure enough clearance between the suspended, fallen worker and the working surface. The safety factor should be at least 1 foot.

In the example illustrated below, the fall clearance distance for a worker using a shock-absorbing lanyard anchored to a point above the worker's head is composed of the following measurements:

- the length of the shock-absorbing lanyard (6 feet);
- the maximum elongation of the shock absorber during deceleration (3.5 feet);
- the average height of a worker (6 feet); and
- a safety factor of 3 feet to allow for the possibility of an improperly fitted harness, a taller-than-average worker, and/or a miscalculation of distance.

The total, 18.5 feet, is the suggested safe fall clearance distance for this example.



Module 6: Inspection, Maintenance, and Storage of Fall Protection Equipment

Module Overview

This module presents the requirements and recommendations for the inspection, maintenance, and storage of fall protection equipment. It also presents the steps for donning a body harness. During this module, users will physically inspect and don a body harness.

Module Objectives

After completing this module, you will be able to recognize

- three types of fall protection equipment inspections,
- what to look for when inspecting fall protection equipment,
- what to do if you find damaged or defective equipment, and
- guidelines for maintenance and storage of fall protection equipment.

Inspecting Fall Equipment

All fall protection equipment, especially PFAS equipment, can be damaged with use.

Requirements for inspection of various kinds of fall equipment can vary, depending on the type, manufacturer, and purpose.

Refer to the manufacturer's guidelines to determine what needs to be inspected, how it needs to be inspected, and how often inspection is required. If you are working under a fall protection plan, refer to the plan for specific inspection requirements.

Three Types of Inspections

The three types of inspections used with PFAS equipment are

- **user inspections**, which must be performed by the user before each use; these inspections should include connectors and anchors;
- **annual inspections**, wherein a *competent person* shall examine PFAS equipment at least annually to determine if the equipment is suitable for continued use; and
- **manufacturer inspections**, for items such as retractable lanyards that must be recertified periodically by the manufacturer.

Body Harness Inspection

Perform the following steps to inspect a harness and its associated attachments or parts:

- **Webbing straps:** Grasp the webbing with your hands 6–8 inches apart. Bend the webbing in an inverted “U” shape. Inspect both sides of the webbing for frayed edges, broken fibers, pulled stitches, cuts, burns, and chemical damage.
- **D-rings:** Check the D-rings for distortions, cracks, breaks, and rough or sharp edges. The D-ring should pivot freely. Check the attachment point of the D-ring to ensure that it is secure.
- **Buckles:** You may encounter three different types of buckles: the simple eyelet or belt buckle type, the “click” type similar to that found on your car seat belts, or the Miller slotted buckle. Ensure that all parts move freely. Check for cuts, wear, and frays on any connecting points, and give a good pull to ensure that they work.
- **Stitching:** Check all stitching for torn or pulled stitches, and ensure that the webbing joints are not loose.
- **Labels:** Check that the labels are present, securely attached, and legible and that the equipment is less than 5 years old.
- **Connectors:** Check that the hardware and webbing/rope/cable are in good condition (see webbing straps). Check that self-retracting lifelines function by jerking on the strap/cable/rope quickly and that the stopping mechanism engages.

- **Anchors:** Ensure that anchors are firmly attached to the supporting structure, that they are in good physical condition, and that they have been certified by a qualified person.

On June 9, 2007, at Sandia National Laboratories, two members of a roofing crew for a roofing contractor attached their fall protection lanyards to anchor points that were not completely installed. They did not notice that the anchor points were not fastened to bolts epoxied into a parapet wall. After scraping gravel from the roof, the roofers took a morning break. While disconnecting their fall protection lanyards from the anchor points, one of the roofers noticed that the anchor point was not bolted down. When the hook was removed from the D-ring, the anchor point came off the bolts and fell four stories to the ground. This event is significant because the roofers believed their fall protection system was adequate.

ORPS Report NA—SS-SNL-NMFAC-2007-0006; Final filed 07/29/2007

A general PFAS inspection checklist is shown below and continues on the next page.

General PFAS Inspection Checklist		
Inspection Criteria	**Pass**	**Fail**
Webbing (body of belt, harness, or lanyard)		
No frayed edges, broken fibers, pulled stitches, cuts, or surface damage. Any cables in any of the equipment should be free of kinks or deformation.		
Buckles		
No loose, distorted, or broken grommets		
For belts without grommets, no elongated holes that could cause the buckle tongue to slip		
No pitted, cracked, or bent rivets		
Rivets are tight and cannot be moved; rivet base and burr are lying flat against fabric		
No distortion of the buckle, and no sharp edges		
Center bars overlap buckle frame and move freely back and forth in their sockets		
Outer and center bars are straight, and roller turns freely		
Ropes		
No fuzzy, worn, broken, or cut fibers		
Rope diameter is uniform throughout, with no noticeable changes from the original diameter		

General PFAS Inspection Checklist—continued		
Inspection Criteria	**Pass**	**Fail**
Hardware		
No cracks, corrosion, pitted surfaces, hook-and-eye distortions, or other defects		
No broken or stretched sewing loops		
D-ring is at a 90° angle and moves vertically independent of the body pad or “D” saddle		
No thread separation or rotting is observed inside or outside the body pad belt		
No distortion or obstruction of the snap hook keeper (latch), and no binding during operation		
Snap hook keeper spring exerts sufficient force to close the keeper firmly		
Bag rings, tool loop rivets, and knife snaps are secure and working properly		
Straps		
No cut fibers, frayed areas, damaged stitches, or corrosion damage		
No slippage or sharp buckle edges on friction buckle		
Tongue buckle holes are not excessively worn or elongated		
Anchors		
Ensure that the anchor has been certified by a competent person		
Check that the anchor is solidly attached to the supporting structure		
Check for damage, corrosion, or similar problems that may affect the anchor’s strength		
Labels		
Labels are present and legible		
The PFAS is less than 5 years old		
Always follow the manufacturer’s inspection and removal requirements. If you are not sure whether a PFAS item passes or fails inspection, tag and remove the item from service until a competent person can inspect it.		

Care and Storage of PFSA Equipment

When exposed for long periods of time, the ultraviolet rays of the sun can degrade the synthetic material from which many PFAS straps and belts are made.

Basic care of PFAS equipment prolongs the life of the unit and contributes to its performance. Always follow manufacturer-specific instructions for the care and storage of equipment.

The following guidelines can be used successfully with many types of PFAS equipment:

- Clean surface dirt with a sponge dampened in plain water or a mild solution of water and commercial soap or detergent. Work up a thick lather with a vigorous back-and-forth motion.
- Rinse the webbing in clean water and dry with a clean cloth.
- Store PFAS equipment away from heat, flame, molten metal, corrosive materials, and solvents that could compromise PFAS materials.
- Store PFAS equipment in a clean, dry area free of sunlight; away from direct heat; and in such a way that heat and light do not warp PFAS components.

Removal from Service

Strict requirements exist for removing fall protection equipment from service.

- Remove from service **all defective fall protection equipment**. Refer any questionable defects to a *competent person*.
- Remove from service **all components of a PFAS that fail inspection**. Ensure that all such components are tagged out of service and remain unused until a *competent person* determines whether they are safe to use.
- Remove from service **all components of a PFAS subjected to a fall or stress load**. Either destroy the PFAS equipment used in a fall or ensure that it is tagged out of service and remains unused until a *competent person* determines that it is safe to use.
- Remove from service and replace fall protection equipment according to manufacturers' guidelines.

Note: *If there is any doubt about the safety of any fall protection equipment, do not use it!*

Donning a Harness

To don a harness, refer to the manufacturer's instructions enclosed with your harness. In general, perform the following steps:

1. Hold the harness by the back D-ring. Shake the harness to allow all straps to fall in place.
2. If chest, leg, and/or waist straps are buckled, release the straps and unbuckle them.
3. Slip the straps over the shoulders so that the D-ring is located in the middle of the back, between the shoulder blades.
4. Pull one leg strap on between the legs and connect it to the corresponding end. Repeat with the second leg strap. If the unit is a belted harness, connect the waist strap after the leg straps. The waist strap should be tight but not binding.
5. Connect the chest strap, and position it in the mid-chest area. Tighten the strap to keep the shoulder straps taut.
6. After all straps have been buckled, tighten all buckles so that the harness fits snugly but allows a full range of movement. Pass excess strap length through loop keepers.

Mating Buckle

1. Pull the center bar buckle completely through the square link.
2. Allow the center bar buckle to fall into place on top of the square link.
3. Pull the loose end of the strap to tighten the adjustment of the harness.
4. Slide the keepers to hold any excess webbing.

Tongue Buckle

1. Insert the loose strap of webbing through the tongue buckle, placing the buckle tongue through the appropriate grommet.
2. Push remaining webbing through the keeper to retain the loose end.

Friction Buckle

1. Pass the webbing under the buckle, over the knurled bar, and back down between the knurled bar and the frame.
2. Pull the web end to tighten. To remove the harness, reverse the procedure.

Defective Stitching Found in Fall Protection Harness

In September 2006, a worker wearing a brand-new fall protection retrieval harness was about to enter a fuel tank. While suspended by the harness over the entryway, the worker repositioned his weight to make access to the tank easier. At this point, one of the two front anchor D-rings pulled loose from the harness. Fortunately, the worker was able to get out of the entryway and no injury resulted. Analysis showed that the stitching used to hold the D-ring in place was missing. It should have been sewn in place during manufacturing but was not. Users must inspect PPE before they use it to identify older equipment weakened by wear and tear and must inspect new equipment that may have manufacturer defects.

–Lesson ID: 2006-RL-HNF-0045

Notes. . . .

Glossary

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

competent person. An experienced person, designated by the responsible line manager (RLM) and trained by an industry-recognized training provider [or equivalent as approved by Occupational Safety and Health-Industrial Safety and Hygiene (OSH-ISH)], who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system (PFAS) or any component thereof, as well as in their application and use with related equipment [see 29 *Code of Federal Regulations* (CFR) 1910.66, Appendix C, and 29 CFR 1926.650 and 1926.32(f)]. A competent person has the authority to take prompt corrective measures to eliminate hazards. At LANL, a competent person is a documented, designated person (by his or her responsible line manager), trained by an industry-recognized training provider (or equivalent as agreed to by the ISH Group), with experience that meets the definition put forth by government regulatory agencies.

connector. A device used to connect the parts of the PFAS (or positioning device system) together, such as a carabiner, harness D-ring, or snap hook of a lanyard.

controlled access zone (CAZ). An area in which certain work may take place without the use of guardrail systems, PFASs, or safety net systems and where access to the zone is controlled.

deceleration device. A mechanism that limits the amount of energy imposed on an employee during a fall, such as a shock-absorbing lanyard or self-retracting lifeline.

fall. An unwanted, uncontrolled downward change in elevation. For the purpose of this document, a fall is 4 feet or greater for general walking/working surfaces and maintenance and 6 feet or greater for construction work and projects.

fall clearance. The distance required to arrest and stop the fall of a worker. In calculating the fall distance, the following factors must be considered: anchorage deflection, which is usually small, but may be up to as much as 3 feet for a horizontal lifeline; static length of the lanyard, which usually may not exceed 6 feet but should be shorter if appropriate for the work site; extension of the personal energy absorber, which may be as much as 3.5 feet; the height of the worker; and a safety factor of 3 feet.

fall restraint system. A fall protection system designed to physically prevent a worker from free falling.

free fall. Falling before fall protection begins to arrest the fall.

free-fall distance. The vertical distance a worker falls before a PFAS begins to stop the fall.

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

hole. Any opening more than 2 inches wide in a floor, roof, or other walking/working surface.

lanyard. A flexible rope or strap used to connect a body harness to a deceleration device, lifeline, or anchorage.

leading/unprotected edge. An unprotected side and edge during periods when it is not actively and continuously under construction and can change location as additional floors, roof, deck, and formwork are placed, formed, and constructed.

lifeline. A flexible line connected between one or more anchorage points that allows connection of other components of a PFAS to the anchorage.

personal fall arrest system. A system used to arrest an employee during a fall from a working level; consists of an anchorage, connectors, and body harness.

positioning device system. A system consisting of a body belt or harness that provides support and allows work on an elevated vertical surface, such as a wall, with both hands free.

qualified person. A person with recognized education; certification; professional standing; or extensive knowledge, training, and experience who has successfully demonstrated the ability to solve problems relating to the subject matter, work, or project (or OSHA definition: a person with extensive knowledge, training, and experience with fall protection systems).

roll out. A condition in which a load on a snap hook (usually from a mismatching connector or rope) places a load on the latch that causes it to open and release the connector.

rope grab. A deceleration device, designed to move along a vertical lifeline, that will automatically engage and lock on the lifeline when a worker falls.

safety monitoring system. A fall protection system that requires a monitor (*competent person*) to be responsible for recognizing fall hazards and warns workers when they are at risk of falling.

safety net system. A fall arrest system of mesh nets, including panels, connectors, and other impact-absorbing components.

self-retracting lifeline/lanyard. A deceleration device consisting of a drum-wound line that retracts or extends from the drum with normal worker movements; in the event of a fall, the drum automatically locks.

snap hook. A hook-shaped connector that may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object.

stopping distance. The vertical distance a worker falls after a PFAS begins to stop a fall.

swing fall. The pendulum motion that results when a worker using a PFAS falls and swings back under the anchor point.

warning line system. A barrier made up of lines or ropes erected on a roof and that is designed to warn employees that they are approaching an unprotected roof side or edge.

Notes . . .

References

Ellis, J. N., *Introduction to Fall Protection*, third edition, American Society of Safety Engineers, 2001.

Fall Protection in Construction, OSHA 3146, 1998 (revised), US Department of Labor, Occupational Safety and Health Administration.

“Fall Protection - It’s A Snap! Employer Kit,” February 2003, US Department of Labor, Occupational Safety and Health Administration Region VII.

“Fall Protection Information, Fall Protection Categories,” US Department of Labor, Occupational Safety and Health Administration.

Oregon Occupational Safety and Health Administration (OR-OSHA), *Oregon OSHA’s Fall Protection for the Construction Industry*, No. 2824, January 2006.

“Defective Stitching Found In Fall Protection Harness,” Fluor Hanford Inc., Information Bulletin Identifier 2006-RL-HNF-0045, November 2006.

Notes . . .

Accidents

What lessons can you learn from these accidents?

Iron Worker Dies after Falling out of Aerial Lift Basket

Employee #1, an iron worker for Midwest Steel Erection, Inc., Oakland, California, was changing out steel bracing atop the cap of the bent of a bridge underneath a freeway connector as part of a seismic retrofit of the freeways. The cap of the bent was between 55 and 60 feet above the ground. Employee #1 and his partner were moving in and out of the basket of a Grove AMZ66XT aerial device. Both wore safety belts and lanyards. When they were working in one spot, they tied off; when they were moving around atop the cap or in and out of the basket, they unhooked and walked around without fall protection. Apparently, Employee #1 was either moving across the cap with a bucket of bolts or trying to get back into the basket with the bucket of bolts, lost his footing, and fell to the ground, either off the bent cap or over the back of the basket. He later died of massive head and chest injuries.

–OSHA Accident Investigation Search 170630057

Fell through Floor Opening after Losing Balance

Employee #1 was assigned the task of placing three support beams across an existing first-level floor hole. The hole was located 15 feet above the lower level. The wooden guardrails had been previously installed as fall protection. Guardrail stanchions had been nailed in place. The guard rails prevented access to the floor hole and interfered with the beam-lifting device and the placement of beams. Employee #1 was removing a guardrail stanchion. Instead of using a wrecking bar, he attempted to loosen the stanchion by kicking at it. The stanchion sprang back and struck the employee. He lost his balance and fell 15 feet to the lower level.

–OSHA Accident Investigation Search 000570853

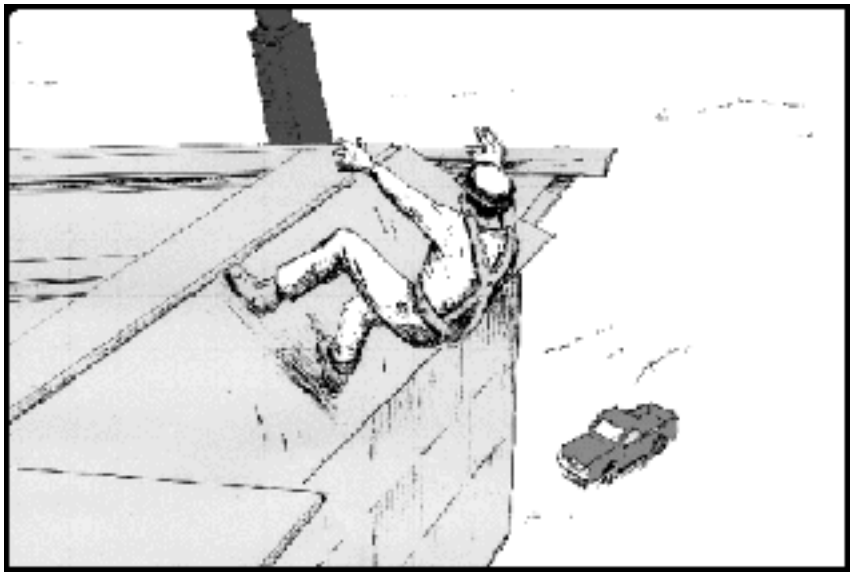
Fatal 40-Foot Fall: Lifeline Not Attached to Safety Harness

On November 13, 1998, a 50-year old ironworker with 30 years of experience was fatally injured at a crushed stone operation. Four contract employees were dismantling a hopper. The victim exited the lift basket onto a beam and fell 40 feet. The victim was wearing a safety harness, but the lifeline was not attached.

In recent years, the use of elevating work platforms has grown in popularity as a means to provide access to steel frame structures and connecting points in the structure. These platforms include scissor lifts and articulating booms with work baskets. These devices must be used in accordance with manufacturers' recommendations, and fall protection should be worn by workers on the work platforms.

One way to eliminate fall hazards is to construct roof trusses on the ground and use a crane to move them into place. Although this practice does not remove every hazard, it eliminates a major fall hazard by removing much of the need to work at height.

http://www.msha.gov/FATALS/1998/FTL98M48.HTM



Appendix

U. S. Department of Labor
Occupational Safety and Health Administration
Directorate of Science, Technology and Medicine
Office of Science and Technology Assessment

Suspension Trauma/ Orthostatic Intolerance

Safety and Health Information Bulletin

SHIB 03-24-2004

Purpose

This Safety and Health Information Bulletin provides employees and employers with important information about the hazards of orthostatic intolerance and suspension trauma when using fall arrest systems. This bulletin:

- describes the signs and symptoms of orthostatic intolerance;
- discusses how orthostatic intolerance can occur while workers are suspended following a fall; and
- outlines recommendations for preventing orthostatic intolerance, as well as recommendations for worker training and rescue.

This Safety and Health Information Bulletin is **not** a standard or regulation, and it creates no new legal obligations. The Bulletin is advisory in nature, informational in content, and is intended to assist employers in providing a safe and healthful workplace. The Occupational Safety and Health Act requires employers to comply with hazard-specific safety and health standards. In addition, pursuant to Section 5(a)(1), the General Duty Clause of the OSHAct, employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm. Employers can be cited for violating the General Duty Clause if there is a recognized hazard and they do not take reasonable steps to prevent or abate the hazard. However, failure to implement any recommendations in this bulletin, is not, in itself, a violation of the General Duty Clause. Citations can only be based on standards, regulations, and the General Duty Clause.

Background

Orthostatic intolerance may be defined as "the development of symptoms such as light-headedness, palpitations, tremulousness, poor concentration, fatigue, nausea, dizziness, headache, sweating, weakness and occasionally fainting during upright standing" [1,2]. While in a sedentary position, blood can accumulate in the veins, which is commonly called "venous pooling," and cause orthostatic intolerance [3]. Orthostatic intolerance also can occur when an individual moves suddenly after being sedentary for a long time. For example, a person may experience orthostatic intolerance when they stand up quickly after sitting still for a long time.

A well-known example of orthostatic intolerance is that of a soldier who faints while standing at attention for long period of time. The moment the soldier loses consciousness, he or she collapses into a horizontal position. With the legs, heart, and brain on the same level, blood is returned to the heart. Assuming no injuries are caused during the collapse, the individual will quickly regain consciousness and recovery is likely to be rapid.

Venous pooling typically occurs in the legs due to the force of gravity and a lack of movement. Some venous pooling occurs naturally when a person is standing. In the veins, blood normally is moved back to the heart through one-way valves using the normal muscular action associated with limb movement. If the legs are immobile, then these "muscle pumps" do not operate effectively, and blood can accumulate. Since veins can expand, a large volume of blood may accumulate in the veins.

An accumulation of blood in the legs reduces the amount of blood in circulation. The body reacts to this reduction by speeding up the heart rate and in an attempt to maintain sufficient blood flow to the brain. If the blood supply is significantly reduced, this reaction will not be effective. The body will abruptly slow the heart rate and blood pressure will diminish in the arteries. During severe venous pooling, the reduction in quantity and/or quality (oxygen content) of blood flowing to the brain causes fainting. This reduction also can have an effect on other vital organs, such as the kidneys [3]. The kidneys are very sensitive to blood oxygen, and renal failure can occur with excessive venous pooling. If these conditions continue, they potentially may be fatal [3].

Description of Hazard

Orthostatic intolerance may be experienced by workers using fall arrest systems. Following a fall, a worker may remain suspended in a harness. The sustained immobility may lead to a state of unconsciousness. Depending on the length of time the suspended worker is unconscious/immobile and the level of venous pooling, the resulting orthostatic intolerance may lead to death. While not common, such fatalities often are referred to as **"harness-induced pathology"** or **"suspension trauma."**

Signs & symptoms that may be observed in an individual who is approaching orthostatic intolerance:

Faintness	Nausea
Breathlessness	Dizziness
Sweating	Unusually Low Heart Rate
Paleness	Unusually Low Blood Pressure
Hot Flashes	"Greying" or Loss of Vision
Increased Heart Rate	

References: Seddon, Paul. Harness Suspension: review and evaluation of existing information. Health and Safety Executive. Research Report 451/2002. 104 pp.

Sheehan, Alan. Suspension Trauma. Training handout.

Factors that can affect the degree of risk of suspension trauma:

Inability to move legs	Hypothermia
Pain	Shock
Injuries during fall	Cardiovascular disease
Fatigue	Respiratory disease
Dehydration	Blood loss

References: Seddon, Paul. Harness Suspension: review and evaluation of existing information. Health and Safety Executive. Research Report 451/2002. 104 pp.

Sheehan, Alan. Suspension Trauma. Training handout

Unconscious/immobile workers suspended in their harness will not be able to move their legs and will not fall into a horizontal position, as they would if they fainted while standing. During the static upright position, venous pooling is likely to occur and cause orthostatic intolerance, especially if the suspended worker is left in place for some time. Venous pooling and orthostatic intolerance can be exacerbated by other circumstances related to the fall. For example, shock or the experience of the event that caused the fall, other injuries, the fit/positioning of the harness, the environmental conditions, and the worker's psychological state all may increase the onset and severity of the pooling and orthostatic intolerance [3,5]. Unless the worker is rescued promptly using established safe procedures, venous pooling and orthostatic intolerance could result in serious or fatal injury, as the brain, kidneys, and other organs are deprived of oxygen [3].

The amount of time spent in this position, with the legs below the heart, affects the manner in which the worker should be rescued [3]. Moving the worker quickly into a horizontal position - a natural reaction - is likely to cause a large volume of deoxygenated blood to move to the heart, if the worker had been suspended for an extended period. The heart may be unable to cope with the abrupt increase in blood flow, causing cardiac arrest [3,5]. Rescue procedures must take this into account. Recommended rescue procedures are outlined below in the ***Conclusions and Recommendations*** section.

Conclusions and Recommendations

Prolonged suspension from fall arrest systems can cause orthostatic intolerance, which, in turn, can result in serious physical injury, or potentially, death. Research indicates that suspension in a fall arrest device can result in unconsciousness, followed by death, in less than 30 minutes [4]. To reduce the risk associated with prolonged suspension in fall arrest systems, employers should implement plans to prevent prolonged suspension in fall protection devices. The plan should include procedures for: preventing prolonged suspension, identifying orthostatic intolerance signs and symptoms, and performing rescue and treatment as quickly as possible.

OSHA recommends the following general practices/considerations:

- Rescue suspended workers as quickly as possible.
- Be aware that suspended workers are at risk of orthostatic intolerance and suspension trauma.
- Be aware of signs and symptoms of orthostatic intolerance.
- Be aware that orthostatic intolerance is potentially life threatening. Suspended workers with head injuries or who are unconscious are particularly at risk.
- Be aware of factors that can increase the risk of suspension trauma.
- Be aware that some authorities advise against moving the rescued workers to a horizontal position too quickly.

Training

OSHA requires employers to train workers to use fall arrest systems and other personal protective equipment correctly while performing their jobs, in accordance with standards 29 CFR 1910.132 (Personal Protective Equipment) 29 CFR 1915.159 (Personal Fall Arrest Systems) and 29 CFR 1926.503 (Training Requirements for Fall Protection).

Workers who wear fall arrest devices while working, and those who may perform rescue activities, should also be trained in:

- How to ascertain whether their personal protective equipment is properly fitted and worn, so that it performs as intended;
- How orthostatic intolerance/suspension trauma may occur;
- The factors that may increase a worker's risk;
- How to recognize the signs and symptoms identified in this bulletin; and
- The appropriate rescue procedures and methods to diminish risk while suspended.

Rescue Procedures

Under 29 CFR 1926.502 (d) (Fall Protection Systems Criteria and Practices), OSHA requires that employers provide for "prompt rescue of employees in the event of a fall or shall assure that employees are able to rescue themselves." This should include identifying rescue procedures that address the potential for orthostatic intolerance and suspension trauma. Rescue procedures also should address how the rescued worker will be handled to avoid any post-rescue injuries.

Rescue procedures should include the following contingency based actions:

- If self-rescue is impossible, or if rescue cannot be performed promptly, the worker should be trained to "pump" his/her legs frequently to activate the muscles and reduce the risk of venous pooling. Footholds can be used to alleviate pressure, delay symptoms, and provide support for "muscle pumping."
- Continous monitoring of the suspended worker for signs and symptoms of orthostatic intolerance and suspension trauma.

3

- Ensuring that a worker receives standard trauma resuscitation[1] once rescued. Some authorities recommend that the patient be transported with the upper body raised.
- If the worker is unconscious, keeping the worker's air passages open and obtain first aid.
- Monitoring the worker after rescue, and ensuring that the worker is evaluated by a health-care professional. The worker should be hospitalized when appropriate. Possible delayed effects, such as kidney failure, which is not unusual in these cases, are difficult to assess on the scene.

References

1. Robertson, David. Orthostatic Intolerance. Vanderbilt University, Nashville, Tennessee.

2. New York Medical College. Orthostatic Intolerance. Vahalla, New York.

3. Seddon, Paul. Harness Suspension: Review and evaluation of existing information. Health and Safety Executive. Research Report 451/2002. 104 pp.

4. Sheehan, Alan. Suspension Trauma. Training handout.

5. Weems, Bill and Bishop, Phil. Will Your Safety Harness Kill You? *Occupational Health & Safety*. 72(3): 86-88, 90, March, 2003.

[1] National Association of Emergency Medical Technicians (NAEMT). Provider Textbook section in: **PHTLS Basic and Advanced Prehospital Trauma Life Support *Fifth Edition*** St. Louis, MO: Mosby; 2003: Section 1. Summary available at: http://phtls.org/datafiles/PHTLS%205ed%20Compendium.pdf

4

Before You Sit Down . . .

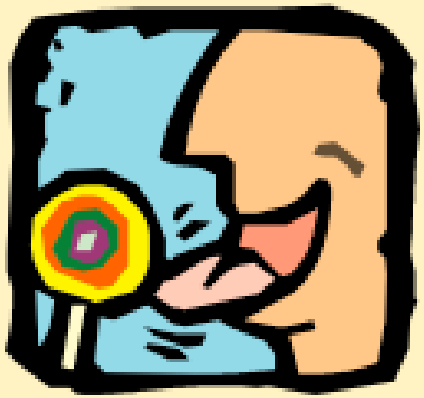
- Pick up course materials when you enter the room.
- Make sure you fill out a class evaluation. We value your feedback!

When in the Classroom . . .

- Be sure to sign the roster.
  - print your name legibly
  - sign your name
  - print your Z number
- Turn off cell phones or put them on vibrate.

Break Time

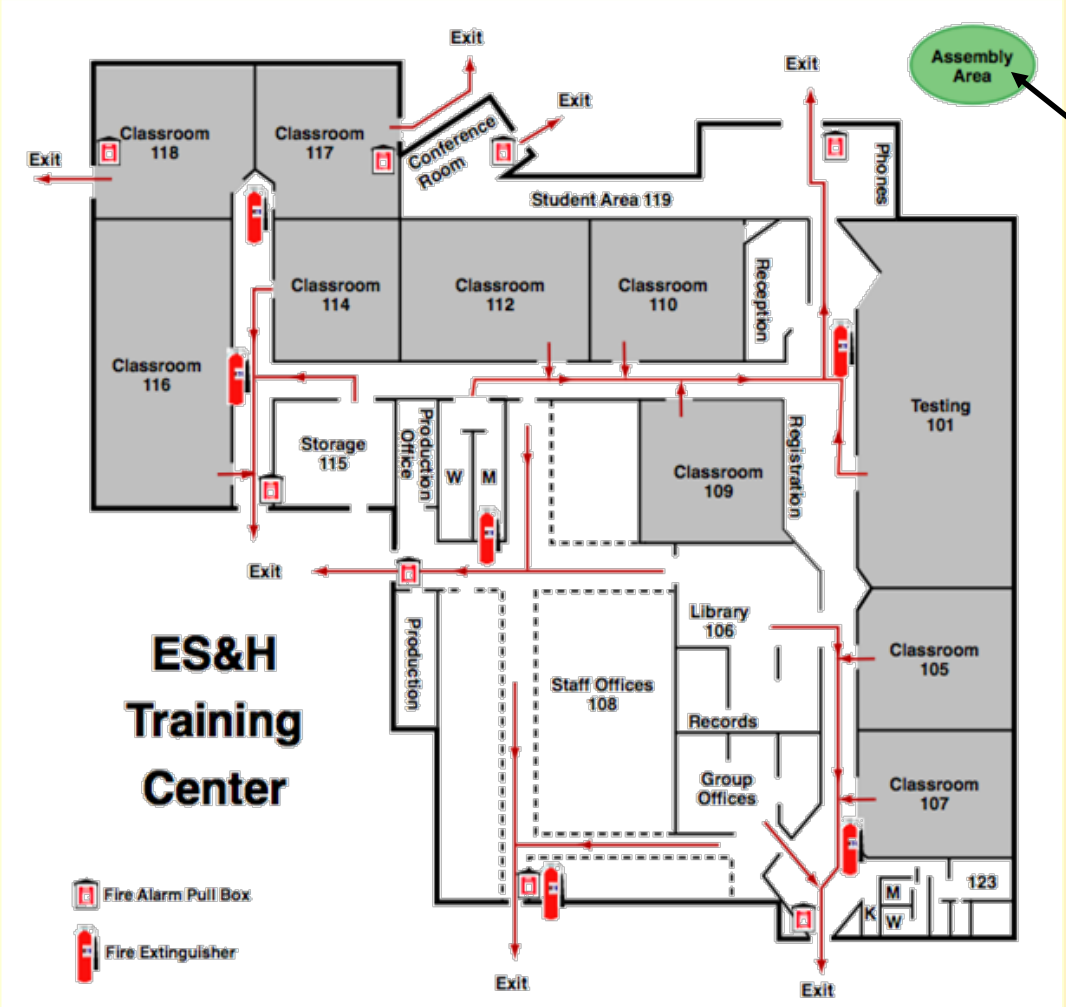
- Telephones are located in the front lobby just beyond the reception area.
- Soft drink and snack machines are located by the telephones.
- Restrooms are located off the corridor between the reception area and classrooms 114–118.



Emergency Evacuation

- If an alarm sounds, all personnel shall evacuate the building and report immediately to the assembly area designated for the building.
- Eating, drinking, and smoking are prohibited during evacuations and at the assembly area.

Emergency Exit Routes



Go to the assembly area when you exit for an emergency.

- DO NOT LEAVE AREA
- NO FOOD OR DRINK
- NO SMOKING
- MINIMIZE TALKING

White Rock Training Center Evacuation Assembly Area

After exiting the building during an emergency, assemble at the grassy knoll across from the fire station.

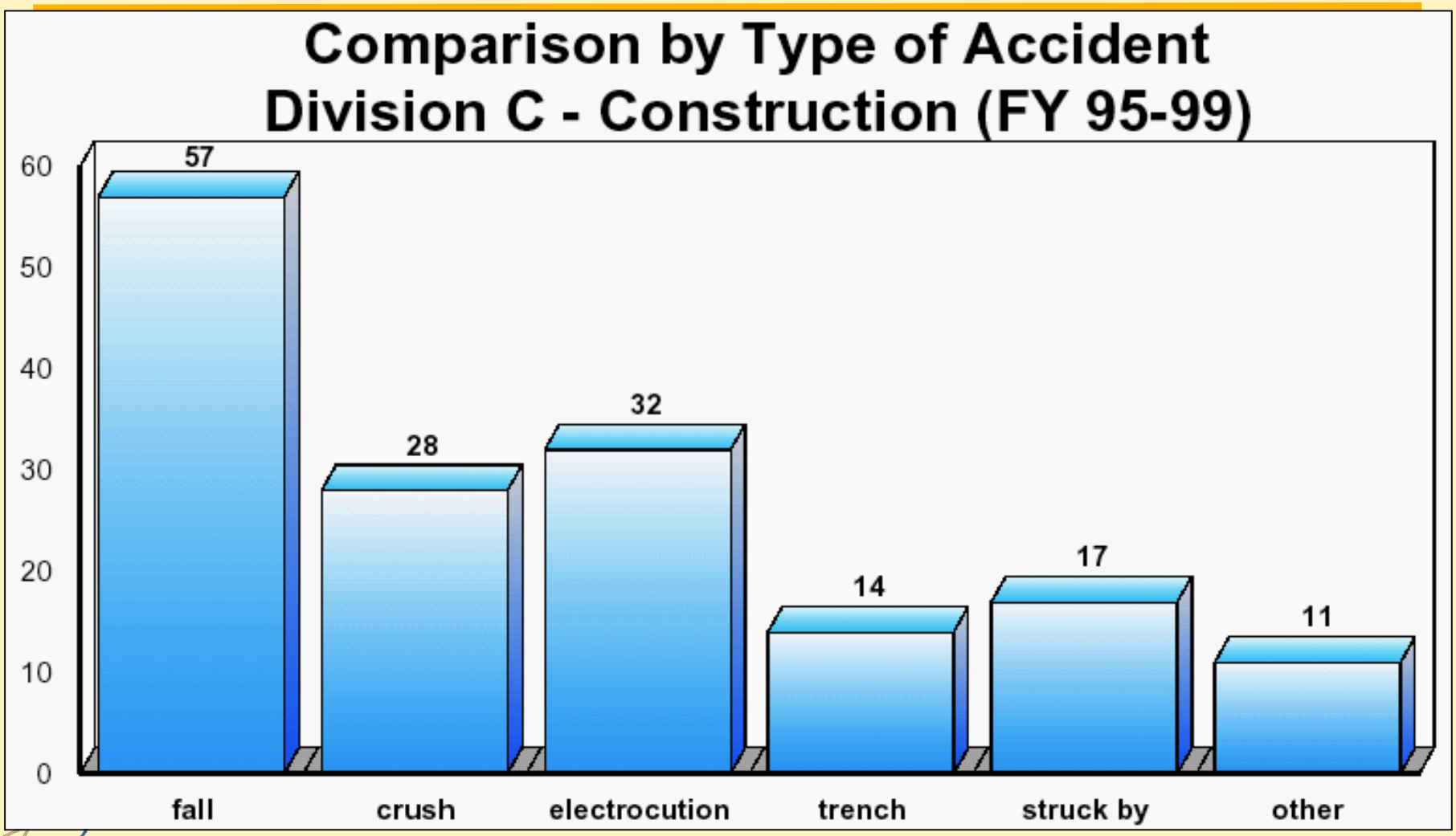
LA-UR-14-29560

Fall Protection Introduction

What is the most commonplace way workers die in construction?

A. Trench collapse
B. Being crushed or struck by an object
C. Falling
D. Electrocution

Fatal/Catastrophic Incidents



Physics of a Fall

Time (seconds)	Distance (feet)	Force (pounds)	Velocity (miles per hour)
0.5	4	1600	10.9
1.0	16	6400	21.8
1.5	36	14,400	32.7
2.0	64	25,600	43.6
2.5	100	40,000	54.5
3.0	144	57,600	65.5
4.0	256	102,400	87.3

QuickTime™ and a
MPEG-4 Video decompressor
are needed to see this picture.

DBI-SALADummyDrop.mpg

Course Objectives

Recognize

- Hazards and controls associated with falls to a lower level
- Actions you can take to reduce the risk of falls to the same level and falls to a lower level
- Hazards and controls associated with walking/ working surfaces

Course Limitations

This course does NOT

- Make you a *competent person* or a *qualified person*
- Address work on scaffolds, ladders, or aerial lifts
- Replace site-specific or on-the-job fall protection training
- Address falls to the same level

Module 1

Regulations and Training

Module 1 Objectives

Recognize

- Types of activities that need fall protection
- Regulations that address fall protection
- The definitions of *competent person* and *qualified person*
- Training for employees who need to use fall protection

Activities That May Require Fall Protection

- Work that exposes a worker to an unguarded fall hazard of 4 ft or more for general industry work
- Work that exposes a worker to an unguarded fall hazard of 6 ft or more for construction work
- Scaffolding 10 ft high or more without guardrails
- Some work that does not require fall protection at much higher height

Requirements

- OSHA 29 CFR 1910, Subpart D, *Walking-Working Surfaces* (4 ft)
- OSHA 29 CFR 1926, Subpart M, *Fall Protection* (6 ft)
- LANL Fall Protection P101-20
- ANSI 359.1

Definitions (abbreviated)

Competent person: one who can identify hazards in the workplace and take prompt corrective measures to eliminate them. The person must have the authority, be specifically designated in writing by the RLM, and have special training.

Qualified person: one who, by education, knowledge, and/or experience, can solve or resolve problems relating to the work. At LANL, this definition means a professional engineer.

Retraining Is Needed

- When workers do not recognize fall hazards
- When changes make the previous training obsolete
- When workers fail to use equipment properly
- When workers fail to follow the fall protection plan

Other Regulations

Work done from or involving

- Scaffolds
- Stepladders
- Stairways
- Derricks and cranes
- Electrical transmission and distribution
- Steel erection
- Aerial lifts
- Articulated manlifts

Special Provision

Fall protection requirements might not apply to

- Inspections
- Investigations
- Assessments of conditions

Before or after construction ONLY!!

Module 2

Types of Fall Protection Systems

QuickTime™ and a
MPEG-4 Video decompressor
are needed to see this picture.

Officfall1.mov

Module 2 Objectives

Recognize

- Factors to consider in selecting a fall protection system
- Four categories of fall protection
- Types of fall protection systems

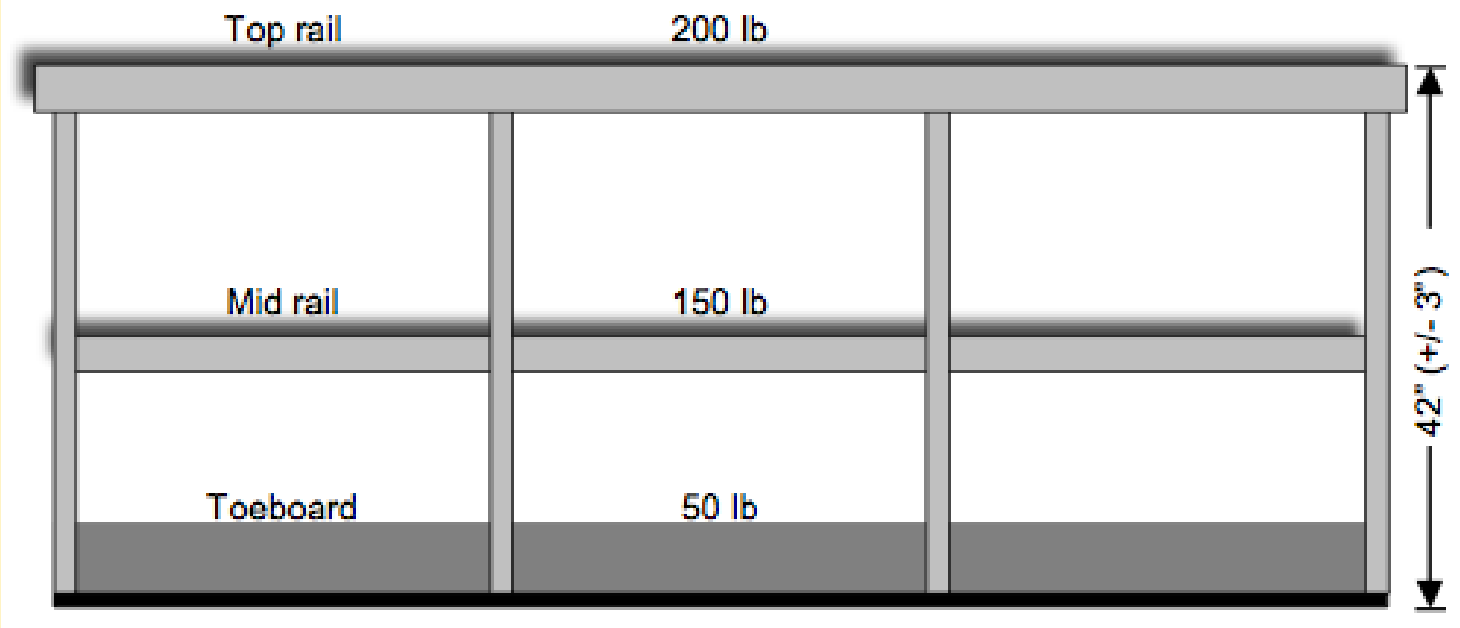
Categories of Fall Protection

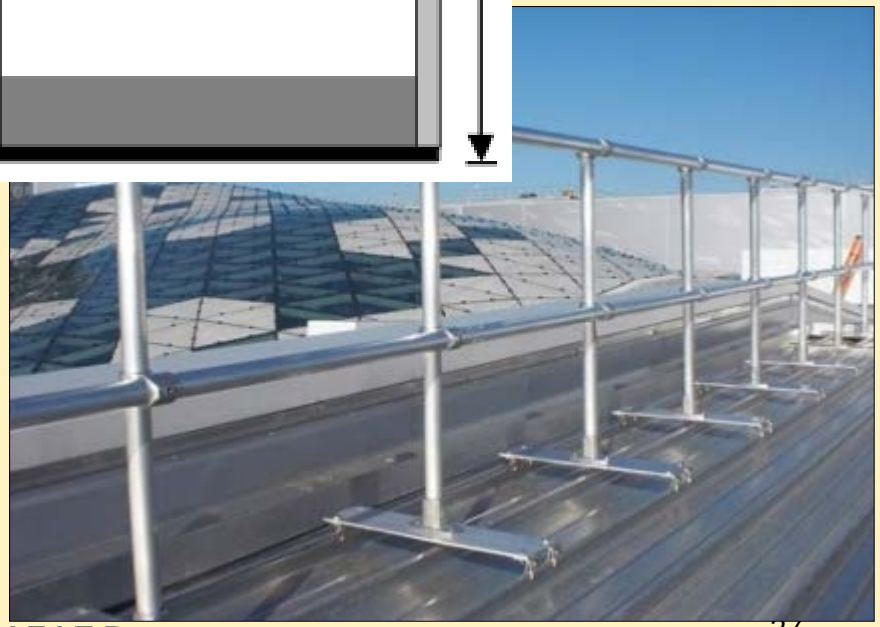
- **Fall elimination:** Eliminate the potential for the fall hazard
- **Fall prevention**: Prevent a fall from occurring
- **Fall arrest:** Reduce the impact of a fall after it has occurred
- **Work procedures:** Reduce the likelihood of a fall

Types of Fall Protection

- **Conventional**
  - Guardrails
  - Covers
  - Fall Restraint
  - Safety Nets
  - Personal Fall Arrest
- **Nonconventional**
  - Control Access Zones
  - Warning Lines
  - Safety Monitors
  - Fall Protection Plans or Procedures

Guardrails (cont)





Where does the midrail go in a guardrail?

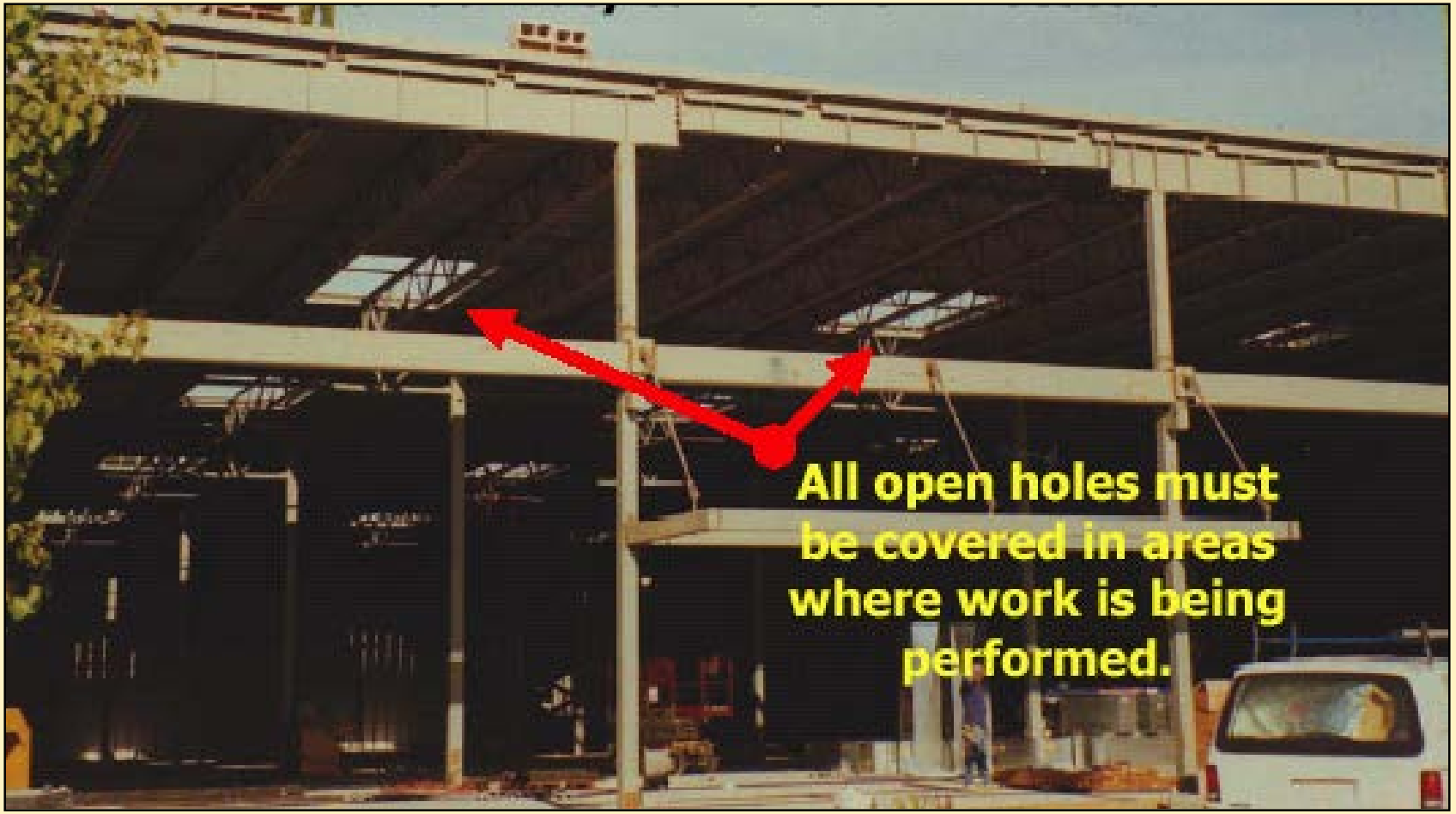
A. 21 inches high

B. This is a trick question. Midrails are optional

C. In the middle between the top rail and deck

D. 22 ½ inches high

Covers


All open holes must be covered in areas where work is being performed.

Covers (cont)

- Must support at least twice the expected weight
- Must be secured and color-coded OR marked “HOLE” or “COVER”
- Should have full edge bearing on all four sides

Covers (cont)

Fall Restraints

Designed to *prevent* workers from reaching a position where they could fall to a lower level

Safety Nets

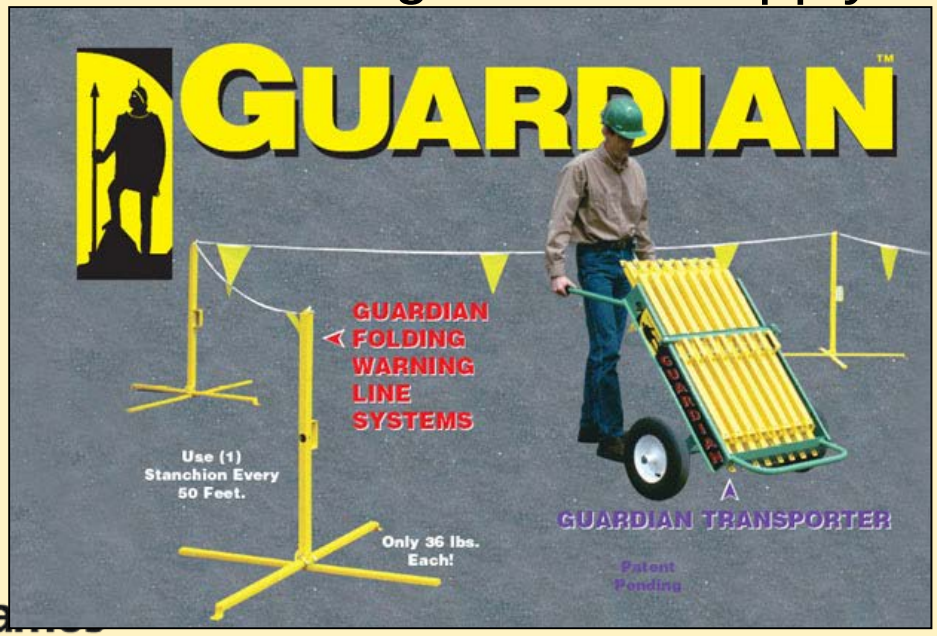
- No more than 30 ft below
- Mesh openings no bigger than 6 x 6 in.
- Sufficient clearance beneath the net
- Inspected at least once a week
- Items must be removed from the net ASAP
- Must be minimum distance from the edge

Warning Lines for Roofing Work

- At least 6 ft from edge
- At least 10 ft if using mechanized equipment
- 34–39 in. high
- Flagged every 6 ft
- Set up so that pulling on one section does not draw slack from another section

Warning Lines for All Other Work

- May not be used for routine or scheduled work, except with the approval of ISH
- Allowed at LANL at least 6 feet from edge
- All other warning line rules apply



Safety Monitors

- Needed when all other fall protection systems have been determined to be infeasible; are not to be used for routine/scheduled work
- Must be a competent person
- Must be trained and authorized
- Must be at the same level and in sight
- Must warn employees if they get too close to danger or act unsafely
- Must have no other responsibilities

Fall Protection Plans for Roofing Work

- Required by regulation for roofing work
- The EWSP serves the same purpose
- Used when conventional equipment is not feasible or creates a greater hazard (reasons must be documented)
- Must be prepared by a *qualified person* and implemented by a *competent person*
- Must be site specific and kept at the job site

Elevated Work Surface Permit for Nonroofing Work

- A LANL requirement, not a regulatory requirement
- May be written by a competent person
- If engineering is needed, need a qualified person
- Only needed for nonconventional fall protection

Positioning Device Systems

NOT considered fall protection!

Fall Protection Selection Activity

- Play “Officefall” video as a continuous loop.

How far from the leading edge does the warning line need to be for roofing work?

How far from the leading edge does the warning line need to be for nonroofing work?

Which of these would you use with warning lines for nonroofing work?

A. Fall Protection Plan
B. Elevated Work Surface Permit

Do you always need an Elevated Work Surface Permit (EWSP) for work with fall hazards?

A. Yes
B. No

You can set up a warning line using caution tape.

A. True
B. False

Which of these are conventional fall protection?

A. Warning Lines
B. Controlled Access Zone
C. Fall Protection Plan
D. Safety Monitor
E. Guard Rails

Which of these controls is best?

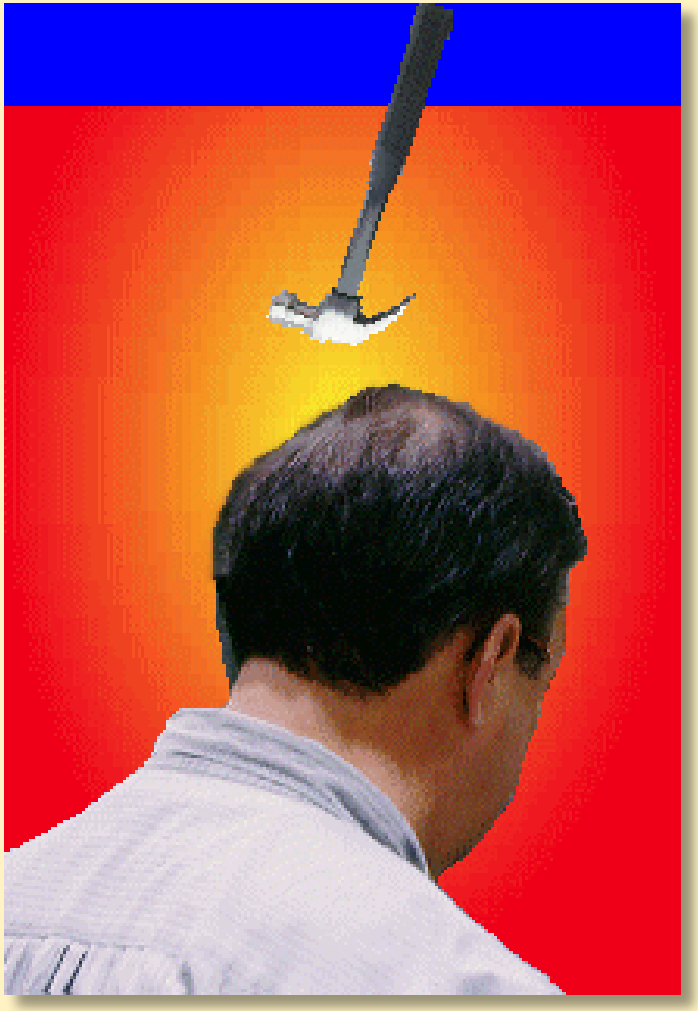
A. Arresting the fall
B. Using administrative procedures
C. Using safety nets
D. Preventing a fall

Module 3

Protection from Falling Objects

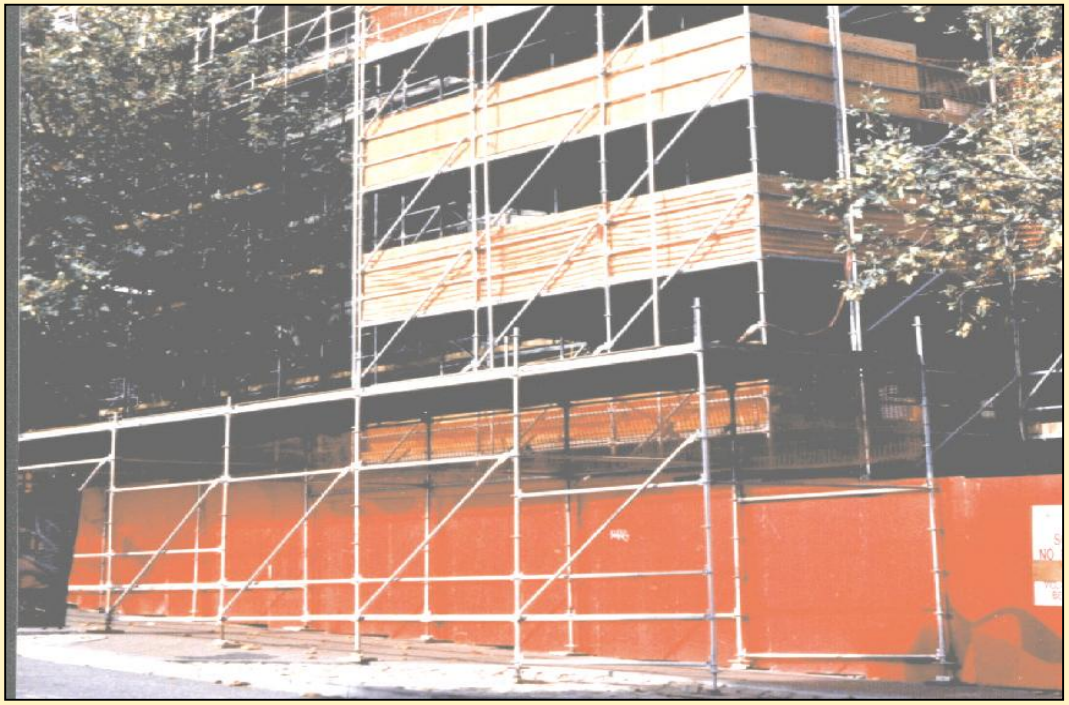
Module 3 Objective

Recognize controls that can be used to reduce the risk of falling object hazards



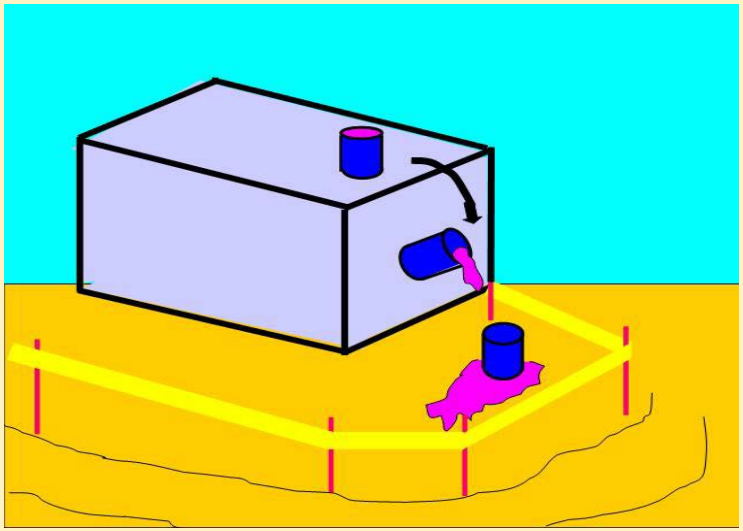
Controls for Falling Objects

- Gantries or canopies
- Signs



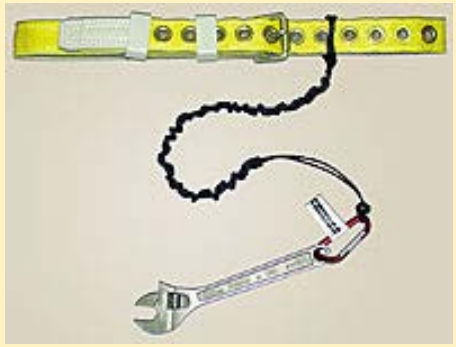
Controls for Falling Objects (cont)

- Exclusion zones
- Floor hole covers and toeboards



Controls for Falling Objects (cont)

- Tool lanyards
- Store materials away from edges
- Housekeeping
- Hardhats



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A toeboard is always required with a guardrail.

A. True
B. False

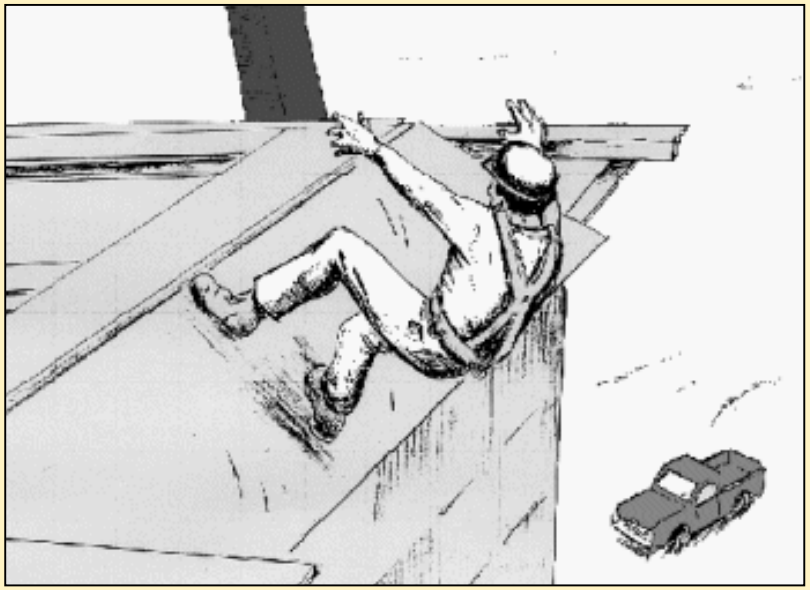
Module 4

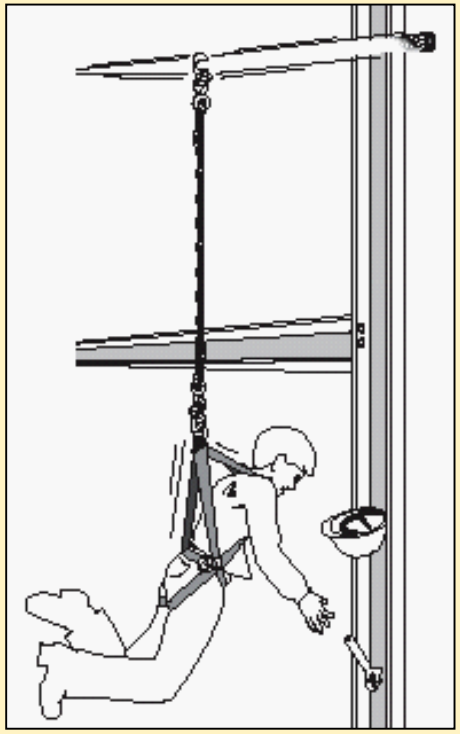
Emergency Planning

Module 4 Objectives

Recognize

- Preparations for response to a fall
- Actions to take if a fall should occur
- The need for “prompt rescue”





DBI-SALARescue.mov

QuickTime™ and a
MPEG-4 Video decompressor
are needed to see this picture.

Before a Fall Occurs

- Know what the rescue procedures are and who the contacts are
- Consider how rescue will be performed if
  - more than one person falls
  - the work is in a secured area
- Identify onsite equipment, such as aerial lifts, forklifts, and ladders, that could be used for rescue and retrieval
- The rescue plan must ensure that person is rescued as quickly as possible but should be performed in less than 15 minutes

If a Fall Occurs

- Activate the rescue plan without delay
- Talk to the victim, and try to determine his/her condition
- Only people formally trained in rescue should attempt a technical rope rescue
- Onsite rescue capability is best
- Be familiar with *suspension trauma* and *reflow syndrome*

How many minutes after falling must a person be rescued (using PFAS)?

Is special training required to perform a rescue?

A. Yes – to operate a manlift, climb a ladder, etc.

B. No – a fall is a life-threatening emergency that requires a rapid response. It is more important to rescue than to worry about a technical safety violation.

Who may perform a technical rope rescue?

A. I can
B. Spiderman
C. The Fire Department
D. The HAZMAT team

Module 5

Personal Fall Arrest Systems

Module 5 Objectives

- Recognize the components of a PFAS
- Recognize requirements and guidelines for using a PFAS
- Inspect, don, and adjust a body harness

Components of a PFAS (ABCs)

- Anchorages
- Body harness
- Connectors
  - Lanyards
  - Lifelines

QuickTime™ and a
MPEG-4 Video decompressor
are needed to see this picture.

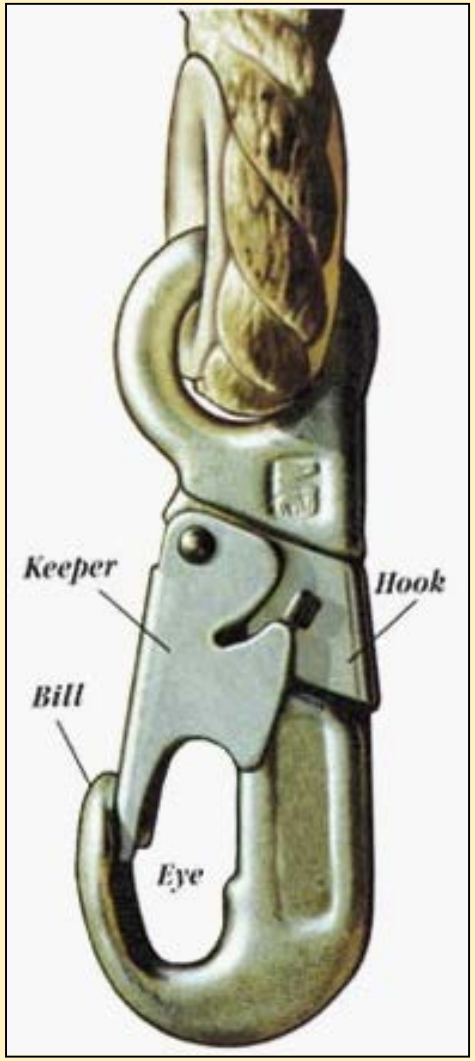
MillerHarness.mov

Body Harnesses

QuickTime™ and a
MPEG-4 Video decompressor
are needed to see this picture.

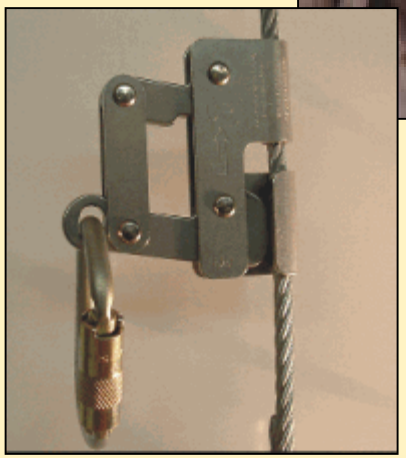
DBI/SalaConnector.mov

Connectors



Lanyards

Vertical Lifelines



Vertical Lifelines (cont)

Horizontal Lifelines

Must be designed, installed, and used under the supervision of a *qualified person*.

QuickTime™ and a
MPEG-4 Video decompressor
are needed to see this picture.

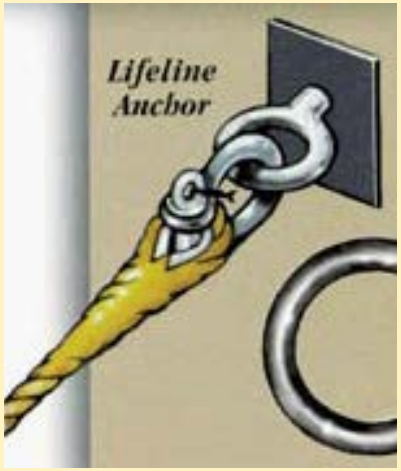
DBI-SALAAnchor.mov

Anchorages

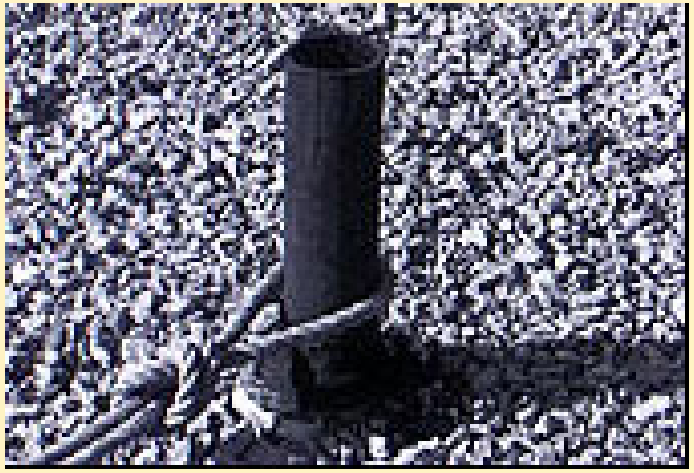
- Anchors must maintain and support 5000 lb and be designed by a qualified person documenting that it supports a fall of 6 ft and a weight of 310 lb per attached person, including a safety factor of at least 2.

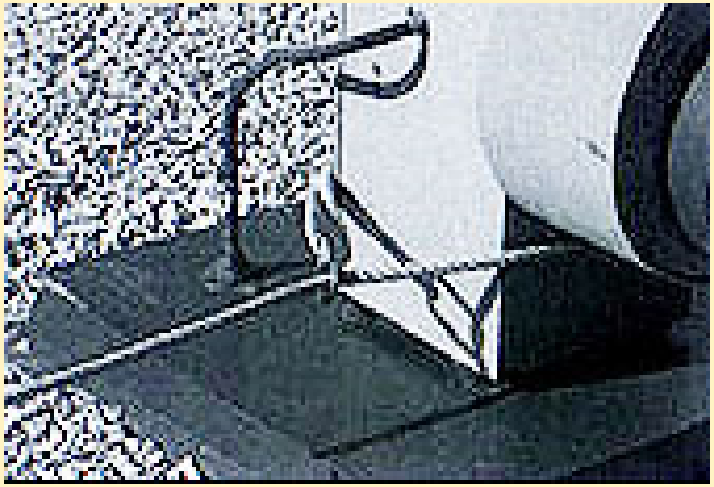
- Anchors must be approved and certified and be inspected annually by a competent person.
- Users must inspect anchors before each use.

Anchorages (cont)



These are NOT Anchorages!!!





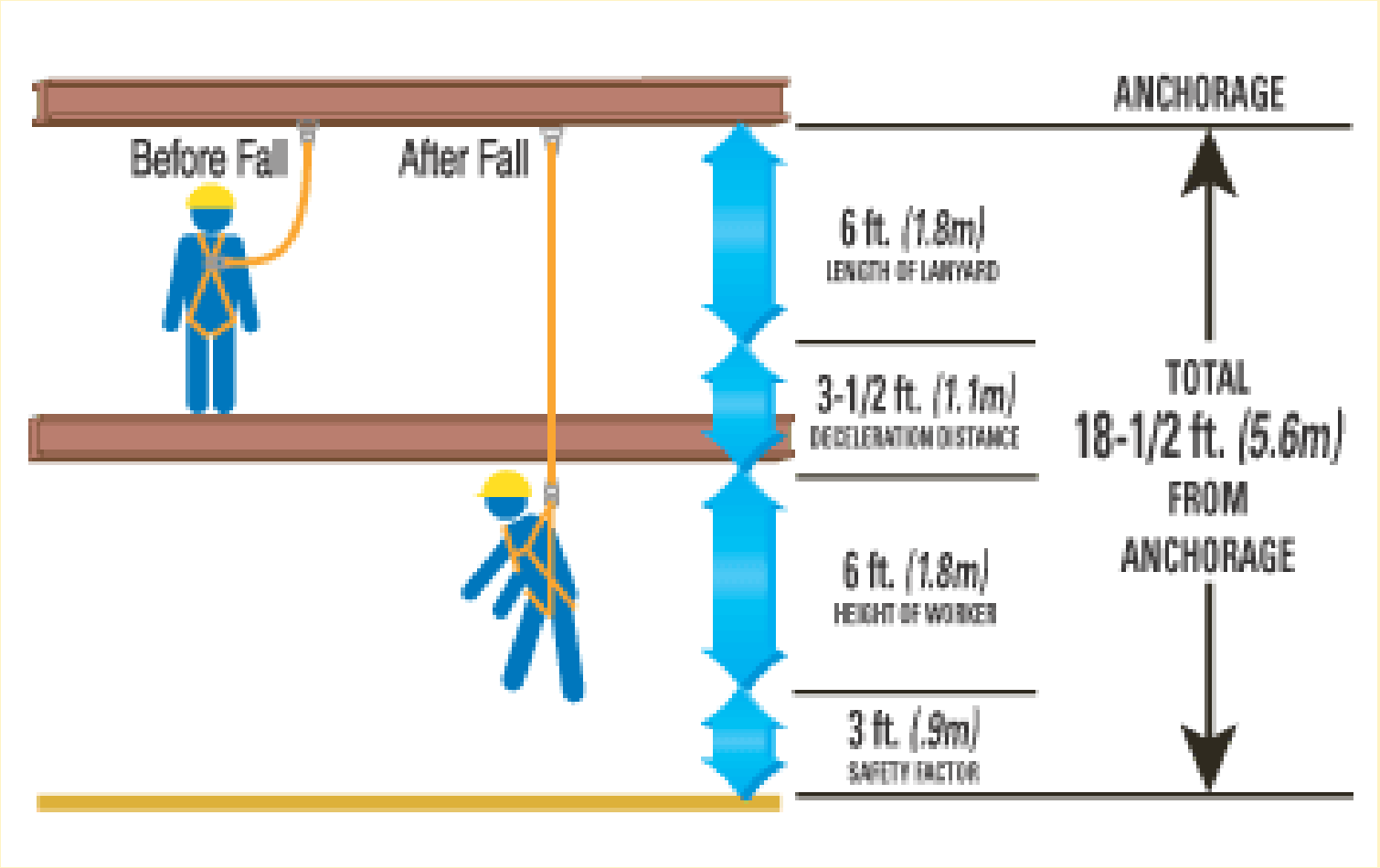
Standing Seam Anchors

- Many different types
- Must be compatible with type of standing seam
- Must be approved and certified by a qualified person
- Must be inspected before use by a competent person
- Must be installed by a trained person

Does this course qualify you to install temporary anchors?

A. True
B. False

PFAS Total Fall Distance



Weight Limitation

Fall protection equipment is designed for a load not to exceed a 310-lb maximum (person and gear).

Personnel who do not meet this criterion must have specially engineered equipment.

If no certified anchor is readily available, you or the competent person can select a site that can support 5000 lb.

A. True
B. False

You need a PFAS. Who will select your equipment?

A. You
B. The PIC
C. The Safety Professional
D. The Competent Person

Module 6

Inspection, Maintenance, and Storage of Fall Protection Equipment

Module 6 Objectives

Recognize

- Types of inspections
- Requirements and guidelines for using a PFAS
- How to inspect a body harness
- What to do if you find damage or defects
- How to don and adjust a body harness
- Guidelines for maintenance and storage

Types of Equipment Inspections

- User inspections: performed by the user before each use
- Annual inspections: inspections performed each year by a trained inspector (competent person)
- After a fall, the equipment must be removed from service and destroyed (although mechanical equipment can be recertified).

User Inspection

- Webbing
- Buckles
- Ropes
- Hardware
- Straps
- Anchors
- All related equipment

Anchor Inspection

- You are required to inspect the anchor before attaching
- Lessons learned from other facilities

Activity

Inspection of PFAS Equipment

Removal from Service

- Defective equipment
- All components of a PFAS that fail inspection
- All components of a PFAS subjected to a fall
- According to manufacturer's guidelines

Care and Storage of PFAS Equipment

- Wipe off surface dirt using
  - a damp sponge and water or
  - a mild soap-and-water solution
- Rinse in clean water, and dry with a clean cloth
- Dry away from direct heat, and keep from long exposure to sunlight
- Store in a clean, dry area, free of sunlight, contaminants, and corrosive materials

Activity

Donning a Body Harness

QUIZ

Can you mix components from different manufacturers?

A. Yes, as long as they have been tested to be compatible

B. No; that is not allowed at the Laboratory

At what height are workers required to have fall protection, according to the Federal OSHA Construction Standard?

A. 6 feet
B. 10 feet
C. 30 feet
D. 4 feet

What are the three components of a Personal Fall Arrest System?

A. Anchor/Anchorage Connector, Body Wear (Harness) and Connecting Device (Lanyard or Retractable)

B. Body Wear (Harness), Hard Hat, and Steel-Toed Boots

C. Body Wear (Harness), Connecting Device (Lanyard or Retractable), and Sturdy Ladder

D. Hard Hat, Safety Glasses, and Safety Training

A fall arrest anchor must be capable of supporting what static force for each attached worker?

After selecting an anchor point, you can ensure a compatible anchorage connection by

A. Joining multiple lanyards together to reach an anchorage point

B. Looping a rope around the anchor point

C. Ensuring that the anchorage connection will cause a load to be applied to the snap hook keeper gate or snap hook lock

D. Using an anchorage connector specifically designed to maintain a compatible connection with the anchor point

When wearing a full body harness, the fall forces must be limited to a maximum of

A properly adjusted full body harness should

A. Be loose and easy to take off
B. Fit like a comfortable jacket
C. Fit snugly but allow for full range of movement
D. Accommodate many users

What is the proper procedure to follow after a fall has occurred?

A. Take the rest of the day off
B. Go back to work and act as though nothing had happened
C. Go to Occupational Medicine
D. Get new equipment from the tool room, and go back to work

After a person falls, what happens to his/her harness and to the anchor?

A. The harness and anchor are inspected and recertified
B. The anchor is recertified but the harness is destroyed
C. Both anchor and harness are destroyed
D. Both are destroyed, and the building anchor point is inspected

What is the correct height for a guardrail?

At what height must you be protected from falling from an unprotected edge if you are performing maintenance?

Personal fall arrest systems, when stopping a fall, shall be rigged such that an employee can neither free fall more than _ _ _ feet nor contact any lower level.

What is the heaviest a person and equipment can weigh when using off-the-shelf fall arrest components?

In 29 CFR 1926, a "hole" is defined as a gap or void _ _ _ inches or more in its least dimension…